JOURNAL OF SCIENCE, TECHNOLOGY, MATHEMATICS AND EDUCATION (JOSTMED)

ISSN: 0748 – 4710

VOLUME 11(3), DECEMBER, 2015

WELCOME TO JOSTMED

Welcome to the Journal of Science, Technology, Mathematics and Education (JOSTMED). The JOSTMED is a scholarly based journal published thrice in a year by the Department of Science Education, School of Science and Science Education, Federal University of Technology, Minna, Nigeria, since September 1998. The scope of the Journal includes the research, development, and practice in all areas of Science, Technology, Mathematics and Education.

INSTRUCTIONS TO CONTRIBUTORS

1. General Guidelines

(i) Types of Manuscripts: The Editorial Board of the Journal of Science, Technology, Mathematics and Education accepts only scholarly and original articles that meet its aim and scope. Contributions must be original, therefore, authors is/are to guarantee that their article is original and not currently being considered for publication elsewhere.

(ii) Language: The JOSTMED is published in English Language.

(iii) Length: Usually full-length article, survey or report should be between 3,000 - 5,000 words (12 – 15 pages).

(iv) Abstract and Keywords: Each article should be summarized in about 150 -200 words, serving as a brief description of the content of the article. In addition, following the abstract, supply 4 - 5 keywords/phrases that characterize the content of the paper and which can be used for indexing purposes.

(v) Manuscript: Manuscripts, including the abstract and references, should be typed double-spaced on A4 paper set-up using Times New Roman, 12 font size.

(vi) Review: Each submission will be subjected to blind peer-review by at least two experts in the fields of the articles. Before the publication of accepted article, corresponding authors will receive a PDF version of their manuscript for final proofing. It should, however, be emphasized that changes in content (new or additional results, corrected values, changes in article title, etc) are not permitted without the approval of the Managing Editor.

2. Copyright

Only original papers will be accepted and processed. Paper accepted will be subjected to viper anti-plagiarize detector software. In addition, no compensation will be given in respect of published papers. However, authors reserve the right to use their own materials for purely educational and research purposes.

3. Format of Submitted Manuscripts

All manuscripts, written in good English, should be submitted electronically as an e-mail attachment (in Microsoft Word format not scanned copy) to the journal e-mail: jostmed@futminna.edu.ng, jostmedscience@yahoo.com or managing editor's e-mail: gambarii@yahoo.com, gambari@futminna.edu.ng.

In a rear occasion, when submitting manuscript in a paper version three copies should be submitted in double line spacing with wide margins, and not more than 12 pages with illustrations inserted. Extra page will attract additional amount of N1,000.00/$7.00 per page. Each article submitted must be accompanied with an assessment fee of three thousand naira (N3,000) only in cash or bank draft in favour of the Managing Editor (JOSTMED). Submission of manuscript is accepted throughout the year.

The beginning of the manuscript must bear the title of the paper and the full names of authors and their affiliations for correspondence (including e-mail and telephone number). Where there are two or more authors include the addresses for correspondence (e-mail and postal addresses) for the contact author.

Once the article is accepted for publication, the final version should be submitted online. Where that is not possible, the manuscript must be provided, accompanied by a Recordable CD of the same version labelled with: author name(s); titles of article and file name. The author must ensure that the final submission is complete, grammatically correct and without spelling or typographical errors. In preparing the disk, please use Microsoft Word. The sum of Fifteen Thousand (N15,000) naira only (£50.00 or $100 US Dollar) should be paid to journal account.
The online version of the published articles are available at www.futminna.edu.ng and can be accessed through the Internet free of charge.

4. Organization

The background and purpose of the manuscript should be given first, followed by details of methods, materials, procedures and equipment used (where applicable). Findings, discussion, conclusions and recommendations should follow in that order. Appendices are not encouraged, but may be countenanced if considered necessary for the manuscript content to be understood. Specifically, author is/are advised to consult the current APA Manual for the details they may need.

5. Figures and Tables

Figures, charts and diagrams should be kept to a minimum, they must be numbered consecutively with roman numerals and a brief title. When submitting electronically, figures should be prepared separately, numbered consecutively and submitted in one of JPEG File interchange (jpg), CompuServe GIF (gif), and PC Paintbrush (pcx). Images should not exceed width of 450 pixels.

6. References

The author should ensure that the references given are complete. References to personal letters, papers presented at meetings and other unpublished material may be included. Where such materials may help in the evaluation of the paper, copies should be made available to the Managing - Editor. Papers that are part of a series should include a citation of the previous papers, and explanatory materials may be appended to the manuscript to avoid footnotes. Citation of an author's work in the text should follow the author / date method of citation; the surname of the author (s) and year of publication should appear in text. Generally, the format for citations in the Manuscript for references is that of the latest edition of the American Psychological Association (APA) format. At the end of the article, a reference list in alphabetical order must be given.

7. Disclaimer

The views and styles expressed in the articles in this publication are those of the individual authors and are not necessarily shared by the reviewers, the editors, the editorial consulting board, the Department of Science Education, or the Federal University of Technology, Minna.

Dr. Gambari, A. I.
Associate Professor
The Managing Editor, (JOSTMED),
Department of Science Education,
Federal University of Technology,
P. M. B. 65, Minna, Niger State, Nigeria.
E-mail: gambarii@yahoo.com; gambariisiaka@gmail.com
gambari@futminna.edu.ng ; gambari@codel.futminna.edu.ng
Website: www.gambariamosaisiaka.com
Mobile Phone: +234-816-680-7534; +234-803-689-7955; +234-805-558-6716

EDITORIAL BOARD

SUSCRIPTION RATES

Nigeria Rate (Personal)	N1,000.00
Rate (Institutions)	N2,000.00
Other Countries Rate (Personal)	$25.00 / £15.00
Rate (Institutions)	$35.00 / £22.00

All Cheques should be made payable to:

The Managing Editor, JOSTMED, Department of Science Education,
Federal University of Technology, Minna, Nigeria.
Subscription must be pre-paid and must include 10% handling charges

ISSN 0748-4710

CONTRIBUTORS TO THE ISSUE

1. [1]HUSSEIN, K. OKORO; [1]AFOLABI, O. IYANUOLUWA & [2]ISMAIL. O. FOLORUNSHO
[1]Environmental-Analytical Research Group, Department of Industrial Chemistry, Faculty of Physical Sciences, University of Ilorin, Ilorin, Nigeria
[2]Department of Geophysics, Faculty of Physical Sciences, University of Ilorin, Nigeria
Email: okoroowo@yahoo.com; Phone No: +234-703-237-0228

2. [1]ALHASSAN, D. U,[2]MAMODU, A, [2]JIMOH, M. O. &[3]MOHAMMED, A.
[1]Department of Physics, Federal University of Technology, Minna, Nigeria
[2]Department of Geology, Federal University of Technology, Minna, Nigeria
[3]Department of General Studies, Niger State College of Education, Minna, Nigeria
E-mail: a.usman@futminna.edu.ng Phone No: +234-806-594-0066

3. AKPANENO, A. F.[1] & ADIMULA, I. A.[2]
[1]Department of Physics, Federal University, Dutsin-ma, Katsina State, Nigeria
[2] Department of Physics, University of Ilorin, Ilorin, Nigeria
E-mail: aakpaneno@fudutsinma.edu.ng Phone No: +234-803-503-7159

4. JONAH, S. A[1]. & OLASEHINDE, P. I[2].
[1]Department of Physics, Federal University of Technology, Minna, Nigeria
[2]Department of Geology, Federal University of Technology, Minna, Nigeria
E-mail: sajonah2003@yahoo.com Phone No: +234-806-468-7977

5. [1]RAFIU ABDULWAHEED ADEWUYI & [2]ABU MALLAM
[1]Physics Department, Federal University of Technology, Minna, Nigeria
[2]Phyics Department, University of Abuja, Abuja
E-mail: iyiolararafiu@futminna.edu.ng Phone No: +234-803-654-4246

6. [1]SALAU, RASAQ BOLAKALE, [2]AMINU MUHAMMAD, [1]BISIRIYU, M. T., [1]MOMOH, B. A. [2]BISHIR USMAN & [3]AHMED SALISU
[1]Department of Chemistry, Federal University of Technology, Minna, Nigeria
[2]Department of Pure and Industrial Chemistry, Bayero University, Kano, Nigeria
[3]Department of chemistry, Umar Musa Yar'adua University, Katsina, Nigeria
E-mail: rasaqsalau@futminna.edu.ng Phone No: +234-905-349-1924

7. JONAH, S. A.; AKPOMIE, D. P.; EZEKWEBEKWE, L. O.; ISAH, E. A.; MUHAMMED, A. N.; MOMOH, A. A.; OKOYE, C. K.; OKPARA, K. K.; ONI, N. O., *ALADE, R. O.; *YAHAYA, G. A.; *ZUBAIR, R. O.; ONOJA, E. U. & DARAMOLA, O.
Department of Physics, Federal University of Technology, Minna, Nigeria
*Department of Geology, Federal University of Technology, Minna, Nigeria
E-mail: sajonah2003@yahoo.com Phone No: +234-806-468-7977

8. [1]RAFIU ABDULWAHEED ADEWUYI & [2]ABU MALLAM
[1]Physics Department, Federal University of Technology, Minna, Nigeria
[2]Phyics Department, University of Abuja, Abuja, Nigeria
E-mail: iyiolararafiu@futminna.edu.ng Phone No: +234-803-654-4246

9. OGUNLADE, I.; AJILORE, O. R. & ADEBAYO, S. A.
Department of Agricultural Extension and Rural Development,
University of Ilorin, Ilorin, Nigeria
E-mail: sijuadeadebayo@yahoo.com; Phone No: +234-816-517-4309

10. BAKE, G. G.[A*], KOLO, A. W. [A] KPOTUN, A.[A] & SADIKU, S.O.E [A]
Water Resources, Aquaculture and Fisheries Technology Department,
Federal University of Technology, Minna, Nigeria
E-mail: gabbygana@yahoo.co.uk Phone No: +234-80-6285-0992

11. SALAUDEEN, M. T[1], UZOMA, A. O[2] & BASHIR, M[3]
[1]Department of Crop Production, Federal University of Technology, Minna, Nigeria
[2]Department of Soil Science and Land Management,
Federal University of Technology, Minna, Nigeria
[3]National Biotechnology Development Agency, Lugbe, Abuja, Nigeria
E-mail: mtsalaudeen@futminna.edu.ng Phone No: +234-806-333-0183

12. ISAH GBODO MOHAMMED
Department of Agricultural Science, School of Vocational Education,
Niger State College of Education, Minna, Nigeria
E-mail: isagbodo@gmail.com Phone No: +234-703-336-6199

13. MAMUDU, A. Y. & ABBAS M. A.
Crop Production Department, School of Agricultural and Agric Technology,
Federal University of Technology, Minna, Nigeria
Email: mamuduay@gmail.com Phone No: +234-805-705-5760

14. MURIANA, R. A.[1]; ABUBAKRE, O. K.[1], & TAJIRI, S. B.[2]
[1]Mechanical Engineering Department, Federal University of Technology, Minna.
[2]The Polytechnic of Sokoto State, Sokoto, Nigeria
E-mail: mraremu@yahoo.com Phone No: +234-703-784-9369

15. OLUTOYE, M. A.[1] & YUSUFF, A. S.[2]
[1]Department of Chemical Engineering, Federal University of Technology, Minna.
[2]Department of Chemical and Petroleum Engineering,
AfeBabalola University, Ado-Ekiti, Nigeria
E-mail: m.olutoye@futminna.edu.ng Phone No: +234-803-405-9454

16. AZEEZ, O. S.[1] UBADIKE, C. J.[2], NASIR, A.[3] & AGBAJELOLA, D. O.[4]
[1,2&4]Department of Chemical Engineering ,[3]Department of Mechanical Engineering,
Federal University of Technology Minna, Niger State, Nigeria.
E-mail: tosin.azeez@tutminna.edu.ng Phone No: +234-806-836-0923

17. ORHEVBA, B. A.; OLORUNSOGO, S. T. & JIMADA, S. A.
Department of Agricultural & Bioresources Engineering,
Federal University of Technology, Minna, Niger State, Nigeria
E-mail: borhevba@yahoo.com, Phone No: +234-806-168-8880

18. YISA, B. M.
Department of Mathematics, University of Ilorin, Ilorin, Nigeria
E-mail: yisa.bm@unilorin.edu.ng Phone No: +234-8108192432

19. *YUSUF, S. I.[1], AIYESIMI, Y. M.[1], JIYA M.[1] & AWOJOYOGBE, O. B.[2]
[1] Department of Mathematics and Statistics,
Federal University of Technology, Minna, Nigeria
[2] Department of Physics, Federal University of Technology, Minna, Nigeria
*Email: shakirudeen.yusuf@futminna.edu.ng; amaams5@yahoo.com
Phone No: +234-706-929-7464

20. OLUTOLA, ADEKUNLE T. (Ph.D.) & DOSUNMU, SIMEON A. (Ph.D.)
Department of Educational Foundations, Faculty of Science and Education,
Federal University, Dutsin-Ma, Katsina State, Nigeria.
E-mail: aolutola@fudutsinma.edu.ng, Simipure@yahoo.com
Phone No: +234-806-029-7940; +234-809-785-0451

21. HASATU ABDULLAHI UMAR GANDUJE, Ph.D.; WUNTI YAKUBU IBRAHIM, Ph.D & IGBAJI CLEMENT, Ph.D
Department Education, Bayero University, Kano
E-mail: Hafsatmohd@yahoo.com, yakubuibrahim@yahoo.com, clementigbaji@gmail.com
Phone No: +234803-323-1925, +234-807-599-1701, +234-803-207-6249

22. SHITTU, AHMED TAJUDEEN (Ph.D)[1], GAMBARI, AMOSA ISIAKA (Ph.D)[1] & OMIOLA MATTHEW ADETAYO (Ph.D)[2]
[1]Department of Science Education, Federal University of Technology Minna, Nigeria
[2]Department of science Education, Federal University Dutsin-Ma, Nigeria
Email: t.shittu@futminna.edu.ng, gambari@futminna.edu.ng
Phone No: +234-816-218-2220

23. ODEWUMI, MICHAEL OLUBUNMI
Department of Educational Technology, University of Ilorin, Ilorin, Nigeria.
E-mail: agbegilerebunmi@yahoo.com Phone No: +234-703-435-5363

24. ZUBAIRU SULEIMAN ABUBAKAR[1] & ISYAKU ABDULRAHEEM[2]
[1]Department of Educational Foundations and Curriculum, Faculty of Education,
Ahmadu Bello University, Zaria
[2]Dept. of primary Education Studies,
Kaduna State College of Education Gidan Waya, Kafanchan, Nigeria
E-mail: sazubairu@gmail.com Phone No: +234-806-545-1770

25. ALABI. T. O. (Ph.D)[1], EMMANUEL OMEIZA[2] & FALODE, C. O.[3] (Ph.D)
[1]Science Education Department, Federal University Of Technology, Minna, Nigeria
[2]Hill-Crest International School Minna, Nigeria
E-mail: dralabiomotayo2012@gmail.com Phone No: +234-806-453-1808

26. ALADE, IBIWUMI A. Ph.D.[1] & AMODA, MORILI BISOLA Ph.D.[2]
[1]Department of Educational Foundations and Instructional Technology,
[2]Department of Vocational and Technical Education,
Tai Solarin University of Education, Ijagun, Ijebu Ode, Ogun State, Nigeria
E-mail: ibiwumiabiodun@yahoo.com, curritech66@gmail.com,
bisolamoda@yahoo.com
Phone No: +234-803-243-7263

27. YUSUF, LATEEF ADEYEMI Ph.D
Department of Educational Management,
College of Education, Al-Hikmah University, Ilorin-Nigeria
E-mail: adedeyemi@yahoo.com Phone No: +234-806-064-5304

28. JIBRIL AHMED WUSHISHI, ABDULRAHMAN MUSA EWUGI & BASHARU MUSA USMAN
[1]Technical Drawing Department,
[2]Automobile Technology Department,
Niger State College of Education, Minna, Nigeria
[3]Education Technical Department, Kaduna Polytechnic, Kaduna, Nigeria
E-mail: jibrilahmed66@yahoo.co Phone No: +234-805-118-2083

29. YUSUF, H. T. (Ph.D), YUSUF, A. (Ph.D)
Department of Arts and Social Sciences Education, University of Ilorin, Ilorin, Nigeria
E-mail: hamdallatyusuf@yahoo.com; yuabra25@yahoo.com;
gambari@futminna.edu.ng
Phone: +234-803-395-3944

30. AKINNUBI, O. P. Ph.D[1] & YUSUF, H. A.[2]
[1]Department of Educational Management, Al-Hikmah University, Ilorin, Nigeria
[2]Department of Educational Management, University of Ilorin, Ilorin, Nigeria
E-mail: akinnubipaul@yahoo.com, princesshabby@yahoo.com
Phone No: +234-805-221-4006, +234-803-482-5291

31. OFILI, GLORY OSARETIN (Ph.D)
Department of Educational Technology and Library Science,
University of Uyo, Akwa Ibom State, Nigeria
E-mail: gloryofili@yahoo.com Phone No: +234-805-173-7808

32. SULE, SAMUEL SARDAUNA
Department of Mathematics and Statistics, Yobe State University, Damaturu, Nigeria
E-mail: profsam8@gmail.com Phone: +234-706-189-3719

33. NSOFOR, C. C. Ph.D[1]., OBUNADIKE, G. N[2.], BELLO. A.[3] & ABUBAKAR, H.[4]
[1]Science Education Department, Federal University of Technology, Minna, Nigeria
[2]Computer Science Department, Federal University Deutse-M, Katsina State.
[3]Firdaus International School Minna, Nigeria
[4]School of Health Technology Minna, Nigeria
E-mail: chinnansofor@yahoo.com Phone No: +234-803-678- 3024

TABLE OF CONTENTS

JOSTMED, VOLUME 11(3), DECEMBER, 2015

ARTICLES AND RESEARCH REPORTS ON SCIENCE

DISTRIBUTION OF SELECTED HEAVY METALS AND OTHER ELEMENTS IN COAL SAMPLES COLLECTED FROM COAL DEPOSITS IN KOGI STATE, NIGERIA

[1]HUSSEIN, K. OKORO; [1]AFOLABI, O. IYANUOLUWA & [2]ISMAIL, O. FOLORUNSHO
[1]Environmental-Analytical Research Group, Department of Industrial Chemistry,
Faculty of Physical Sciences, University of Ilorin, Ilorin, Nigeria
[2]Department of Geophysics, Faculty of Physical Sciences, University of Ilorin, Ilorin, Nigeria
Email: okoroowo@yahoo.com; hkoadeola@gmail.com Phone No: +234-703-237-0228

Abstract
It is important that emissions of potentially toxic heavy metals and other elements from coal combustion are measured and if necessary, controlled in order to limit any environmental effects. Coal samples were collected from Enjema, Ibibio, and Okaba coal deposits in Kogi state to determine the selected heavy metals and trace elements in the samples. The coal samples were analyzed with the aid of Atomic absorption spectrometry (AAS) and X-Ray fluorescence (XRF) techniques. Heavy metals (Cd, Cr, Mn, Pb and Ni) were determined by AAS while selected trace elements (Fe, K, Ca, S) by XRF. The result shows that the selected heavy metals chromium, manganese, nickel, and lead were present at a high level when compared with heavy metals determined in coal samples collected from Lafia-obi and Chikila in Nasarawa State, North Central, Nigeria. in their previous study. Cadmium was not detected in the samples analyzed; the trace element determined were at lower concentrations when compared to the value of trace elements concentrations found in coal samples obtained from river Ekulu in Enugu State, South East, Nigeria. Sulphur was present at high concentration which can affect the body either when inhaled or absorb. The results indicated that the concentrations of the metals were high and this could have adverse effects on the inhabitant of the area. Apparently, there is need for constant monitoring of the stations to ascertain its pollution status.

Keywords: Coal, metals, soil, x-ray fluorescence, AAS

Introduction
Coal has been found to range from trace quantities of aluminium and thorium, to larger quantities of aluminium. Coal contain organic and inorganic materials, they are physically and chemically heterogeneous, combustible sedimentary rock. Organically, coal primarily consists of carbon, hydrogen and oxygen with lesser amounts of sulphur and nitrogen, while inorganically it consists of a diverse range of ash-forming compounds distributed throughout the coal (Cojocaru, Pantelica, Pincovschi & Georgescu, 2006). Various elements in coal have been used to correlate coal beds. The elemental abundances vary between coal basins, within coal beds, and over distances in the same beds. These variations arise from differences in geologic and geochemical processes acting upon the peat and the coal over geologic time. In addition, variations in the plant communities, source material, detritalinflux, diagenetic processes and epigenesis do influence the type and abundance of elements in the coal (Orem & Finkelman, 2004).

The metallic elements in coal can have profound environmental, economical, geological, technological and human health effects (Jauro, Agho, Abayeh, Obaje, & Abubakar, 2008). For instance; a few elements in coal (e.g. gold, silver, and uranium) have potential threats to the environments. Coal has been found to be important energy sources required to sustain the standard of living in the United States and many other developing countries such as China and

India, coal will be relied upon as the primary source of energy required to fuel industrialization and to improve standard of living of the populace (Finkelman, Orem, Castranova, Tatu, Belkin, Zhebg, Lerch, Maharaj, & Bates, 2002). In today's industrial society, there is no escaping exposure to toxic chemicals and metals. This is so because somehow, our society is dependent upon metallurgy for proper functioning. It is therefore not surprising that human exposure to heavy metals has risen dramatically in the last 50 years because of an exponential increase in the use of heavy metals or their compounds in industrial and agricultural processes. In the United States for instance, tons of toxic industrial waste are reportedly mixed with liquid agricultural fertilizers and dispersed across America's farmlands. Environmental contamination and exposure to heavy metals is a serious growing problem throughout the world, as both natural sources and anthropogenic processes emit heavy metals into various environmental media. Human exposure to aluminium, for instance, is caused by environmental factors such as soil contamination whereby aluminium can be mobilized as a consequence of soil acidification due to the use of certain fertilizers or acid rain; or as a result of aluminium use in some Industrial processes such as metallurgy, food preservation, water purification (Krewski, Yokel, Nieboer, Borchelt, Cohen, Harry, Kacew, Lindsay, Mahfouz, & Rondeau, 2007), and the use of pharmacological and cosmetic products (Ernst, & Coon, 2000; Ganrot, 1986).

The Federal government of Nigeria has a great renewed interest in the coal deposit. The main objectives of these are to diversify the economy which has been solely dependent on crude oil and its refined products. Nigeria has one of the largest coal deposits in Africa. Nigeria coal reserves are large, over 2 billion metric tons of which 650 million tons are proven. If fully resustained, the coal industry could fetch up to 5 billion naira in export earnings annually (Akande, Andreas & Erdtmann, 1992). Coal contains diverse amounts of trace elements in their overall composition (Adaikpoh, Nwajei, & Ogala, 2005). Combustion of coal is a potential source of several trace element emissions to the atmosphere. The electric power sector is the largest source of toxic pollutants, due to coal ash and coal waste, which contain toxins such as heavy metals. The waste left over from burning coal generates tons of coal ash and coal sludge in which 40% of that waste finds its way into new products and 60% is stored in ponds or pits, which can present health and environmental risks when released into ground water (Clean Air Task Force (CATF), 2000).

Equally, a study on Ikorodu, Lagos lagoon area (Ladigbolu, Balogun, & Shelle, 2011) reported higher concentrations of Fe, Cu, Pb, Cd and Zn in sediments when compared with the values in unpolluted sediment as well as the standards of the regulatory authorities (WHO, 1982; Federal Environmental Protection Agency (FEPA), 1988). Thus, there is indeed very high possibility of coal pollution from several environmental pollutants that most probably include some metal forms with equally very high possibilities of human contaminations through the environmental.

With the increasing use of coal, the growing impact on the environment from the potentially hazardous trace elements becomes a great concern. The information about the concentration, distribution and occurrence of trace elements in coal is of great importance (Zhan, Ren, Zhu, Chou, & Zheng, 2004). Only few studies and data on the chemical contents of metals in coal samples on the present sample locations are available. The objective of the present study is to investigate trace metal contents and heavy metal concentrations in coal samples collected from different locations in Kogi state, using AAS and XRF techniques for their metal analysis.

Materials and Methods

Sample Collection

The samples were collected during dry season (2014) from Enjema, Ibiobio and Okaba coal deposit, Kogi state North central zone of Nigeria. The samples were kept in polythene bags, sealed and labelled with a masking tape and transported to the laboratory for further analysis. Detailed record of every sample collected was done by attaching and appropriately inscribing labels showing the site, time and method of collection.

Pre-treatment of samples for ED- XRF analysis

The selected lumps of coal samples were air-dried and then pulverized with clean mortar and pestle and sieved into selected mesh powder. The powdered samples with particles diameter less than 50 mm were retained for all examinations. The powdered samples were pressed into pellets and analysis of coal samples were performed using ED- XRF (Adedosu, Adedosu & Adebiyi, 2007).

Sample preparation for AAS analysis

The coal sample was grinded into smooth particles and was sieved using a 5 mm micro-sieve. 5g of the sieved sample was weighed and kept in a clean dried conical flask. It was moistened with a little distilled water and was digested in different ratio of acid mixtures (5 ml of HNO_3, 3 ml of $HClO_3$, 2 ml of HCl). The mixture was placed on hot plate, heated at 90 ^oC until solution was reduced to 20 ml. The solution was allowed to cool and later transferred to 100 ml volumetric flask which was finally made up to the mark with distilled water. The solution was then filtered and kept refrigerated at 4^{o}Cprior to analysis.

Results and Discussion

Five heavy metals were detected in samples of coal from Enjema, Ibibio, and Okaba coal deposits in Kogi State using Atomic Absorption Spectrophotometer. These are Pb, Cd, Cr, and Mn and Ni. In addition; the following trace elements were also measured; Fe, Ca, S, K using XRF technique. The results were summarized in the tables 1 and 2 below

Table 1: Mean and standard deviation of heavy metals concentrations (mg/kg) using AAS technique

No	Locations	Cr ± S.D	Cd ± S.	Pb ± S.D	Mn ± S.D	Ni ± S.D
1	Enjema 1	0.45 ± 0.06	ND	0.32 ± 0.11	3.27 ± 0.06	1.71 ± 0.01
2	Enjema 2	0.165 ± 0.03	ND	0.36 ± 0.09	2.71 ± 0.07	0.93 ± 0.06
3	Ibibio 1	0.105 ± 0.04	ND	0.47 ± 0.02	0.54 ± 0.00	0.35 ± 0.00
4	Ibibio 2	0.075 ± 0.03	ND	0.65 ± 0.05	1.16 ± 0.05	1.33 ± 0.13
5	Okaba 1	0.300 ± 0.00	ND	0.54 ± 0.02	2.41 ± 0.01	1.33 ± 0.02
6	Okaba 2	0.190 ± 0.02	ND	0.42 ± 0.04	2.54 ± 0.03	0.64 ± 0.02

Table 2: Concentration (mg/kg) of trace elements using XRF technique

Locations	K	Fe	Ca	S
Enjema 1	21.6	7.02	5.36	24.27
Enjema 2	19.9	8.20	5.56	30.01
Ibibio 1	9.8	7.70	3.52	29.88
Ibibio 2	9.2	7.76	3.40	27.81
Okaba 1	6.52	5.10	8.01	68.92
Okaba 2	6.54	5.50	7.65	64.26

The mean concentration of the heavy metals in the coal samples had values of Pb that range from 0.32 mg/kg to 0.65 mg/kg, Cr; 0.075 mg/kg to 0.45 mg/kg, Mn; 0.54 mg/g to 3.27 mg/kg, Cd; not detected, Ni; 0.35 mg/kg to 1.71 mg/kg All heavy metals measured are harmful and toxic at high concentration to human and can lead to environmental metal poisoning during combustion of coal. The results of this investigation also revealed that heavy metal occurrence are also of natural origin. The negative impacts of heavy metals result from their toxicity to biological processes including those catalyzed by microorganisms.

Manganese was the most abundant metal determined in coal samples from the selected locations. Manganese has the highest concentration in the coal sample at location 1with a concentration of 3.27 mg/kg and lowest concentration at location 3 with a concentration of 0.54 mg/kg. High values recorded for manganese, this could be due to the presence of different effluents of variable sources e.g. sewage and domestic, agricultural and industrial wastes produced from outlets (Jauro, Agho, Abayeh, & Obaje, & Abubakar, 2008).

The manganese concentration in each location varies as effluents concentration varies in each location. The concentration of manganese recorded in this study was lower than the one recorded by Adekola, Alafara and Buhari (2012) (45.81- 155 mg/kg). Therefore, we can conclude that effluents of variable sources were present in soil of the coal samples resulting in high manganese concentration and this occurred mostly in location 1. Exposure to high levels of Mn (concentrations above 2.22 mg/kg) can affect the nervous system and very high levels may impair brain development in children.

FEPA standard for manganese intake either by exposure to or by inhalation is 2.22 mg/kg (Federal Environmental Protection Agency (FEPA) Act, 1991). Apparently, the use of coal samples collected from location 1, 2 and 5 can pose serious environmental effects to the users. Manganese may be organically bound in coal but is minor in high rank coals like West virginal (Swaine, 1990). Manganese in coal can impact coal mining. Manganese is important in steel alloy, in glass making and permanganate, it is a strong oxidizer used in laboratories and medicine. The next abundant metal in the coal samples was Nickel. Nickel has the highest concentration in the coal samples collected from location 1 with a concentration of 1.71 mg/kg and lowest concentration at location 3 with a concentration of 0.35 mg/kg. In a related research studies the obtained value recorded for Ni ranged between 0.064 - 0.067 mg/kg and this value were very low compared to the values recorded in this study. Accumulation of nickel in the heavy metal is also due to intake of sewages and effluents from industrial companies into water in the soil. . Small amounts of Nickel are needed by the human body to produce red blood cells, however, in excessive amounts, can become mildly toxic. Short-term over exposure to nickel is not known to cause health problems, but long-term exposure can cause decreased body

weight, heart and liver damage, and skin irritation. FEPA standard for Nickel intake either by exposure to or by inhalation is 1.08 mg/kg (Jauro, Agho, Abayeh, Obaje, & Abubakar, 2008) and therefore, at location 1, 3 and 4, the use of the coal samples from these aforementioned locations can be detrimental to human. Nickel inhalation possesses a greater risk than nickel in water. It may cause lung cancer or nasaltumors. Many people also develop dermatitis upon skin contact with nickel (Jauro, Agho, Abayeh, Obaje, & Abubakar, 2008).

Lead was detected at high concentrations lower than manganese and nickel in the coal samples, but in location 4 highest concentration for lead was recorded (0.65 mg/kg) and lowest concentration (0.32 mg/kg) was recorded in location 1 respectively. Lead has the highest concentration in the coal samples. The observed values for lead was found to be within the acceptable FEPA limit (0.32-0.65 mg/kg) and the acceptable limit according to FEPA is <1.00. The obtained results were compared with their related studies, in Jauro et al., lead was not detected at all in the samples analyzed. In Adaikpoh, Nwajei and Ogala (2005). The value recorded for lead ranged between 0.013 – 0.0017 mg/kg which was very low to the results obtained in this study. Accumulation of Lead as heavy metal in coal is through deposition of sewages and gaseous effluents etc. High Lead concentration recorded in the fourth location could be due to natural and anthropogenic sources. Others sources include, the use of lead containing ceramics dishware, metal plumbing, food and lead solder (White, Cory-Slechta, Gilbert, Tiffany-Castiglioni, Zawia, Virgolini . . ., 2007). Human being can get exposed to lead contamination from industrial sources such as lead smelting and manufacturing industries (White, Cory-Slechta, Gilbert, Tiffany-Castiglioni, Zawia, Virgolini . . ., 2007; Goyer, 1996).

Various effects occur over a broad range of doses, with the developing foetus and infant being more sensitive than the adult. High levels of exposure may result in toxic biochemical effects in humans which in turn cause problems in the synthesis of haemoglobin, effects on the kidneys, gastrointestinal tract, joints and reproductive system, and acute or chronic damage to the nervous system. FEPA standard for lead intake either by exposure to or by inhalation is 0.45 mg/kg (Federal Environmental Protection Agency (FEPA) Act, 1991). and therefore, at location 3, 4 and 5, the use of the coal samples from locations 3, 4 and 5 are be detrimental to human and can lead to human poisoning. The acceptable limit for chromium according to FEPA standard is < 1.00. Apparently, from these results it can be inferred that concentration falls within the acceptable limit of FEPA. Chromium has the highest concentration in the coal sample at location 1 with a concentration of 0.45 mg/kg and lowest concentration at location 4 with concentration of 0.075 mg/kg. Chromium is used in metal alloys and pigments for paints, cement, paper, rubber, and other materials. Low-level exposure can irritate the skin and cause ulceration and long-term exposure can cause kidney and liver damage, and damage to circulatory and nerve tissue. FEPA standard for chromium intake either by exposure to or by inhalation is 0.24 mg/kg (Federal Environmental Protection Agency (FEPA) Act, 1991).

Cadmium was not detected in all coal samples at each location. In the current study cd was not detected in the sample analyzed. Accumulation of Cadmium as heavy metal in coal is through deposition of sewages, atmospheric deposition and fertilizer application on the soil (Goyer, 1996). However, with the absence of cadmium, we can say that no agricultural activities was done near the coal deposits because, fertilizer would have been applied to boost growth of crops and that would have been the source of our cadmium as heavy metal.

The most significant use of cadmium is in nickel/cadmium batteries, as rechargeable or secondary power sources. Cadmium coatings provide good corrosion resistance, particularly in high stress environments such as marine and aerospace applications where high safety or reliability is required. Cadmium is also present as an impurity in several products, including phosphate fertilizers, detergents and refined petroleum products. In humans, long-term exposure is associated with renal disfunction, obstructive lung disease and lung cancer. Cadmium may also produce bone defects in humans. FEPA standard for Cadmium intake either by exposure to or by inhalation is 0.18 mg/kg (Federal Environmental Protection Agency (FEPA) Act, 1991) or therefore, it is not risky to human health.

The major elements in soil are derived from inorganic and organic sources (Swaine, 1990). Most of these trace elements are useful in low concentration in human but in high concentration; they can be toxic to human and can affect the body. These trace elements have been proven dispensable for normal growth and reproduction of all higher plants (Bowen & Kratky, 1983).

The concentrations of trace elements in most of the samples analyzed were found to be less than the levels in most U.S and China coals (Finkelman, Orem, Castranova, Tatu, Belkin, Zhebg, Lerch, Maharaj, & Bates, 2002). This has been shown not dangerous to human health. Thus, proper use of the coal should not result in significant health concerns regarding exposure to these trace elements. Sulphur, the most abundant trace element found in the coal samples from these locations. The highest concentrations of sulphur were recorded in location 6 with a concentration of 56.2 mg/kg while lowest concentration was recorded at location 1 with a concentration of 24.27 mg/kg (Ryoo, Choi, & Hong, 2000).

The sulphur content of coal varies considerably with the nature and origin of the fossil deposits. When coal is burnt, its sulphur content combines with oxygen to form sulphur dioxide, which contributes to both pollution and acid rain (Liu, Cao, Luo, & Chen, 2009). Sulphur in coal cannot be removed by physical means and the existing chemical processes are costly. Short term exposure to high level of sulphur causes breathing difficulties and obstructing airways while long term exposure results in chronic bronchitis and respiratory illness.

Sulphur is required in the body for detoxification. Sulphur bonds are required for proteins to maintain their shape and the bond determine the biological activity of the proteins. Potassium was the next abundant elements in the selected coal samples. Potassium has its highest concentration in the coal sample at location with a concentration of 21.6 mg/kg and lowest concentration at location 5 with a concentration of 6.52 mg/kg. Industrial activities and plants or sewages deposits in the surrounding water and oil are sources of potassium in coal. Kidney disease is the most common symptoms of exposure to high level of potassium. Low level of potassium can also lead to breakdown of red blood cells, muscle tissues and other tissue injury. Potassium in the body helps muscles to move, nerves to work and kidneys to filter blood.

Highest concentration of iron in the coal sample was recorded at location 2 with a concentration of 8.2 mg/kg and lowest concentration at location 5 with a concentration of 5.1 mg/kg. In a related study carried out by Jauno et al., on Lafia-Obi and Chukka coal samples in Nasarawa State. The concentration of iron recorded ranged between 21.95 - 49.555 mg/kg. The values were higher than FEPA limit of 70 mg/kg. Therefore, the value recorded for iron in this study found within the acceptable limit. Iron is mainly produced by industrial activities, and deposit slowly in the surrounding water and soil. Since Iron is present, its high concentration indicates

the presence of iron bearing minerals such as iron pyrite, and a kerinite (Liu, Cao, Luo, & Chen, 2009). Exposure to high level of Iron concentration causes nausea and vomiting, abdominal pain and diarrhoea, gastrointestinal bleeds, serious overdose, which causes hepato cellular necrosis (jaundice, hepatic failure) and gastric outflow obstruction, which may be a late complication. Calcium, the least abundant elements determined in the coal samples from the selected locations has its highest concentration in coal samples from location 5 with a concentration of 8.01 mg/kg and lowest concentration at location 4 with a concentration of 3.4 mg/kg.

Calcium is used in the body for the production of bones. Exposure to high level of calcium can cause damage to kidneys, kidney stone, nausea, vomiting, constipation, poor appetite, weakness and weight loss. The heavy metals and trace elements determined were compared with results of a study of environmental metals pollutants load of a densely populated and heavily industrialized commercial city of Aba, Nigeria (Tobias, Ndubuisi, Ezejiofor, Udebuani, Ezeji, & Ayalogbu, 2013) which generally revealed that the mean concentrations for most of the metals including such toxicants as lead, nickel, chromium, cadmium, etc. were all found to be quite high relative to those of the control sites where (except iron, manganese and copper)most of them were either not detected at all or the concentration of the detected ones were relatively low which is in concord with the concentration of heavy metals and trace element determined except in cadmium which was not detected in the coal samples.

Trace elements concentration was compared with concentration result of the physico chemical characterization and speciation of sulphur of Nigerian coal samples carried out by Adekola, Alafara and Buhari (2012) and was found relatively low to concentration of trace elements in the coal samples from the present study. The data also shows that all metals investigated in these coals have mean content lower than the Chinese Pernian coals (Shifeng, Deyi, Yuegang, Mei, & Liming, 2005). The concentrations of heavy metals and trace elements determined in this study were found to be higher than trace elements determined in coal sediments from river Ekulu in Enugu (Adaikpoh, Nwajei, & Ogala, 2005). In general, the result of the trace elements recorded in this study, it was observed that ca, fe, and sulphur was found as a major elements, similar case was observed in this study.

Conclusion

The study of heavy metals and trace elements content needs to be considered and studied for the interest of geochemical studies and economic interest. The selected heavy metals were all present except cadmium. The other elements were also present both in small and larger percentage. Therefore, the monitoring and assessment of the environmental quality of coal plays an important role in restoring damaged ecosystems, protecting soil environmental quality, and developing a scientific basis for sustainable coal mining with improved human health impact. Thus, heavy metals determined and found in the coal samples are detrimental to human beings, residents of these areas are at great risk of environmental metal poisoning, and the selected trace elements was found in the coal sample. The heavy metals and trace elements bioaccumulation in plants and especially in human can lead to serious health challenges. From the findings, it shows that coal combustion is a source of toxic heavy and trace elements and the use as fuel should be minimized.

References

Adaikpoh, E. O., Nwajei, G. E. & Ogala, J. E. (2005). Heavy metals concentrations in coal and sediments from river Ekulu in Enugu, coal city of Nigeria. *J. Appl.Sci. Environ. Mgt.,* 9(3), 5 – 8.

Adedosu, T. A., Adedosu, H. O. & Adebiyi, F. M. (2007). Geo - chemical and mineralogical significance of trace metals in Benue through coal. *Nigeria J. of Appl. Sci.*, 7 (20), 3101-3105.

Adekola, F. A., Alafara, B. A., & Buhari, S. (2012). Physico-Chemical characterization and speciation of sulphur of Nigerian coal sample. *J of Min and Mat Charact and Eng.*, 11, 965-969.

Akande, S. O., Andreas, H., & Erdtmann, B. D. (1992). Upper cretaceous and tertiary coals from Southern Nigeria: Composition, rank, depositional environments and their technological properties. *Nig. Assoc. Pet. Explorationists Bull.*, 7, 26-38.

Bowen, T. & Kratky, S. (1983). Micro-nutrients soil and climatic conditions that often determines Micronutrient deficiencies. *World Family,* 25, 10-14.

Clean Air Task Force (CATF) (2000). Laid to waste: The dirty secret of combustion waste from America's power plants.

Cojocaru, V., Pantelica, A., Pincovschi, E. & Georgescu, I. (2006). EDXRF *versus* INAA in pollution control of soil. *Journal of Radioanal. Nucl. Chemistry,* 268(1), 71.

Ernst, E. & Coon, J. T. (2000). Heavy metals in traditional Chinese medicines: A systematic review. *Cl in. Pharmacol. Therapeut,* 70(6), 497-504.

Federal Environmental Protection Agency (FEPA) (1988). Guidelines and standards for environmental pollution control in Nigeria. *Decree 58 of 1988.* p. 238.

Federal Environmental Protection Agency (FEPA) Act (1991). Guidelines and standards for Industrial effluent, gaseous emissions and hazardous waste management in Nigeria. *National Environmental Protection Regulations, Federal Republic of Nigeria. Supplement to Official Gazette Extraordinary-Part B.* 78 (42), B15 –31.

Finkelman, R. B., Orem, W., Castranova, V., Tatu, C. A., Belkin, H. E., Zhebg, B., Lerch, H. E., Maharaj, S. V. & Bates, A. L. (2002). Health impacts of coal and coal use: Possible solutions. *Int. J. Coal Geol.,* 50, 425 - 443.

Ganrot, P. O. (1986). Metabolism and possible health effect of aluminium. *Environ. Health, Perspect.*, 65, 363 - 441.

Garvey, G. J., Hahn, G., Lee, R. V., & Harbison, R. D. (2001). Heavy metal of hazards Asians traditional remedies. *Inter. J. Environ. Hlth Res.,* 11, 63-71.

Goyer, R. A. (1996). Results of lead research: Prenatal exposure and neurological consequences. Environ. *Health perspect*, 104, 1050-1054.

Hutton, M. (1987). Human health concern for lead, mercury and arsenic in land: Mercury, cadmium, and arsenol in the Environment. *Wiley Scope,* 85 - 89.

Jauro, A., Agho, M. O., Abayeh, O. J. & Obaje, N. G. & Abubakar, M. B. (2008). Petrographic studies and coking properties of Lamza, Chikila and Lafia-Obi coals of the Benue trough. *Nigeria Journal of Min and Geol.*, 44, 11 - 19.

Krewski, D., Yokel, R. A., Nieboer, E., Borchelt, D., Cohen, J., Harry, J., Kacew, S., Lindsay, J., Mahfouz, A. M. & Rondeau, V. (2007). Human health risk assessment for aluminium, aluminium oxide and aluminium hydroxide. *Journal Toxicol. Environ. Health B Crit. Rev.,* 10 (11), 1 - 269.

Ladigbolu, I. A., Balogun, K. J. & Shelle, R. O. (2011). Hydrochemistry and levels of some heavy metals in samples of Ibeshe, Lagos Lagoon Complex, *Nigeria J. of Am. Sci.,* 7(1), 625 - 632.

Liu, Y., Cao, Q., Luo, F. & Chen, J. (2009). Biosorption of Cd^{2+}, Cu^{2+}, Ni^{2+} and Zn^{2+}ions from aqueous solutions by pretreated biomas of brown algae. *J. of Haz. Mat.,* 163, 931 - 938.

Orem, W. H. & Finkelman, R. B. (2004). *Coal formation and geochemistry*. In: Treatise on geochemistry. *Amsterdam, Elsevier*, 1 (7), 191 - 222.

Ryoo, K. S., Choi, J. & Hong, Y. P. (2000). Analysis of sulphur in coal and coal desulfurization by counter flow oxidative treatment. *Bull. of the Kor. Chemical Soc.*, 21 (8), 828 - 830.

Shifeng, D., Deyi, R., Yuegang, T., Mei, Y. & Liming, H. (2005). Concentration and distribution of elements in late permian coals from westernguizhou province, china. *Int. J. of Coal Geol.*, 61, 119-137.

Swaine, D. J. (1990). *Trace elements in coal.* London: Butterworth, 278.

Tobias, I., Ndubuisi, E., Ezejiofor, A. N., Udebuani, A. C., Ezeji, E. U. & Ayalogbu, E. A. (2013). Environmental metals pollutants load of a densely populated and heavily industrialized commercial city of Aba. *Nig. J. of Toxic and Environ Health Sci.*, 5(1), 1 - 11.

White, L. D., Cory-Slechta, D. A., Gilbert, M. E., Tiffany-Castiglioni, E., Zawia, N. H., Virgolini, M., Rossi-George, A., Lasley, S. M., Qian, Y. C. & Basha, M. R. (2007). New and evolving concepts in the neurotoxicology of lead. *Toxicol. Appl. Pharmacol,* 225,1 - 27.

WHO (1982). Rapid assessment of sources of air, water and land pollution. *Offset Publication*, 62,7.

Zhan, J, D., Ren, Y. Zhu, C. L., Chou, R. & Zheng, B. (2004). Mineral matter and potentially hazardous trace elements in coals from Qianxi fault depression area in South-Western Guizhou, China. *Int. J. Coal Geol.*, 57, 49-61.

GEOTECHNICAL INVESTIGATION OF THE EARTH SUBSURFACE FORMATION FOR ITS SUITABILITY FOR HIGH-RISE BUILDINGS IN SOUTHERN PART OFPAIKO, NIGER STATE, NORTH CENTRAL NIGERIA

[1]ALHASSAN, D. U,[2]MAMODU, A, [2]JIMOH, M. O. &[3]MOHAMMED, A.
[1]Department of Physics, Federal University of Technology, Minna, Nigeria
[2]Department of Geology, Federal University of Technology, Minna, Nigeria
[3]Department of General Studies, Niger State College of Education, Minna, Nigeria
E-mail: a.usman@futminna.edu.ng Phone No: +234-806-594-0066

Abstract
Vertical electrical sounding (VES) was carried out insouthern Paiko, north central Nigeria, using AbemTerrameter model SAS 4000. The study was carried out with a view of determining the subsurface layer parameters (resistivity, depth and thickness) which were employed in delineating the sites for building construction. A total of six transverses with ten VES stations along each traverse, having separation of 50 m apart were investigated. It has a maximum current electrode separation (AB/2) of 100 m. Three to four distinct geoelectric layers were observed namely; Top layer, weathered/fractured layer, and fresh basement. The observed frequencies in curve types include 21.6% of H, 0.6% of HA, 2.4% of K, 0.6% of A, 3.6% of KH, 6% of QA and 1.2% of HK. Eight VES stations were delineated for building site construction,having depths to bedrock varying between 0.63 m and 3.99 m.

Key words: Vertical electrical sounding, site, construction, resistivity, depth, geoelectric layer, bedrock, AbemTerrameter

Introduction
Paiko (the study area) is the headquarter of Paikoro local government area in Niger state, North Central, Nigeria. The population of Paiko is increasing rapidly as a result of people migrates from rural areas to urban towns to earn a living. As such, there is need for more estate development to accommodate the growing population of the area. However, in Nigeria Presently there are several cases of building collapse and cracking of walls as a result of poor foundation and lack of site investigation. There is need to search for the areas where the consolidated basement is shallow which can provide strong base for building construction. Therefore, the aim of this work is to applied geophysical method to determine sites where the fresh basement is intruded close to the surface that can support foundations to buildings. Presently, there is only one known geophysical survey conducted in the area (Dangana, 2007).
Among several geophysical methods employed in determine depth to bedrock (electrical resistivity, gravity, seismic, magnetic, remote sensing, and electromagnetic), the electrical resistivity method is the most effective (Kearey*et al.*, 2002). It is an effective and a reliable tool in slicing the earth into geoelectric layers. It has the advantage of non-destructive effect on the environment, cost effective, rapid and quick survey time and less ambiguity in interpretations of results when compared to other geophysical survey methods (Todd, 1980). The vertical electrical sounding (VES) technique provides information on the vertical variations in the resistivity of the ground with depth (Ariyo, 2005). It is used to solve a wide variety of problems, such as; determination of depth, thickness and boundary of aquifer (Asfahani, 2006; Bello & Makinde, 2007).

Geology of the Study Area

The study area is located within the north central Nigerian basement complex. It has an elevation of 304 m above sea level with population of about 736,133 people as at 2006 census. It is bounded by latitudes 9°25′N and 9°27′N and longitudes 6 ° 37′E and 6 ° 39′E.Generally, the area mapped forms part of the Minna - granitic formation that consists of Metasediment`and metavolcanics. The Metasediment include quartzites, gneisses and the metavolcanics are mainly granites. Among the main rock groups are granites which occur at the central and northern parts of the area, while on the south and east, cobbles of quartzite are found especially along the channels and valley. However, the other bodies like pegmatites and quartz veins also occur within the major rock types (Figure 1).The rocks are mainly biotite –granites with medium to coarse grained, light colored rocks with some variation in biotite content. The mineral constituents are leucocratic to mesocratic. However, the biotite minerals are thread like and are arranged rough parallel streak, although some are disoriented in the groundmass. The feldspar minerals occur as fine to medium grained, though grains are cloudy as a result of alteration mostly along the twin planes, while the quartz minerals are constituents of the granitic rocks which show strong fracturing in the granitic rocks of the area (Ajibade, 1980).

The raining period runs from April to October with the highest amount of rainfall recorded in August while the average annual rainfall is between 1200mm- 1300mm (Niger State Water and Sanitation Board, 2001). The mean annual temperature is between 22^{0}C to 25^{0}C. The period between November and February are marked with the NE trade wind called the harmattan, which often causes very poor visibility during this period.

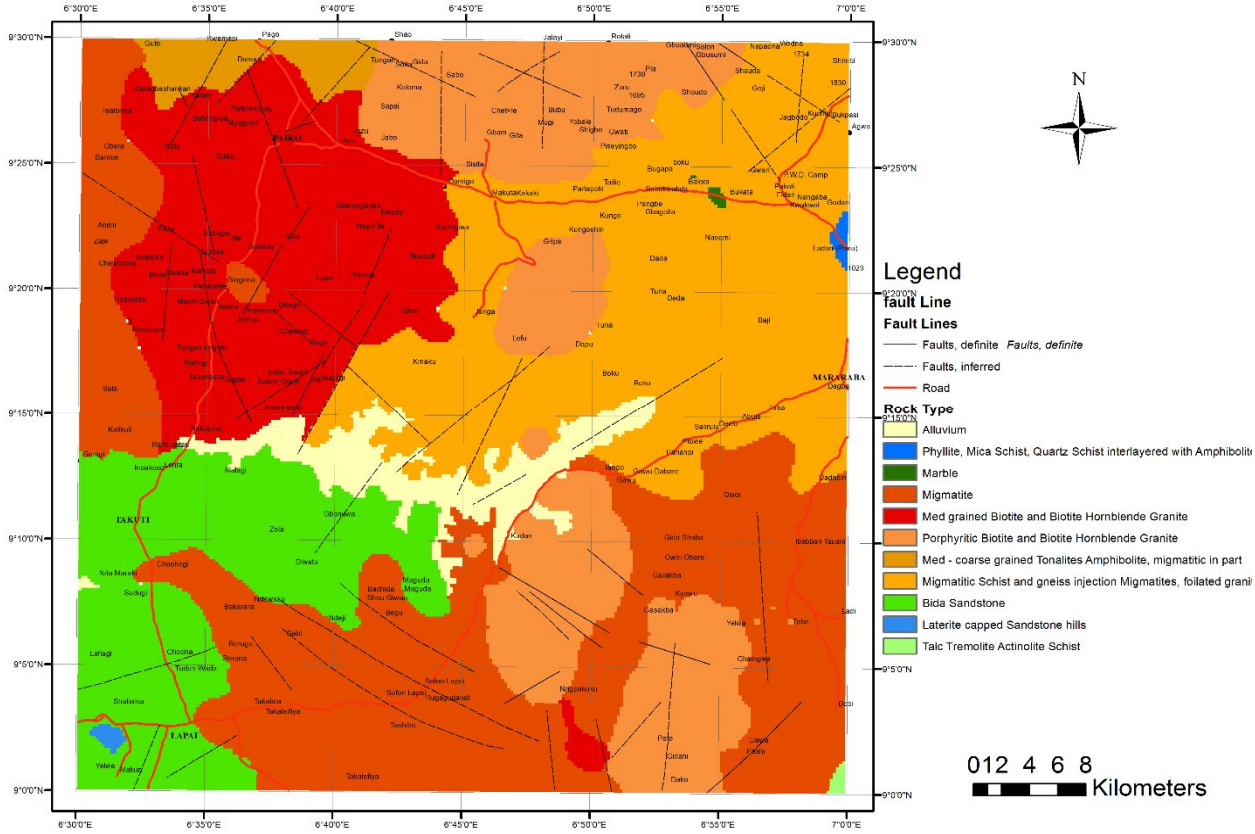


Figure 1: Geological Map of Paiko area (Modified after NGSA 2010)

Methodology

This research has utilized the electrical resistivity method in delineating the shallow consolidated basement of the study area. Sixty vertical electrical soundings were carried out using SAS 4000 model Terrameter and its accessories. The conventional Schlumberger array pattern with half electrode spacing (AB/2) varying from 1 m to a maximum of 100 m was adopted. The apparent resistivity was computed using equation 1

$$\rho_a = KR \quad (1)$$

Where

ρ_a is an apparent resistivity

$\mathbf{R} = \frac{\Delta V}{I}$, is the earth resistance (2)

$\mathbf{K} = \pi\left(\frac{\left(\frac{AB}{2}\right)^2 - \left(\frac{MN}{2}\right)^2}{MN}\right)$ is the geometric factor (3)

The apparent resistivity values obtained from equation (1) were plotted against the half current electrode separation spacing using IPI2WIN software. From these plots, vertical electrical sounding curves were obtained (Figure 2) and qualitative deductions such as resistivity of the layers, the depth of each layer, the thickness of each layer, number of layers and curve types were made.

Analysis, Results and Discussion

The summary of the interpreted electrical resistivity survey is presented in Tables 1, 2, 3 and 4. Table 1 consists of VES stations A_1toC_{10} while table 2 comprised of VES stations D_1 to F_{10}.Tables 3 and 4 show the depth to consolidated basement. The geoelectric section (Figure 3 a-f) reveals that the area is characterized by 3 to 4 geoelectric subsurface layers. Six profiles with sixty VES stations were covered and their subsurface geoelectric sections were presented in Figure 3. From the figure, 3- layer type occurring more and are characterized by H curve type. Some are characterized by A and K curve types. The 3- layer geoelectric sections are generally made up of topsoil, weathered/fractured layer and fresh basement rock from top to the bottom with variable depths, thicknesses and resistivities. The 4- layer geoelectric sections are characterized by HA; QA, KH and HK curve types. The observed frequencies in curve types include 21.6% of H, 0.6% of HA, 2.4% of K, 0.6% of A, 3.6% of KH, 6% of QA and 1.2% of HK. The 4- layer geoelectric section is made up of topsoil, weathered layer, fractured layer and fresh basement rock. Generally, the topsoil of the area is made up of loose sand, gravels, sandy clay, laterite and clay. In a basement complex terrain, areas with fresh basement layer depth of 4 m and below are good for building construction.

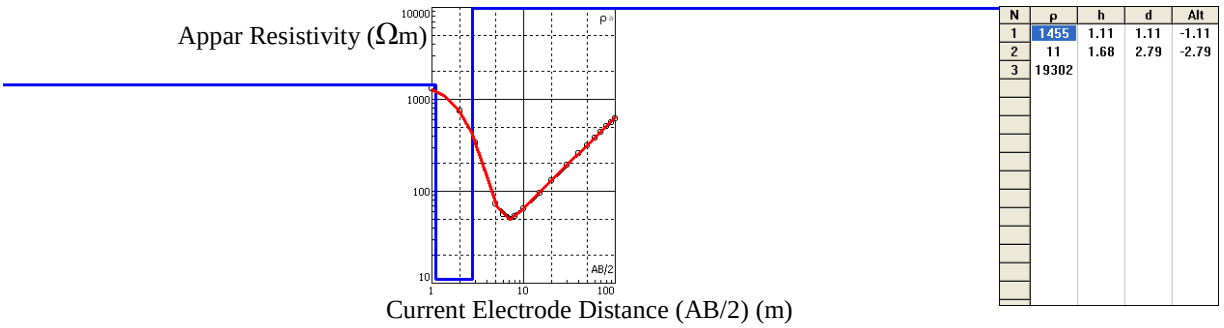
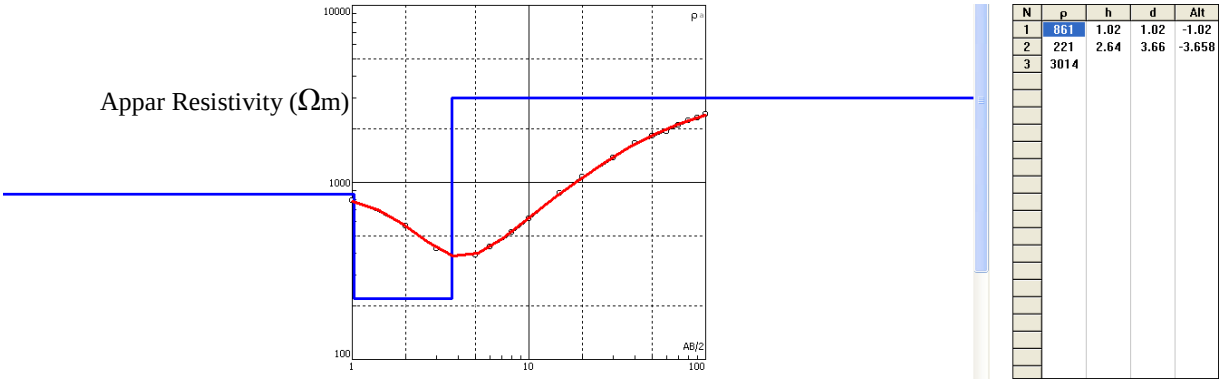


Figure 2a: VES Curve C_{10}



Current Electrode Distance (AB/2) (m)

Figure 2b: VES Curve D_1

Table 1: Layers resistivity, depth, thickness and curve types.

VES station	Latitud (degree)	Longitud (degree)	No of Layer	Layer resistivity (Ωm)				Layer depth (m)				Layer Thickness (m)				Curve type
				ρ_1	ρ_2	ρ_3	ρ_4	d_1	d_2	d_3	d_4	h_1	h_2	h_3	h_4	
A_1	09.41662	006.61831	3	836	59	3818		2.63	7.88	∞		2.62	5.63	∞		H
A_2	09.41675	006.61790	3	1164	203	3654		1.15	12.50	∞		1.15	11.40	∞		H
A_3	09.41687	006.61747	4	2387	801	81.30	2464	1.23	3.32	9.32	∞	1.23	2.09	6.01	∞	QA
A_4	09.41715	006.61671	4	1060	472	73.30	4277	1.23	3.66	9.40	∞	1.23	2.43	5.74	∞	QA
A_5	09.41725	006.61631	3	918	112	1443		1.97	8.85	∞		1.97	6.88	∞		H
A_6	09.41749	006.61580	4	1366	768	142	4620	1.22	3.57	9.54	∞	1.22	2.35	5.96	∞	QA
A_7	09.41767	006.61548	3	980	297	1998		2.35	12.60	∞		2.35	10.20	∞		H
A_8	09.41774	006.61507	4	459	1050	286	40444	0.50	3.31	26.70	∞	0.50	2.81	23.40	∞	KH
A_9	09.41783	006.61461	3	1346	237	124764		6.90	23.40	∞		6.90	16.50	∞		H
A_{10}	09.41804	006.61410	3	1621	546	43036		3.88	59.60	∞		3.68	55.70	∞		H
B_1	09.41619	006.61822	3	1457	174	97309		1.43	22.00	∞		1.43	20.60	∞		H
B_2	09.41629	006.61772	4	1371	126	309	113313	3.48	10.60	25.00	∞	3.48	7.12	14.40	∞	HA
B_3	09.41635	006.61732	4	1300	582	113	145699	0.50	4.77	16.00	∞	0.50	4.27	11.20	∞	QA
B_4	09.41646	006.61690	3	608	157	3101		2.50	14.50	∞		2.50	12.00	∞		H
B_5	09.41660	006.61646	3	781	236	95144		2.25	21.00	∞		2.25	18.80	∞		H
B_6	09.41639	006.61587	4	290	1132	217	179122	0.97	1.58	24.80	∞	0.97	0.60	23.30	∞	QA
B_7	09.41653	006.61548	3	799	225	142855		2.79	23.90	∞		2.79	21.10	∞		H
B_8	09.41700	006.61519	4	592	2238	54.90	111801	1.10	2.5	7.16	∞	1.10	1.41	4.55	∞	KH
B_9	09.41700	006.61474	4	968	391	42	91457	1.25	6.72	13.20	∞	1.25	5.47	6.51	∞	QA
B_{10}	09.41688	006.61424	4	729	1317	143	54961	2.50	7.13	20.40	∞	2.50	4.63	13.20	∞	KH
C_1	09.41498	006.61760	2	387	32711			47.90	∞			47.90	∞			A
C_2	09.41505	006.61715	3	22130	84752	305		0.50	1.33	∞		0.50	0.83	∞		K
C_3	09.41500	006.61663	4	1648	512	48.80	45332	1.06	4.75	15.50	∞	1.06	3.69	10.80	∞	QA
C_4	09.41502	006.61623	3	2175	40.20	19998		3.52	12.50	∞		3.52	9.00	∞		H
C_5	09.41535	006.61672	3	215	51.80	96394		1.02	3.64	∞		1.02	2.62	∞		H
C_6	09.41510	006.61634	3	1487	165.0	1850		1.00	4.67	∞		0.99	2.61	∞		H
C_7	09.41483	006.61597	3	194	50.30	78052		1.01	3.62	∞		1.01	2.61	∞		H
C_8	09.41458	006.61562	3	2954	144.0	64875		1.17	9.18	∞		1.17	8.01	∞		H
C_9	09.41424	006.61528	3	468	27.20	38527		1.61	3.99	∞		1.61	2.38	∞		H
C_{10}	09.41383	006.61491	3	1455	11.00	19302		1.11	2.79	∞		1.11	1.68	∞		H

VES-vertical electrical sounding; ρ-layer resistivity; d- layer depth; h – layer thickness; m-met

Table 2: Layers resistivity, depth, thickness and curve types

VES station	Latitud (degree)	Longitud (degree)	No of Layer	Layer resistivity (Ωm)				Layer depth (m)				Layer Thickness (m)				Curve type
				ρ_1	ρ_2	ρ_3	ρ_4	d_1	d_2	d_3	d_4	h_1	h_2	h_3	h_4	
D_1	09.41425	006.61774	3	861	221	3014		1.02	3.66	∞		1.02	2.64	∞		H
D_2	09.41437	006.61752	3	3620	51	78106		5.41	12.70	∞		5.41	7.31	∞		H
D_3	09.41456	006.61714	3	1724	12.70	20794		0.99	3.07	∞		0.99	2.08	∞		H
D_4	09.41469	006.61676	3	1288	84.20	1377		3.58	11.70	∞		3.58	8.15	∞		H
D_5	09.41483	006.61633	3	1070	88.90	42100		3.10	21.00	∞		3.10	17.90	∞		H
D_6	09.41504	006.61570	3	547	145	104870		3.56	23.4	∞		3.56	19.80	∞		H
D_7	09.41515	006.61550	4	823	917	193	70063	1.66	3.12	27.10	∞	1.66	1.46	24.00	∞	KH
D_8	09.41552	006.61475	3	852	154	1203		5.83	18.00	∞		5.83	12.20	∞		H
D_9	09.41575	006.61440	3	4582	74814	442		1.23	4.51	∞		1.23	3.28	∞		K
D_{10}	09.41588	006.61396	3	1356	140	939		4.46	7.91	∞		4.46	3.45	∞		H
E_1	09.41379	006.61769	3	1788	106	336		1.38	14.6	∞		1.38	13.30	∞		H
E_2	09.41402	006.61705	3	1592	76.5	45894		2.76	17.70	∞		2.76	14.90	∞		H
E_3	09.41420	006.61666	3	1199	53.3	2261		4.79	12.40	∞		4.79	7.64	∞		H
E_4	09.41440	006.61623	4	580	1015	38	86514	1.33	3.62	9.67	∞	1.33	2.28	6.06	∞	QA
E_5	09.41452	006.61581	3	855	49.5	88577		2.09	8.79	∞		2.09	6.70	∞		H
E_6	09.41475	006.61539	4	315	608	107	899	2.24	5.05	10.40	∞	2.24	2.80	5.36	∞	QA
E_7	09.41489	006.61500	3	26068	58093	259		1.94	10.00	∞		1.94	8.06	∞		K
E_8	09.41994	006.61456	4	1062	130	3686	50.20	3.90	14.20	32.10	∞	3.90	10.30	17.90	∞	HK
E_9	09.41511	006.61409	3	4262	575	65539		1.08	20.20	∞		1.09	19.10	∞		H
E_{10}	09.41528	006.61363	3	2073	49	77337		4.81	11.00	∞		4.81	6.24	∞		H
F_1	09.41335	006.61747	3	1320	40.40	1394		1.60	4.26	∞		1.60	2.67	∞		H
F_2	09.41362	006.61750	3	839	33	17193		4.72	11.00	∞		4.72	6.31	∞		H
F_3	09.41386	006.61090	3	2052	44.80	46860		3.74	10.20	∞		3.74	6.45	∞		H
F_4	09.41402	006.61565	3	1005	140	1039		3.52	18.70	∞		3.52	15.20	∞		H
F_5	09.41423	006.61529	3	38093	12628	380		0.50	0.63	∞		0.50	0.13	∞		K
F_6	09.41454	006.61494	4	489	1139	95	1470	1.40	3.52	10.00	∞	1.40	2.11	6.49	∞	KH
F_7	09.41467	006.61450	3	963	198	82835		7.28	25.70	∞		7.28	18.40	∞		H
F_8	09.41468	006.61401	4	1494	536	98	2093	1.13	5.76	12.70	∞	1.13	4.63	6.94	∞	QA
F_9	09.41490	006.61370	4	762	3772	151	118102	1.11	3.55	9.62	∞	1.11	2.44	6.07	∞	KH
F_{10}	09.41498	006.61315	4	1910	280	4126	316	8.41	18.70	32.60	∞	8.41	10.30	14.00	∞	HK

VES-vertical electrical sounding; ρ-layer resistivity; d- layer depth; h – layer thickness; m-meter.

Table 3: Depths to Fresh Basement of the Area

VES STATION	Latitude (degrees)	Longitude (degrees)	Elevation (m)	Depth to Bedrock (m)
A_1	09.41662	006.61831	296	7.88
A_2	09.41675	006.61790	300	12.50
A_3	09.41687	006.61747	297	9.32
A_4	09.41715	006.61671	294	9.40
A_5	09.41725	006.61631	294	8.85
A_6	09.41749	006.61580	297	9.54
A_7	09.41767	006.61548	295	12.60
A_8	09.41774	006.61507	296	26.70
A_9	09.41783	006.61461	297	23.40
A_{10}	09.41804	006.61410	296	59.60
B_1	09.41619	006.61822	299	22.00
B_2	09.41629	006.61772	301	25.00
B_3	09.41635	006.61732	303	16.00
B_4	09.41646	006.61690	294	14.50
B_5	09.41660	006.61646	296	21.00
B_6	09.41639	006.61587	297	24.80
B_7	09.41653	006.61548	295	23.90
B_8	09.41700	006.61519	299	7.16
B_9	09.41700	006.61474	299	13.20
B_{10}	09.41688	006.61424	301	20.40
C_1	09.41498	006.61760	296	47.90
C_2	09.41505	006.61715	284	1.33
C_3	09.41500	006.61663	287	15.50
C_4	09.41502	006.61623	246	12.50
C_5	09.41535	006.61672	301	3.64
C_6	09.41510	006.61634	302	4.67
C_7	09.41483	006.61597	302	3.62
C_8	09.41458	006.61562	301	9.18
C_9	09.41424	006.61528	298	3.99
C_{10}	09.41383	006.61491	296	2.79

Table 4: Depths to Fresh Basement of the Area

VES STATION	Latitude (degrees)	Longitude (degrees)	Elevation (m)	Depth to Bedrock (m)
D_1	09.41425	006.61774	290	3.66
D_2	09.41437	006.61752	292	12.70
D_3	09.41456	006.61714	289	3.07
D_4	09.41469	006.61676	291	11.70
D_5	09.41483	006.61633	293	21.00
D_6	09.41504	006.61570	288	23.4
D_7	09.41515	006.61550	292	27.10
D_8	09.41552	006.61475	301	18.00
D_9	09.41575	006.61440	286	4.51
D_{10}	09.41588	006.61396	296	7.91
E_1	09.41379	006.61769	289	14.6
E_2	09.41402	006.61705	289	17.70
E_3	09.41420	006.61666	287	12.40
E_4	09.41440	006.61623	291	9.67
E_5	09.41452	006.61581	287	8.79
E_6	09.41475	006.61539	280	10.40
E_7	09.41489	006.61500	254	10.00
E_8	09.41994	006.61456	298	32.10
E_9	09.41511	006.61409	293	20.20
E_{10}	09.41528	006.61363	302	11.00
F_1	09.41335	006.61747	285	4.26
F_2	09.41362	006.61750	275	11.00
F_3	09.41386	006.61090	282	10.20
F_4	09.41402	006.61565	292	18.70
F_5	09.41423	006.61529	294	0.63
F_6	09.41454	006.61494	294	10.00
F_7	09.41467	006.61450	304	25.70
F_8	09.41468	006.61401	313	12.70
F_9	09.41490	006.61370	236	9.62
F_{10}	09.41498	006.61315	284	32.60

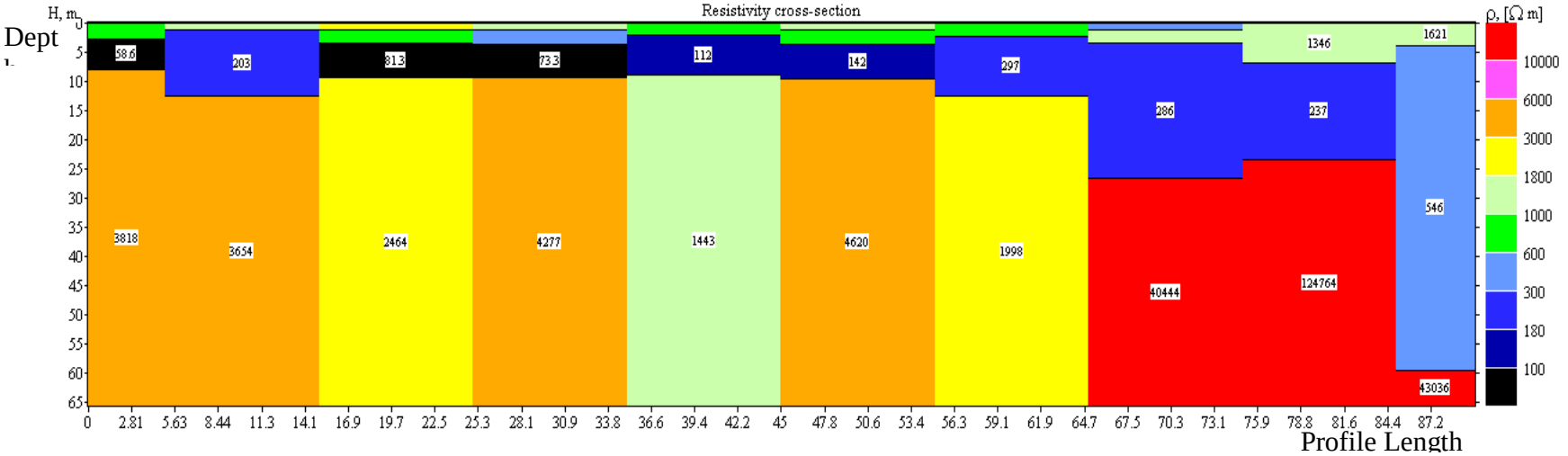


Figure 3a: Geoelectric Section for Tranverse A

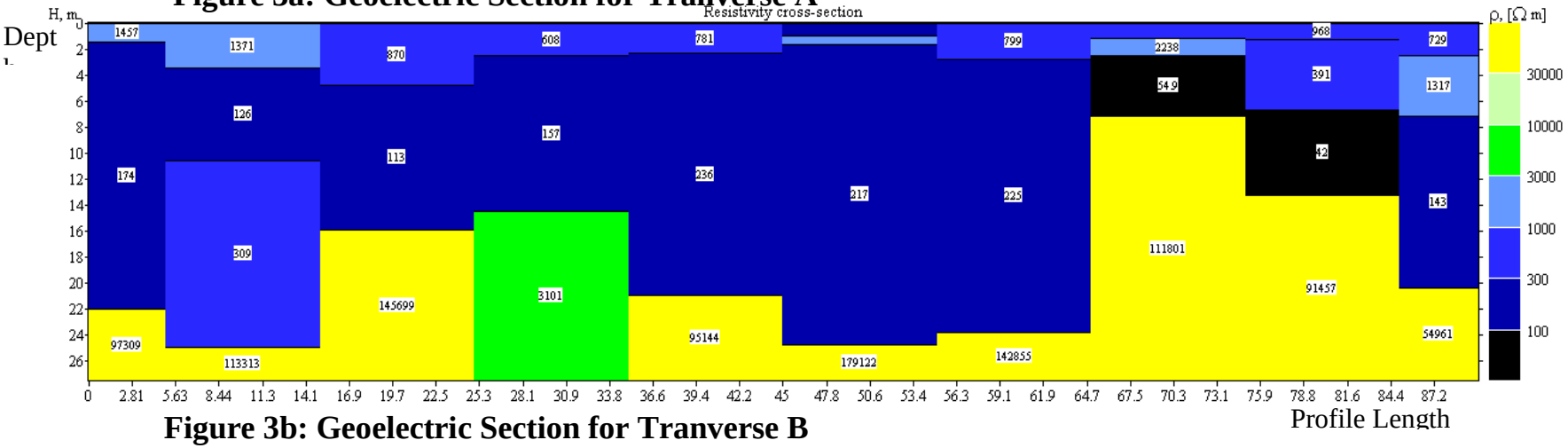


Figure 3b: Geoelectric Section for Tranverse B

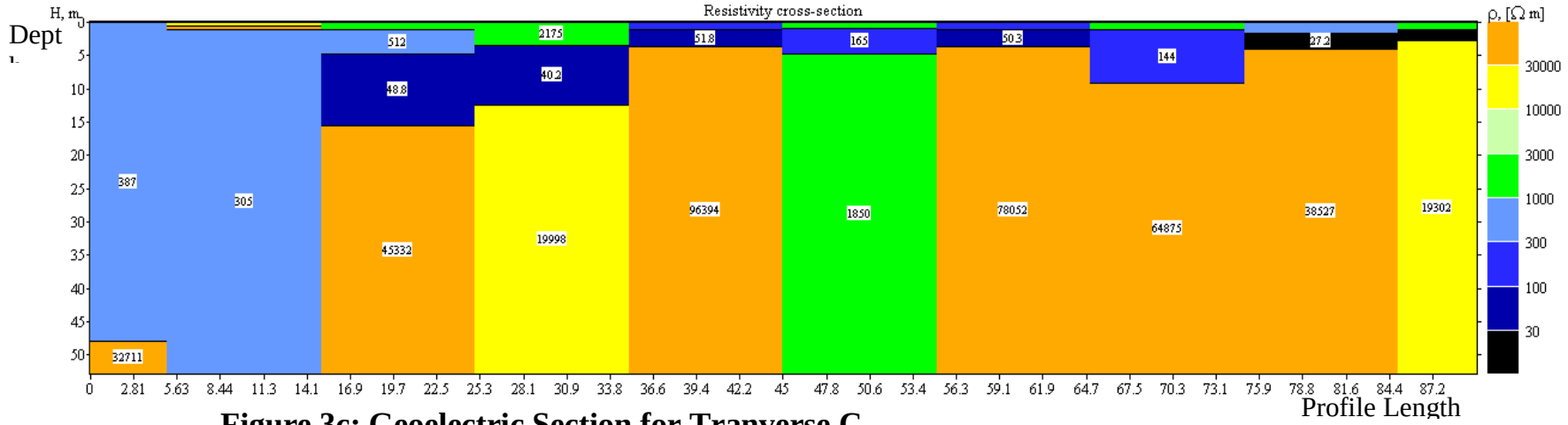


Figure 3c: Geoelectric Section for Tranverse C

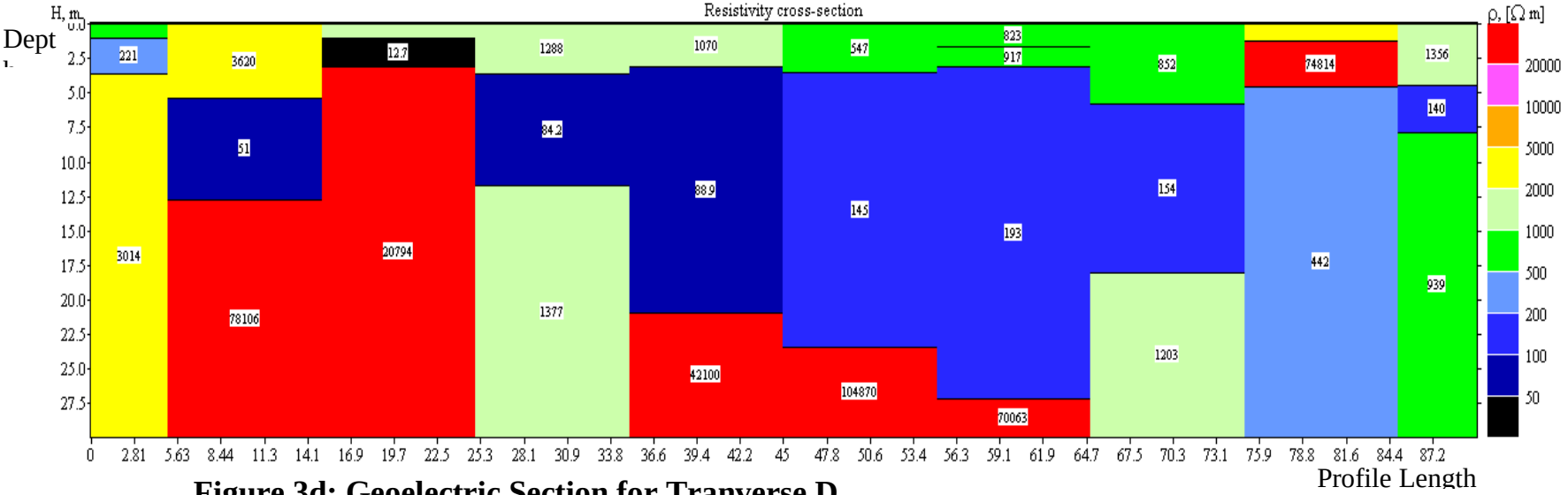


Figure 3d: Geoelectric Section for Tranverse D

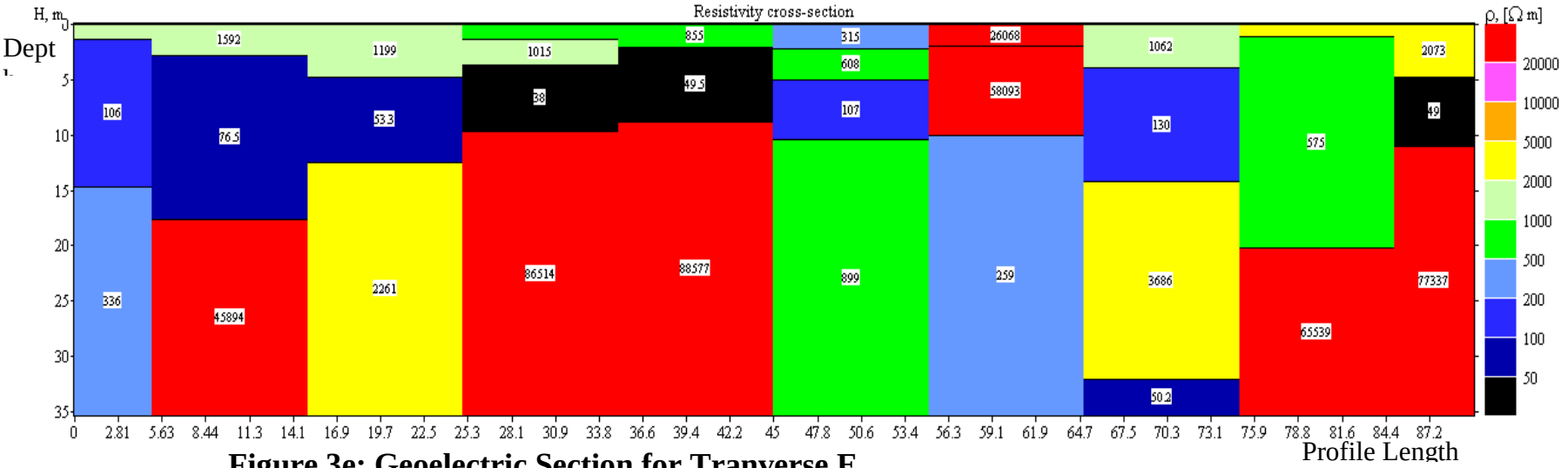


Figure 3e: Geoelectric Section for Tranverse E

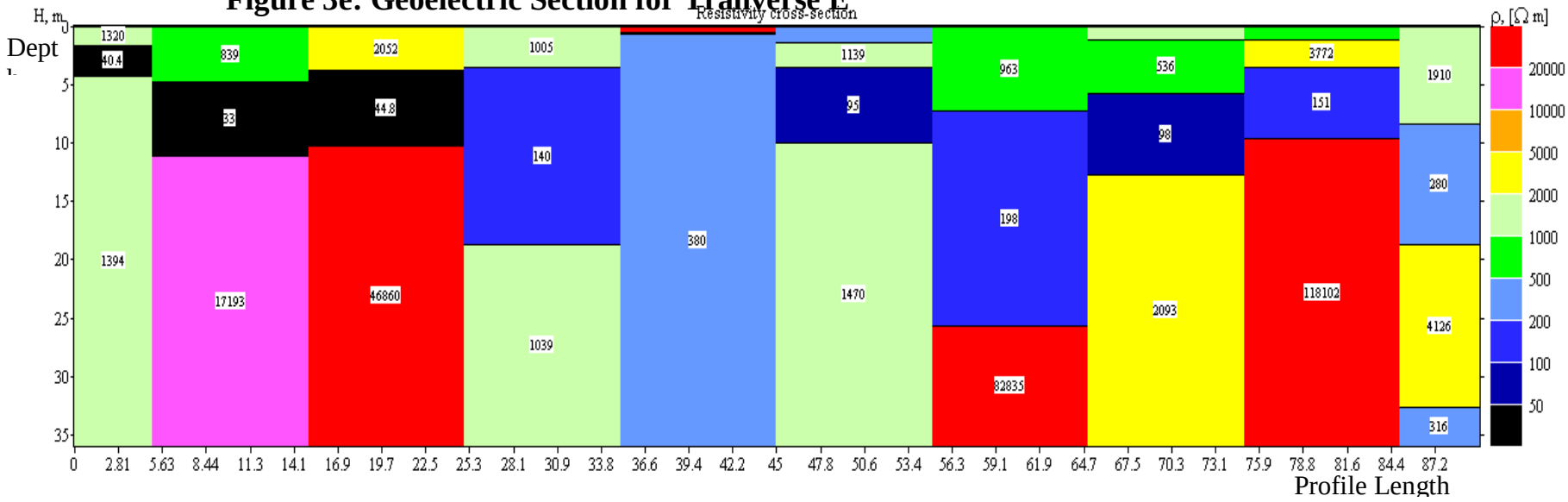


Figure 3f: Geoelectric Section for Tranverse F

Table 5: Areas Delineated for Building Construction

VES STATION	Latitude (degrees)	Longitude (degrees)	Elevation (m)	Depth to Bedrock (m)
C_2	09.41505	006.61715	284	1.33
C_5	09.46535	006.63672	305	3.64
C_7	09.46483	006.63597	306	3.62
C_9	09.46424	006.63528	308	3.99
C_{10}	09.46383	006.63491	296	2.79
D_1	09.41425	006.61774	290	3.66
D_3	09.41456	006.61714	289	3.07
F_5	09.41423	006.61529	294	0.63

Eight VES stations were delineated for building construction having depths to fresh basement varying between 0.63 m and 3.99 m, where consolidated basement is shallow (Table 5).In investigating the continuous variation of resistivity with depth, iso-resistivity map using Golden software (Surfer 11.0) version were obtained for the layers (Figure 4). It shows the color range corresponding to resistivity range of the earth materials. The iso-resistivity map of the first layer reveal that blue represent gravels, sky blue represent sand, green correspond to laterite and yellow represent alluvial deposits (Figure 4a).

The iso-resistivity map of the second layer shows that blue color corresponds to clay and sky blue represent laterite (Figure 4b). Third layer iso-resistivity maps reveal that blue represent granite, sky blue represent gneiss, green correspond to igneous rock, yellow represent gabbros rock and red correspond to ultramafic rock (Figure 4c).

The depth to consolidated basement map shows the depth distribution within the area (figure 5). From the map, the area with black and blue coloration corresponds to depth range of 0 m to 8 m and therefore be the suitable areas suggested for building construction.

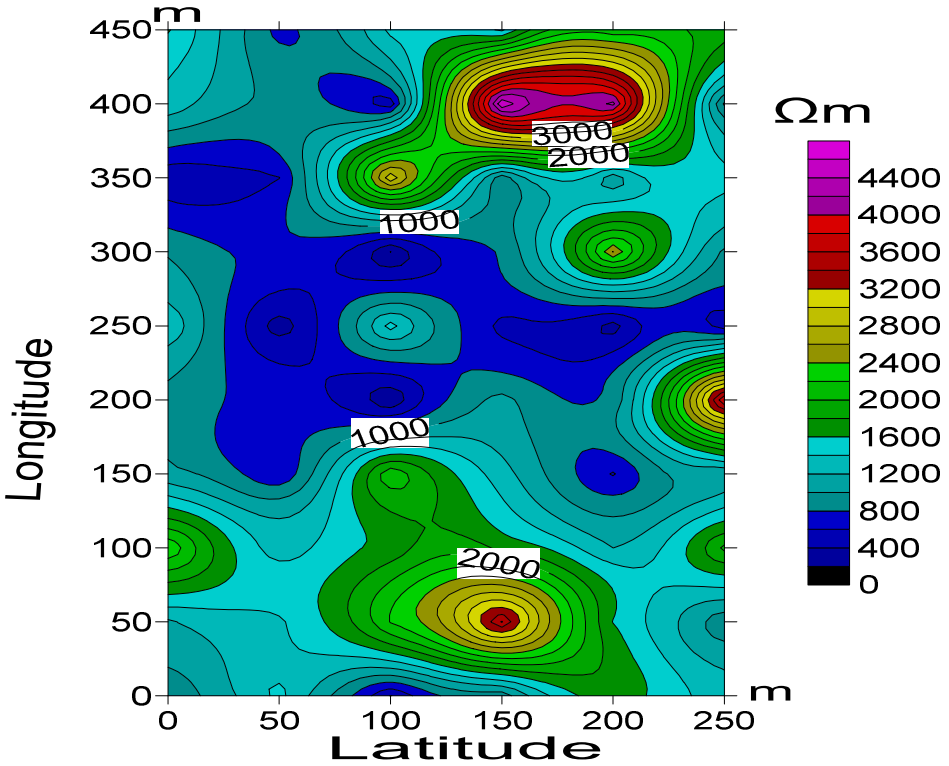


Figure 4 a: Iso-resistivity Map at First Layer

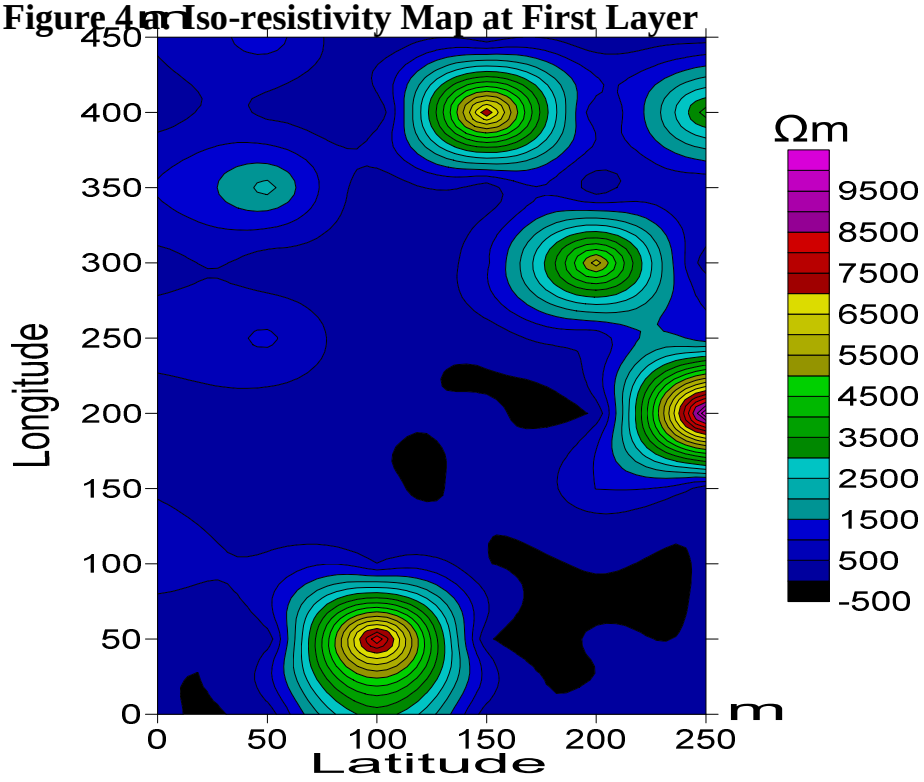


Figure 4 b: Iso-resistivity Map at Second Layer

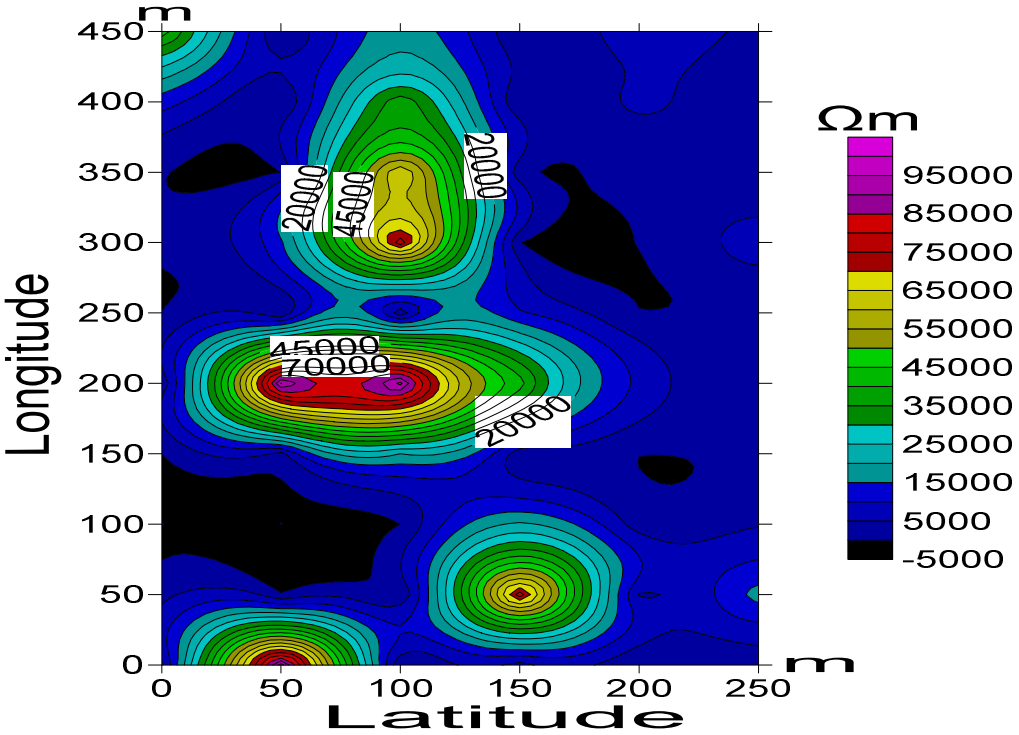


Figure 4 c: Isoresistivity Map at Third Layer

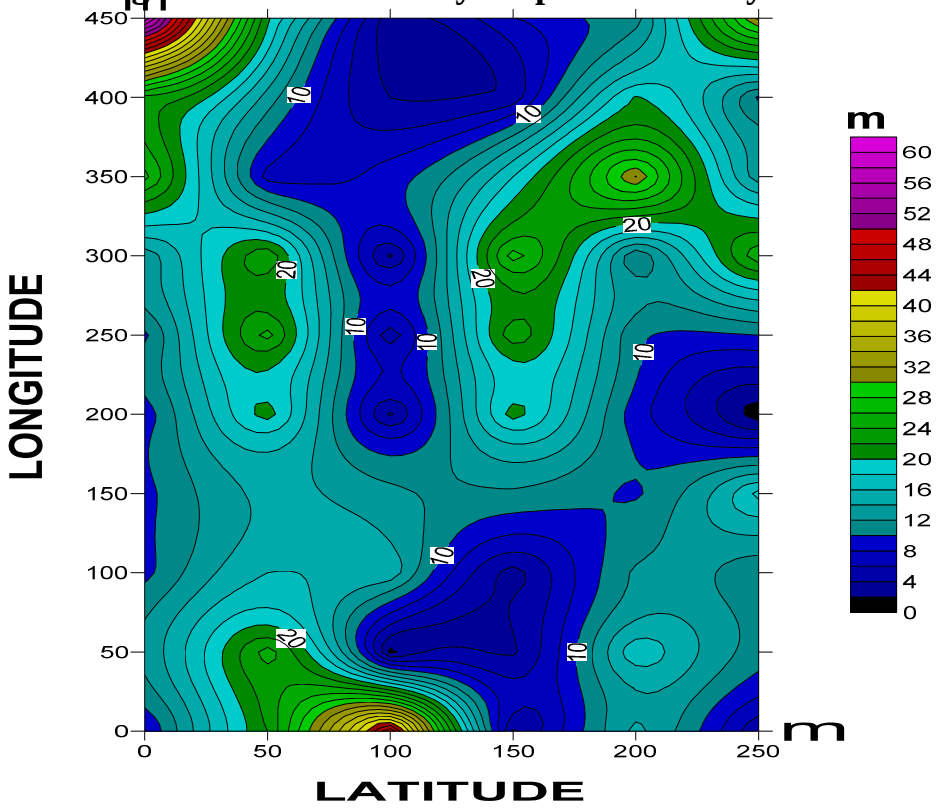


Figure 5: Depth to Basement Map of the Area

Conclusion

The use of various electrical resistivity parameters (resistivity of the layer, depth of the layer and thickness of the layer) were employed to determine the suitable site for building construction. Three to four distinct geoelectric layers were observed namely; Top layer, weathered layer, fractured layer, and fresh basement layer. The observed frequencies in curve types include 21.6% of H, 0.6% of HA, 2.4% of K, 0.6% of A, 3.6% of KH, 6% of QA and 1.2% of HK. Eight VES stations were delineated for building construction, having depths to fresh basement varying between 0.63 m and 3.99 m.Government and estate developers inPaiko are encouraged to make use of the results of this study for building construction site selection to reduce the problem of building collapse and cracking of walls. More research work in this area would contribute to solving the problemof collapse of building completely.

References

Ajibade, A. C. (1980). *The geology of the country around Zungeru, Northwestern state of Nigeria.* Unpublished M.Sc. thesis, University of Ibadan, Ibadan, Nigeria.

Ariyo, S. O. (2005). *Geoelectrical characterization of aquifers and geochemical study of groundwater in the basement complex/sedimentary transition Zone around Isharsa, Southwest Nigeria.* Unpublished M.Sc. thesis, University of Ibadan, Ibadan, Nigeria

Asfahani, J., (2006). Geoelectrical investigation for characterizing the hydrogeological conditions in semi-arid region in Khanasser valley, Syria. *J. Arid Environ.* 68, 31 – 52.

Bello, A. A. & Makinde, V. (2007). Delineation of the aquifer in the Sout-Western part of the Nupe Basin, Kwara State, Nigeria. *J. Am. Sci.*, 3, 36 – 44.

Dangana, L. M. (2007). *Geoelectric survey for subsurface water in Paiko town, Niger State, Nigeria.* Unpublished Ph.D thesis, University of Abuja, Nigeria.

Todd, K. D. (1980). *Groundwater hydrology, 2nd edition.* John Wiley and Sons, New York.

LONGITUDINAL VARIATION OF GEOMAGNETIC H- FIELD ALONG THE MAGNETIC EQUATOR DURING QUIET DAY

AKPANENO, A. F.[1] & ADIMULA, I. A.[2]
[1]Department of Physics, Federal University, Dutsin-ma, Katsina State, Nigeria
[2] Department of Physics, University of Ilorin, Ilorin, Nigeria
E-mail: aakpaneno@fudutsinma.edu.ng Phone No: +234-803-503-7159

Abstract
One year data of hourly values of H-component of the earth magnetic field were used to study the longitudinal variation along the magnetic equator. The results showed that the magnitude of dH has diurnal variation with the value between 25 to 110nT and the time of occurrences of noontime peaks of EEJ is around 1200-1300LT. The variation in tidal strength and the sudden longitudinal gradient in the diurnal non-migrating tides between the longitudes could be one of the factors responsible for variations. Enhanced EEJ amplitudes was recorded at the Asian sector during equinox and solstice than their corresponding values at the African sector. Series of CEJs were recorded during this period which could be as a result of night reversal of electric field. The variability in occurrence of CEJs could be as a result of the differences in local wind shears that modify jet fields.

Keywords: Counter electrojet, Electrojet, Geomagnetic field, Magnetic equator

Introduction
The first regular geomagnetic observation close to the magnetic equator was established at Trivandrum in India in 1841. However, one of the early observations made at Huancayo (Peru) in 1922 of the abnormal large solar daily variations of the horizontal component H near geomagnetic equator was attributed to a narrow current of about 300km in width flowing over the dip equator, which was later in 1951 named by Chapman, the equatorial electrojet (EEJ) (Doumouya et al., 1998, Chandra et al., 2000). The characteristics of the Equatorial Electrojet (EEJ) includes, the configurations and regular temporal variations of the EEJ current system, the spatial structures of its very high current density, the magnetic fields of the EEJ current system, the ionospheric plasma density irregularities generated by the turbulent flow of the EEJ, the electric fields and ionospheric plasma drift in the dip equatorial zone, the quiet time counter equatorial electrojet (CEJ), and the temporal variabilities of the phenomena (Onwumechili, 1997).

In the dayside ionosphere, the neutral winds set up a polarization electric field which normally points into the eastward direction. At the magnetic dip equator, where the magnetic field is nearly horizontal, the resulting upward $\boldsymbol{E} \times \boldsymbol{B}$ drift of the electrons generated a negative charge at the top and positive charge at the bottom of the ionospheric E-region (about 90 to 130km). The resulting electric field prevents the further upward drift of electrons. Instead, the electrons are now propelled westward by the eastward electric field. This westward movement of the electrons constitutes an eastward electric current which is called the Equatorial Electrojet (Stefan & Patrick, 2010). Luhr et al. (2004) explained that the main reason for the high current density is the geomagnetic field geometry exhibiting horizontal lines of force at these latitudes. Chandra et al. (1971) explained that the current intensity in the ionosphere depends on the ionization density as well as on the electric field. They concluded that the daily, seasonal or solar cycle variation of the solar quiet variability of the magnetic field horizontal component

(S_qH) could be primarily due to one of these parameters or due to the simultaneous impacts of both. Cowling (1933) was the first to recognize that in such a field configuration, the hall current, flowing normal to the boundaries (non-conducting atmosphere at the bottom and effectively collision less plasma at the top) is restricted, setting up a vertical field which in turn causes a pronounced enhancement of the conductivity (cowling conductivity) parallel to the boundaries (Luhr et al., 2004). Radar, rockets, satellites and ground geomagnetic observatories are employed to study EEJ. There have been many studies investigating EEJ and all these types of measurements are complimentary but it should be noted that the geomagnetic observatory at Huancayo facilitated the discovery of EEJ and provided data for many early studies. Chandra et al. (2000), Doumouya et al. (2003), Rastogi et al. (2007) and Rastogi, (2007) focused on explaining the mechanism responsible for the current flow. It was discovered that the current sometimes reversed directions and thus have a westward movement during certain morning and evening hours, which was known as the 'counter- electrojet' (Rabiu et al., 2007). Physical models and theories were developed in the 1970s which studied the vertical (Hall) current flow, longitudinal and local time structure of the EEJ and the impacts of local winds on EEJ (Stefan & Patrick, 2010). Doumouya et al., (2003) studied that the longitudinal variation of geomagnetic field intensities at equatorial zone using surface magnetic data recorded at 26 observatories in six different longitude sectors that were set up during the International Equatorial Electrojet year (IEEY). Results show that there are longitudinal inequalities in the EEJ strength which indicates that the equatorial electrojet is strongest in South America ($80^\circ - 10^\prime$) and weakest in the Indian sector ($75^\circ E$) with a secondary minimum and a maximum centered respectively in the Atlantic Ocean (30°W) and in West Africa ($10^\circ E$). Yacob (1977) conducted a study on the seasonal width and peak current intensity of the equatorial electrojet at different longitudinal zones by considering mean seasonal diurnal ranges in H on quiet days at 20 low latitude stations for the year 1958. His result showed that the half width of the electrojet at all longitudinal zones is about 280-300km with no significant change with the seasons. He also found that the current density of the electrojet in any season varies considerably from one zone to another with average current intensity for the global electrojet current of 221 ± 12A/Km during the equinoxes, 169 ± 10A/Km during the northern summer and 179 ± 19A/Km during the northern winter. Luhr et al. (2004) in their study of the spatial characteristics of noon-time EEJ established that; the intensity of the EEJ varies strongly from day to day, the average peak current density exhibits clear dependence on the longitude, the longitude dependence of the EEJ intensity can be explained by varying cross-sectional area of the cowling channel and there is no deviation from it either on a seasonal basis or with longitude. Alex *et al.* (1992) examined the abnormalities associated with certain characteristics of westward counter electrojet (CEJ) current which completely inhibits the equatorial enhancement of dH over the dip equator. CEJ occurrence at different observatories have been reported by various researchers like Kane and Trivedi (1981), Rastogi (1974), Rangarajan and Rastogi (1993). They attributed this phenomenon to the stronger westward current that exceeds the global eastward S_q current. The main objective of this paper is to investigate the longitudinal variation of the geomagnetic H-field along the magnetic equator during quiet conditions.

Data Analysis

Data from Magnetic Data Acquisition System (MAGDAS) at the University of Ilorin, Ilorin (geographic latitude: $8.50^\circ N$, geographic longitude: $4.68^\circ E$, geomagnetic latitude: $-1.82^\circ S$, geomagnetic longitude: $76.8^\circ S$), Nigeria were used for the study. The year 2009 (a year of low solar activity) was considered. Hourly averages of horizontal component at ten (10) MAGDAS stations along the magnetic equator were analyzed for regular solar quiet variation. However, in

some stations like ANCON, EUSEBIO and CEBU, data were not available. Table 1 depicts the basic parameters of the stations employed in the study while figure 1 depicts the locations of the observatories.

Five international quiet days (IQDs) were chosen for the analysis. These days are based on magnetic activity index K_p (Geoscience Australia, 2013). The concept of local time (LT) was used in the analysis. The daily baseline value of the geomagnetic element is the mean hourly value of the hour before (24 hr LT) and the hour after (1hr LT) local midnight on each IQDs, represented by:

$$H_o = {}^1/_2 (H_{24} + H_1) \quad (1)$$

H_1 and H_{24} represent the values of the geomagnetic element H, at 24 hr LT and 1hr LT respectively. The midnight baseline values were subtracted from the hourly values to get the hourly departure of the midnight for a particular day. That is:

$$dH = H_t - H_0 \quad (2)$$

Where t = 1 to 24 gives the measure of the hourly amplitude of variation of H.

Table 1: Parameters of the station used in the study

S/N	STATIONS	Code	Geographic latitude(^{o})	Geographic longitude(^{o})	Geomagnetic Latitude(^{o})	Geomagnetic Longitude(^{o})	Dip latitude(^{o})
1	Ilorin	ILR	8.50	4.68	-1.82	76.8	-2.96
2	Lagos	LAG	-6.48	3.27	-3.04	75.33	-4.95
3	Ancon	ANC	-11.77	-77.15	0.77	354.53	0.74
4	Davao	DAV	7.00	125.40	-1.02	195.54	-0.65
5	Eusebio	EUS	-3.88	-38.43	-3.64	34.21	-7.03
6	Yap Island	YAP	9.50	138	1.49	209.06	1.70
7	Addis Ababa	AAB	9.04	38.77	0.18	110.23	0.57
8	Lang kawi	LKW	6.30	99.77	-1.23	170.06	-0.47
9	Cebu	CEB	10.36	123.91	2.53	195.06	2.74
10	Triunelvelli	TIR	8.50	77.0	-1.2	146.4	-0.2

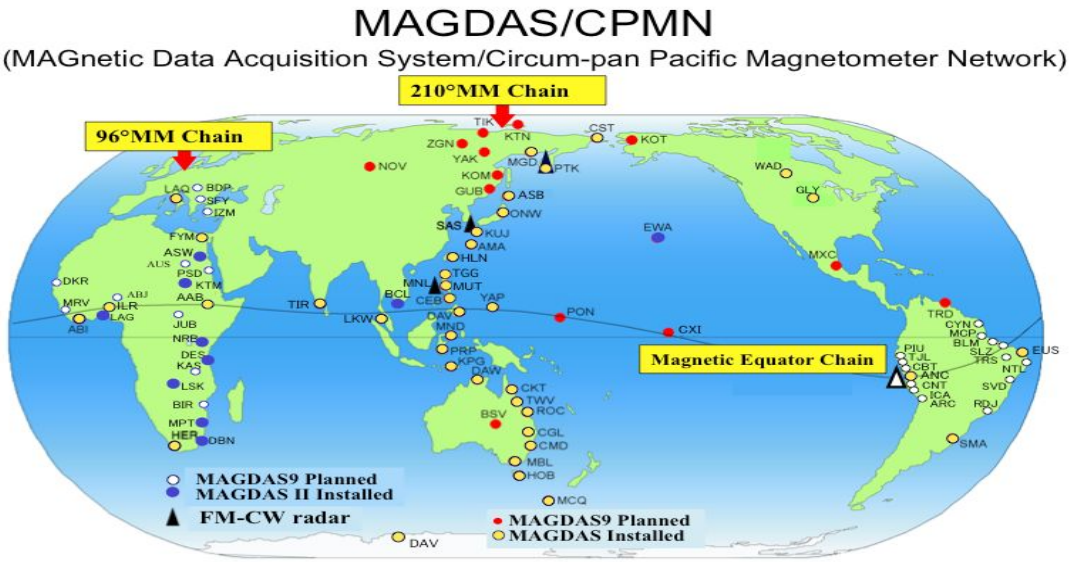


Figure 1: Showing the locations of the observatories

Results and Discussion

The daily variation of the H component of the geomagnetic field under quiet condition was examined. The year 2009 (year of low solar activity) was highlighted in figure 2. Ten stations along the magnetic equator were considered for the analysis. The hourly values of ΔH signifies the strength or intensity of EEJ over any magnetic equatorial observatory, and the time variations of ΔH during daytime is the proxy parameter for showing the variations in the east-west electric field in EEJ. The results of the plots below show that the electrojet strength in all the stations varied between 25 to 110nT and the time of occurrence of noontime peaks of EEJ are not the same.

Highlighted in figure 2a, b, c and d are daily variations in H component of geomagnetic field at various equatorial stations considered. The buildup flanks to their declines vary from day to day throughout the months. It is steeper in the morning hours than that of the decay phase in the night hours. On the month of January (fig. 2a) the electrojet strength is in the range of 25 to 110nT; peaks around 1100 and 1300 LT, for February (fig.2b), the range is between 25 to 100nT; peaks at 1200LT , for June solstice (fig.2c), the range is 25 to 70nT; peaks at 1200LT and for the month of September(fig. 2d), the range is between 35 to 90nT; peaks around 1200LT. Averagely the peak values vary between 25 to 110nT for all the months (i.e a range of about 85nT), but the time and amplitudes of occurrence of noontime peaks of EEJ are not the same. Evidence of the spectrum of counter electrojet (CEJs) were chronicled in this period of study. CEJ is known to take place during magnetically quiet and disturbed conditions (Akpaneno & Adimula, 2015). The occurrence of CEJs were observed during few hours in the morning and before evening. On January 23 CEJs were recorded at 1600LT at YAP and TIR with the amplitude of -49nT and -50nT respectively. In figure 2,. CEJs were recorded on February 2 in the morning with an amplitude of -30nT at 0800LT, while on February 10 and 19, CEJs were recorded at 1600LT with the amplitudes of -48nT and -18nT respectively at TIR. CEJs were also

recorded on September 19 at AAB with the amplitudes of -25nT and -30nT at 0800LT and 1600LT. It should be noted that the EEJ events in these stations are reduced to 45nT.

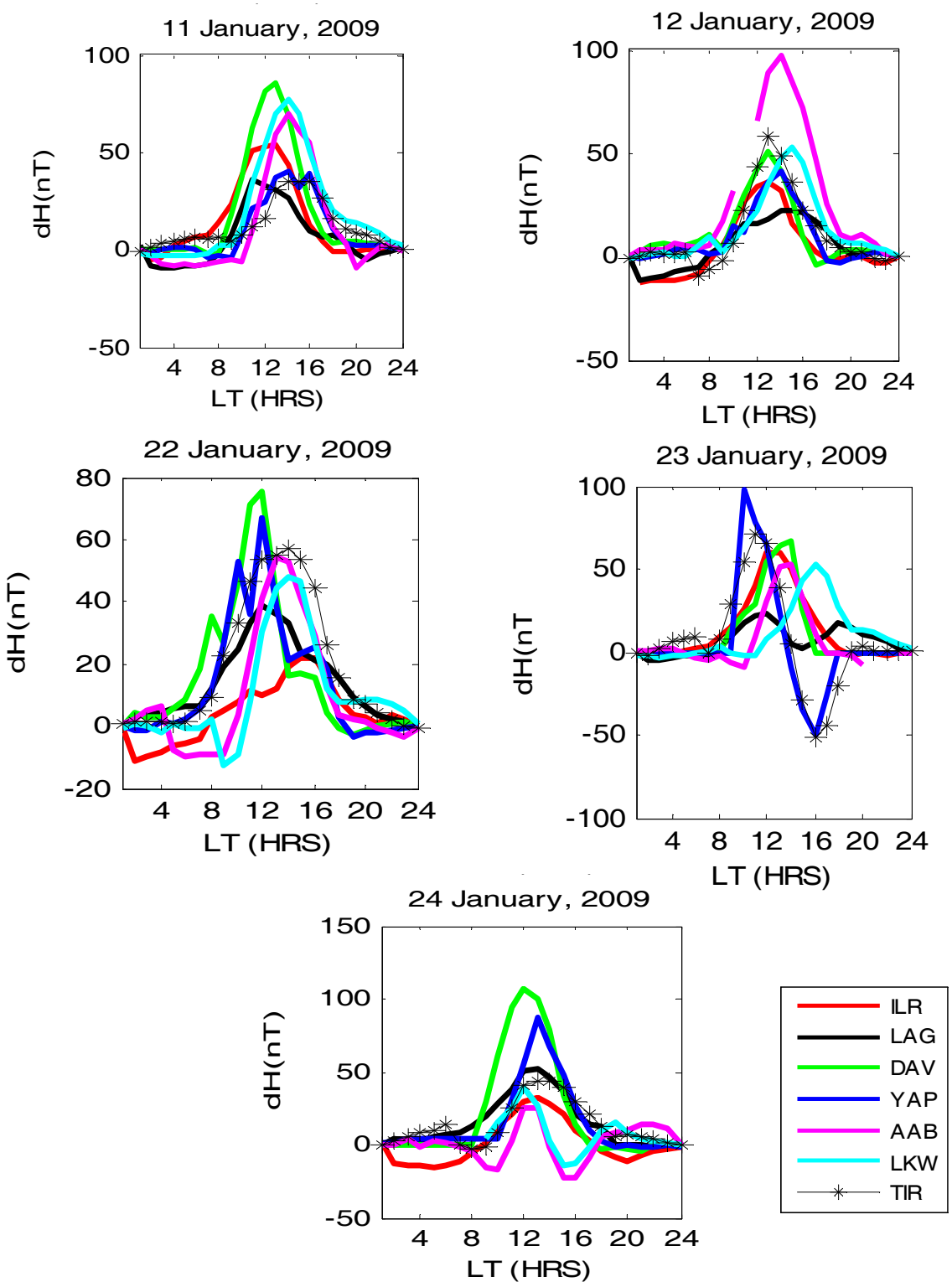


Fig. 2a: Quiet day variation of the horizontal component of the magnetic field dH for January 11, 12, 22, 23 and 24, 2009.

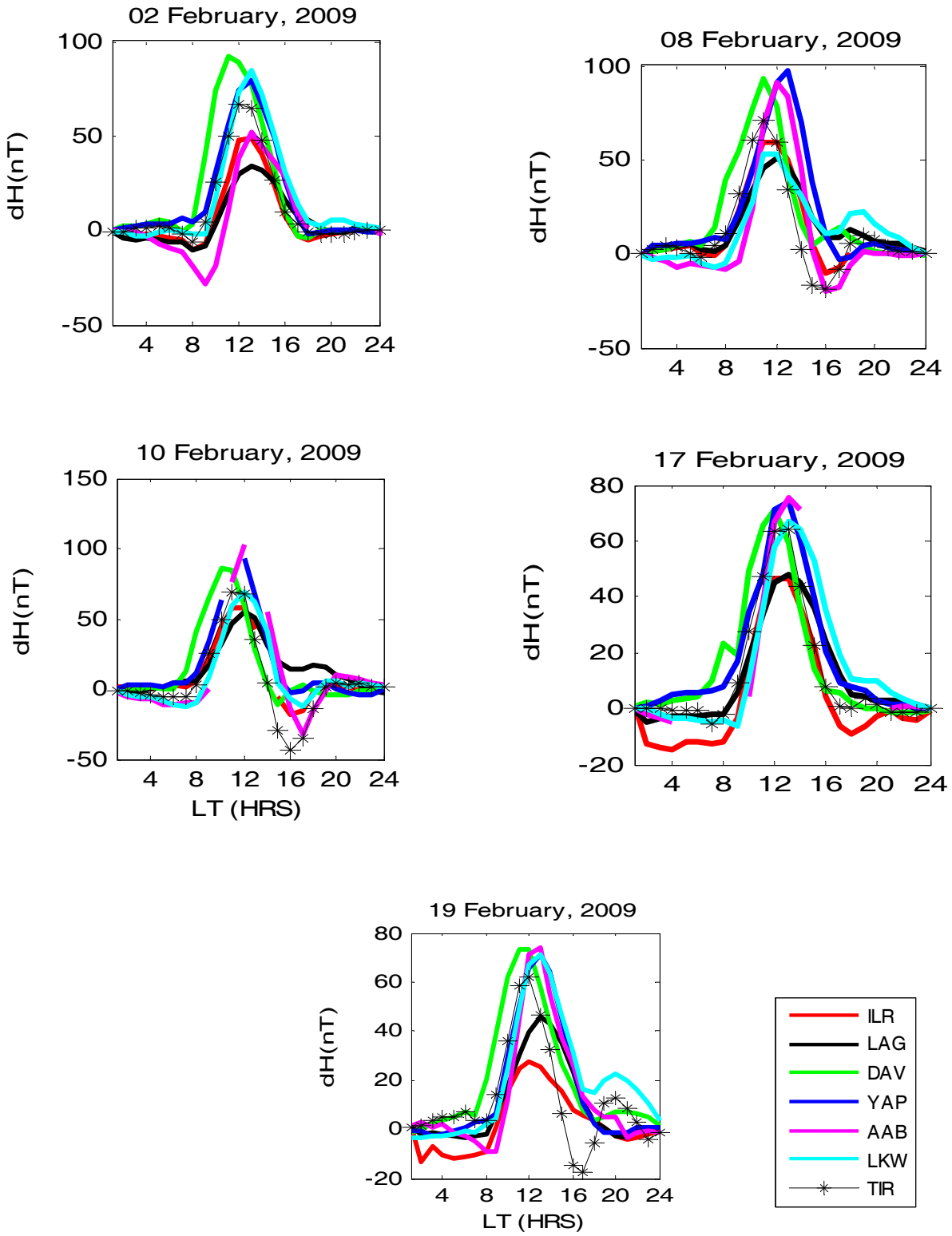


Fig. 2b: Quiet day variation of the horizontal component of the magnetic field dH for February 08, 02, 17, 10 and 19, 2009.

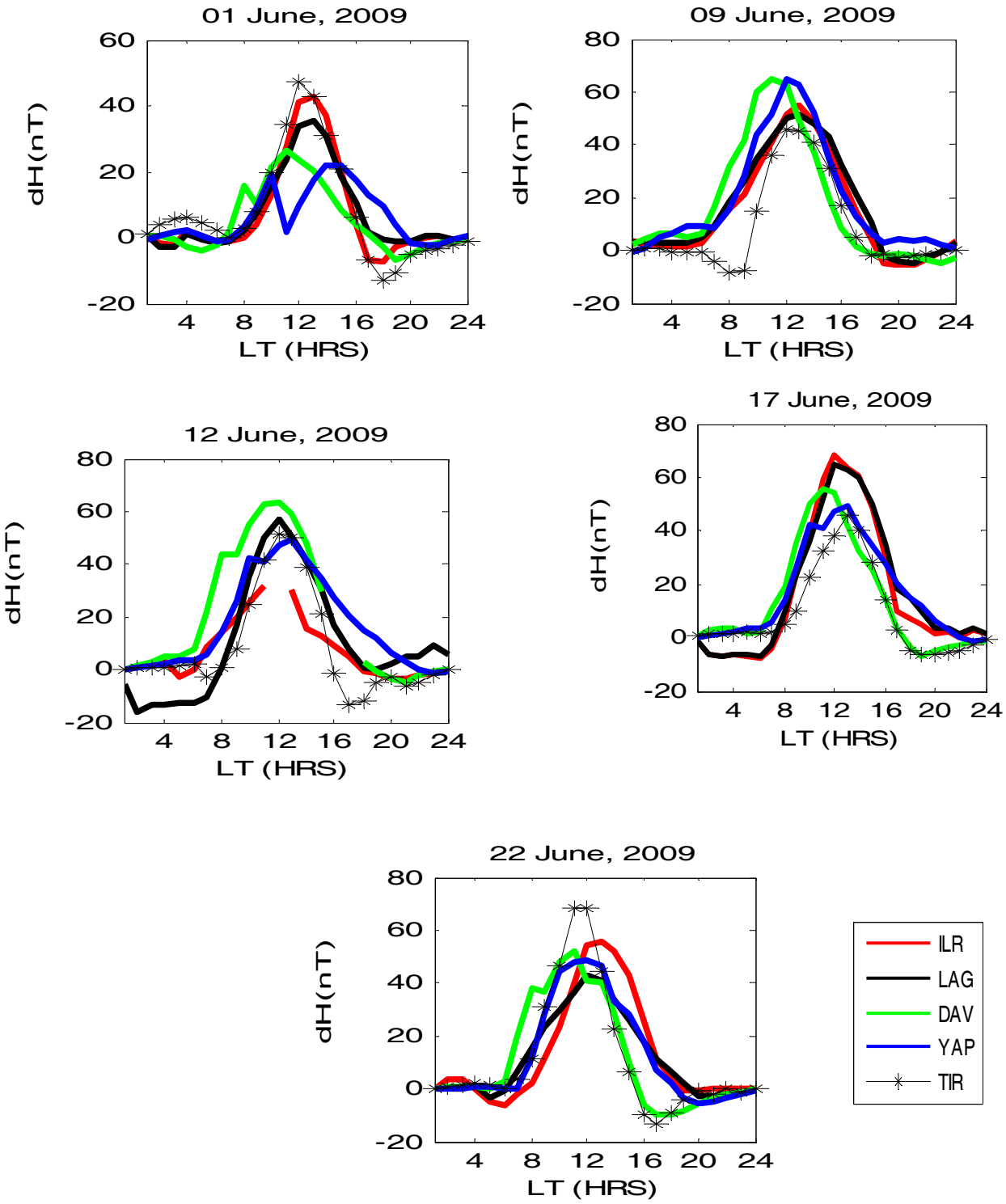


Fig. 2c: Quiet day variation of the horizontal component of the magnetic field dH for Jnue 12, 01, 09, 22 and 17, 2009.

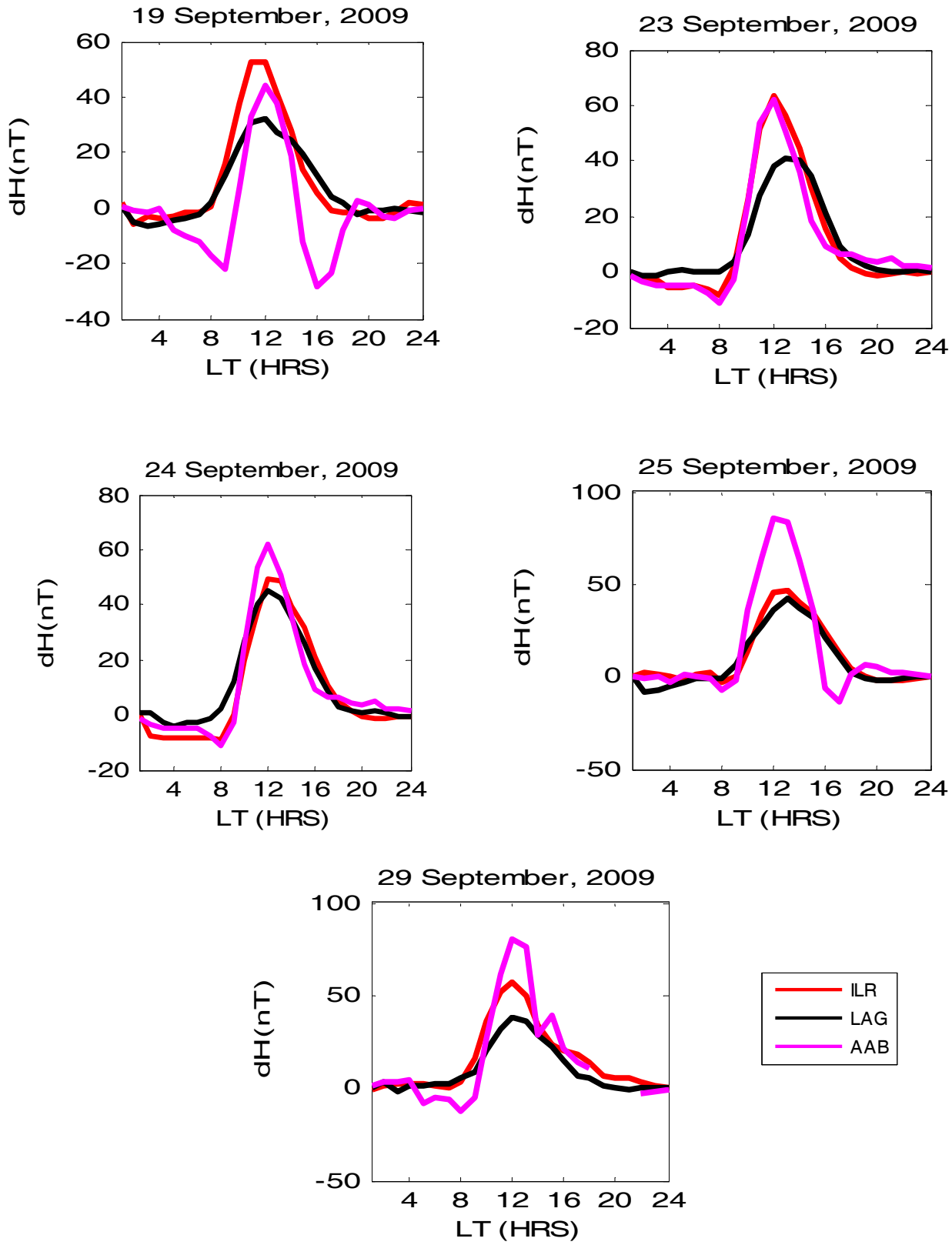


Fig. 2d: Quiet day variation of the horizontal component of the magnetic field dH for Septembe 23, 29, 19,25 and 24,2009.

It was noticed that the EEJ strength is not the same in the stations considered. This intensity could be a function of longitude and has an inverse dependence on geomagnetic field intensity. The different variability in dH recorded could be attributed to the variability of the ionospheric processes and physical structure such as conductivity and wind, which are responsible for the S_q variation. These results are quite in agreement with the works of (Adimula *et al.,* 2011; Akpaneno & Adimula, 2015; Matsushita, 1969; Onwumechilli, 1997). Variability could be as a result of the modulation of ionospheric dynamo in the middle atmosphere through the excitation of solar non-migrating tides in the troposphere. The daily variation of EEJ could also be as a result of day to day variability of zonal winds (Fang *et al.,* 2008). The variations in tidal strength and the sudden longitudinal gradients in the diurnal non-migrating tides between the longitudes over 15° separation which are also factors responsible for different variability (Anderson *et al.,* 2006). Neutral winds in the lower atmosphere can influence and modulate the E-region dynamo and this can also produce spatial variability. The daily variation trend is also due to the variation in dynamo driving and variations in conductivity (Alex & Mukherjee, 2001). The equatorial electrojet strength between sectorial regions in this study depicts the enhanced amplitudes at the Asian sector during the equinox and solstice recorded than their corresponding values at the Afican sector. This is an indication that the equatorial current flow is stronger in the Asian than in the African sector. This sectorial dependence has also been reported by Manoj et al. (2006), Rabiu et al (2011), and Rastogi et al. (2010) at various times in their works. Rabiu et al. (2011) suggested that there could be a process of introduction of energy as jet flows eastward.

The current enhancement recorded is as a result of localized ionospheric currents flowing at the dip equator with higher current intensities during the time (Okeke & Hamano, 2000). The contrast in time for the peak electrojet across the entire months may be as a result of the sum total of the effects of the peak electron density and electric field. This agrees with the findings of Chandra *et al.,* (2000). It was also noticed that the buildup flank in the morning hours is steeper than that of the decay phase in the night hours. In the year 2009 (fig.2a), EEJ is strongest in January (solstice). This deviation could be as a result of wind effect.

Spectrum of counter electrojets were observed during this period. CEJs were noticed at YAP and TIR on 23/01, AAB on 02/02, TIR on 19/02 etc. The CEJ events are unexpected and it has a short time and a variable intensity. There is variability in occurrence of these CEJ events. Some occurred in the morning and some in the evening. This variability in occurrence could be as a result of the differences in local wind shears that modify jet fields. The morning depression of H component of the magnetic field observed is in line with the work of Rangarajan and Rastogi (1993) who suggested that the depressions could be due to localized events and in some occasion, the events may not occur on the same day even at observatories separated by a longitude of 2 to 3h. These depressions observed do not change the pattern of the diurnal variation at any station. Hence, maximum variation around noon is recorded. Adimula *et al.* (2011) also obtained similar results.

The depressions of H field during day time below the night level (CEJ) were connected with sudden exit of the equatorial E_s layer and were simultaneous with the reversal of the ionospheric drifts (Rastogi,1971). It was noticed that the occurrence of CEJs events during this period of study were mostly seen during few hours in the morning and before evening and is sparingly seen around local noon. This is in line with the work of Marriot *et al.,* (1979). The magnitudes and time of occurrence of EEJ seen in those different months differ. However, post-

sunset counter electrojet showed higher magnitudes than the pre-sunrise magnitude. For instance on 19/09 (fig.2d), counter electrojet (CEJ) occurred at AAB during pre-sunrise and post-sunset, the post-sunset value is -30nT while pre-sunrise is -20nT. According to Matsushita (1977), CEJ mechanism could be a reversal of electric fields due to lunar tides, substorms and localized winds. Study revealed that CEJ events are more frequent in equinoxes than solstice months. Morning CEJs are common in equinoxes and afternoon events in solstice.

Conclusions

The daily variability of the H component of the geomagnetic field during quiet time was observed to have similar pattern with gradual increase from the night level to noontime peak and gradual decrease back to night level. The maximum range is 85nT with peaks around 1200 to 1300LT. Enhanced EEJ amplitude was recorded at the Asian sector during the equinox and solstice than their corresponding values at the African sector. This indicates that EEJ current flow is stronger in the Asian than the African sector. Series of counter electrojet (CEJs) were recorded during this period. This is as a result of reversal of electric fields due to lunar tides, sub storms and localized winds.

Acknowledgements

The authors are grateful to Prof. K. Yumoto and the Magdas Group (SERC) Kyushu University for providing the magnetic data used in this study through Prof. I. A. Adimula.

References

Adimula, I. A., Rabiu, A. B., Yumoto, Y. & MAGDAS Group (2011). Geomagnetic field variations from some equatorial elctrojet stations. *Sun and Geosphere,* 6(2), 45 - 49.

Akpaneno, A. F. & Adimula, I. A. (2015). Variability of H component of the geomagnetic field from some equatorial electrojet stations. *Sun and Geosphere,* 10, 65 - 77.

Alex, S. & Mukherjee, S. (2001). Local time dependence of the equatorial counter electrojet effect in a narrow longitudinal belt. *Earth Planet Space,* 53, 1151 - 1161.

Alex, S., Jadhav, L. & Roa, D. R. K. (1992). Complexity in the variation of declination component (D) of the geomagnetic field in the Indian region. *Geological Society Indian Man,* 24, 263 - 274.

Anderson, D., Angel, A., Chan, J. L. & Yumoto, K. (2006). Global, low - latitude, vertical E×B drift velocities inferred from day -time magnetometer observations. *Space Weather,* 4, S08003.

Babatunde, R. (2011). *The equatorial ionosphere: A tutorial.* National Space Research & Development Agency (NASRDA), Abuja, Nigeria.

Chandra, H., Misra, R. K. & Rastogi, R. G. (1971). Equatorial ionospheric drift and electrojet. *Planet and Space science,* 1497 - 1503.

Chandra, H., Sinha, H. S. S. & Rastogi, R. (2000). Equatorial electrojet studies from rocket and ground measurement. *Earth planet space,* 52, 111 - 120.

Cowling, T. G. (1933). The electrical conductivity of an ionized gas in the presence of a magnetic field. *Geophysical Journal of Research, Astronomical Society,* 93, 90 - 98.

Doumoumya, A., Vassal, V., Cohen, Y., Fambitakoye, O. & Menviell, B. (1998). The equatorial electrojet: First results from magnetic measurement.

Doumouya, V., Cohen, Y., Arora, B. R. & Yumuto, K. (2003). Local time and longitude dependence of the equatorial electrojet magnetic effects. *Journal of Atmospheric, Solar - Terrestrial Physics,* 65, 1265 - 1282.

Fang, T. W., Richmond, A. D., Liu, J. Y. & Mante, A. (2008). Wind dynamo effects on ground magnetic perturbations and vertical drifts. *Journal of Geophysical Research,* 113.

Geoscience Australia, (2013). Tabulated IQDs and IDDs data. Available at http://www.ga.gov.au

Kane, R. P. & Triveli, N. B. (1981). Implication of Z variations during a near noon equatorial counter electrojet. *Journal of Geophysical Research,* 85, 470 - 710.

Luhr, S., Maus, S. & Rother, M. (2004). Noon-Time equatorial electrojet: Its spatial features as determined by the CHAMP satellite. *Journal of Geophysical Research,* 109.

Manoj, C., Luhr, H., Maus, S. & Nagarajan, N. (2006). Evidence of short spatial correlation lengths of the noontime equatorial electrojet inferred from a comparison of satellite and ground magnetic data. *Journal of Geophysical research,* 111, A11312.

Marriot, R. T., Richmond, A. D. & Venkateswaram, S. V. (1979). The quiet time equatorial electrojet and counter electrojet, *Journal of Geomagnetism and Geoelectricity,* 31, 311-340.

Matsushita, S. (1969). Dynamo currents, wind and electric fields. *Radio Science,* 4, 771.

Matsushita, S. (1977). IMF effects on the equatorial geomagnetic field and ionosphere. A Review, *Journal of Atmospheric and Terrestrial Physics,* 39, 1207-1215.

Okeke, F. N. & Hamano, Y. (2000). Daily variation of geomagnetic H, D and Z- field at equatorial latitudes. *Earth Planet Space,* 52, 237-243.

Onwumechili, C. A. (1997). *The equatorial electrojet.* Amsterdam: Gordon and Breach Science Publishers.

Rabiu, A. B., Mamkuyomi, A. I. & Joshua, E. O. (2007). Variability of equatorial ionosphere inferred from geomagnetic field measurements. *The Bulletin of the Astronomical Society India,* 25, 607 - 618.

Rangarajan, G. K. & Rastogi, R. G. (1993). Longitudinal difference in magnetic field variations associated with quiet day counter electrojet. *Journal of Geomagnetism and Geoelectricity,* 45, 649-656.

Rastogi, R. G. (1974). Westward equatorial electrojet during daytime hours. *Journal of Geophysical Research,* 79, 1503 - 1512.

Rastogi, R. G. (2007). Day to day variability of the equatorial electrojet current in the South American sector. *Earth planets space,* 59, 459 - 461.

Rastogi, R. G., Chandra, H., Chakrabarty, D., Kitamura, K. & Yumoto, K. (2007). Day to day correlation of equitorial electrojet at two stations seperated by 2000km. *Annals of Geophysics,* 25, 875 - 880.

Rastogi, R.G., Chandra, H. & Chakravarty, S. C. (1971). The disappearance of equatorial E_s and the reversal of electrojet current, *Indian Academic of Sciences*, 74, 62 - 67.

Stefan, M. & Patrick, A. (2010). *Geomagnetic equatorial electrojet*. Available at http://geomagnetic/info/equatorial_electrojet.html

Yacob, A. (1977). Internal induction by the equatorial electrojet in India examined with surface and satellite geomagnetic observations. *Journal of Atmospheric and Terrestrial Physics,* 39, 601 - 603.

QUALITATIVE INDUCED POLARISATION VALIDATION OF THE RESULTS OF A 2KM^2 VES STUDY COMPLETED AT THE GIDAN KWANO CAMPUS PHASE II DEVELOPMENT, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA

JONAH, S. A[1]. & OLASEHINDE, P. I[2].
[1]Department of Physics, Federal University of Technology, Minna, Nigeria
[2]Department of Geology, Federal University of Technology, Minna, Nigeria
E-mail: sajonah2003@yahoo.com Phone No: +234-806-468-7977

Abstract
The 2km^2 vertical electrical sounding (VES) study under consideration here was completed without a tandem and coincident-point induced polarisation (IP) in the course of that survey completed in 2013; this 2km^2 VES survey was conducted at 200m principal station-spacing and the areal extent is subsumed within the southern half of the 8km^2 total area Gidan Kwano Campus (GKC) Phase II Development. The aim of this study is to provide "a refinement of sorts" or "a further constraint" on the result of the interpretation of the VES survey at the 2km^2 slice of Phase II of the GKC by employing corresponding IP data set in quality control (QC) mode. All aspects of the tandem VES-IP survey in two-dimensional (2-D) mode was completed in the transverse traverse (TT) trend. For the qualitative discussion herein, examination of each of the separate IP tables of values was fixed for a benchmark depth of 40m. Based on the analysis of the corresponding IP tables, for which the IP method is the second-stage constraint to the earlier VES interpretation, the aquifer prospects that were tagged "strongly aquiferous" in the 2013 survey are now even qualified as "very strongly aquiferous," meaning that the IP method is a great QC tool.

Keywords: Quality-control; Areal; Transverse-traverse; Subsume; Triumvirate; Aquiferous

Introduction
The 2km^2 vertical electrical sounding (VES) study under consideration here is Jonah *et al.* (2014[i]) for which no tandem and coincident-point induced polarisation (IP) data set was collected in the course of that survey completed in 2013; this 2km^2 VES survey was conducted at 200m principal station-spacing and the areal extent is subsumed within the southern half of the 8km^2 total area Gidan Kwano Campus (GKC) Phase II Development. A tandem, triumvirate schedule geoelectrical survey has been defined for the southern half 4km^2 of the Gidan Kwano Campus Phase II Development; this triumvirate schedule is the VES, IP, and self-potential (SP) surveys. Only the tandem VES-IP survey in two-dimensional (2-D) mode has been completed to a reasonable degree at this 4km^2 areal extent; the result of the interpretation of the VES component of the total data field is discussed in Jonah *et al.* (2015[c]); based on the recommendation of Jonah *et al.* (2015[c]), another vista was explored in Jonah *et al.* (2015[d]). The tandem VES-IP survey in 2-D mode was completed at 100m principal station-spacing, and thus there would be coincident points of survey for all the principal stations occupied in the course of the single-mode VES survey of the 2km^2 areal extent; actually, this 4km^2 areal extent 2-D survey, begun in 2011, was completed in 2014. It is the IP results at coincident locations of the 2km^2 areal extent, still 2-D, survey that would be used in the validation discussion herein. Thus, the IP data field that is employed for the present study lags the VES data field by one year, essentially clarifying that both sets of data were not collected in *pari passu*. There is no problem about this time lapse because Jonah *et al.* (2015[e]) have demonstrated that the readings of the

ABEM Terrameter SAS 4000 terrameter that was the "workhorse" of all of these surveys correlates fairly well over varying weather conditions.

The aim of this study is to provide "a refinement of sorts" or "a further constraint" on the result of the interpretation of a VES survey at a 2km^2 slice of Phase II of the GKC by employing corresponding IP data set in quality control (QC) mode.

The nearest to the kind of endeavour being presented herein was discussed in Jonah *et al.* (2015[b]) where an intercalated VES-IP survey was carried out in *pari passu*, the VES in tandem with the IP, over a 1km^2 areal extent subsumed in the 2km^2 areal extent of the present study. Well, suffice to emphasize once more that the 2km^2 areal extent of the present study is subsumed in the 4km^2 areal extent of Jonah *et al.* (2015[c]) and this 4km^2 is subsumed in the 8km^2 total area of Phase II (discussed, amongst other related works in Jonah *et al.*, 2014[j]). Even though the area of study of Jonah *et al.* (2015[b]) is subsumed in the area of study of Jonah *et al.* (2014[i]), the IP data of Jonah *et al.* (2015[b]) could not be used for the present analysis because the principal stations of Jonah *et al.* (2015[b]) intercalates the principal stations of the present study by 100m and thus their survey stations are not coincident.

The extent of the 2km^2 area of study is shown in Fig.1 in relation to Phase I (that is, the existing developed portion of the GKC). The missing green dots of Fig.1 are the two locations of the principal stations coincident with the tops of two unitary bodies of outcrops where VES measurements could not be taken in 2013 for the Jonah *et al.* (2014[i]) schedule.

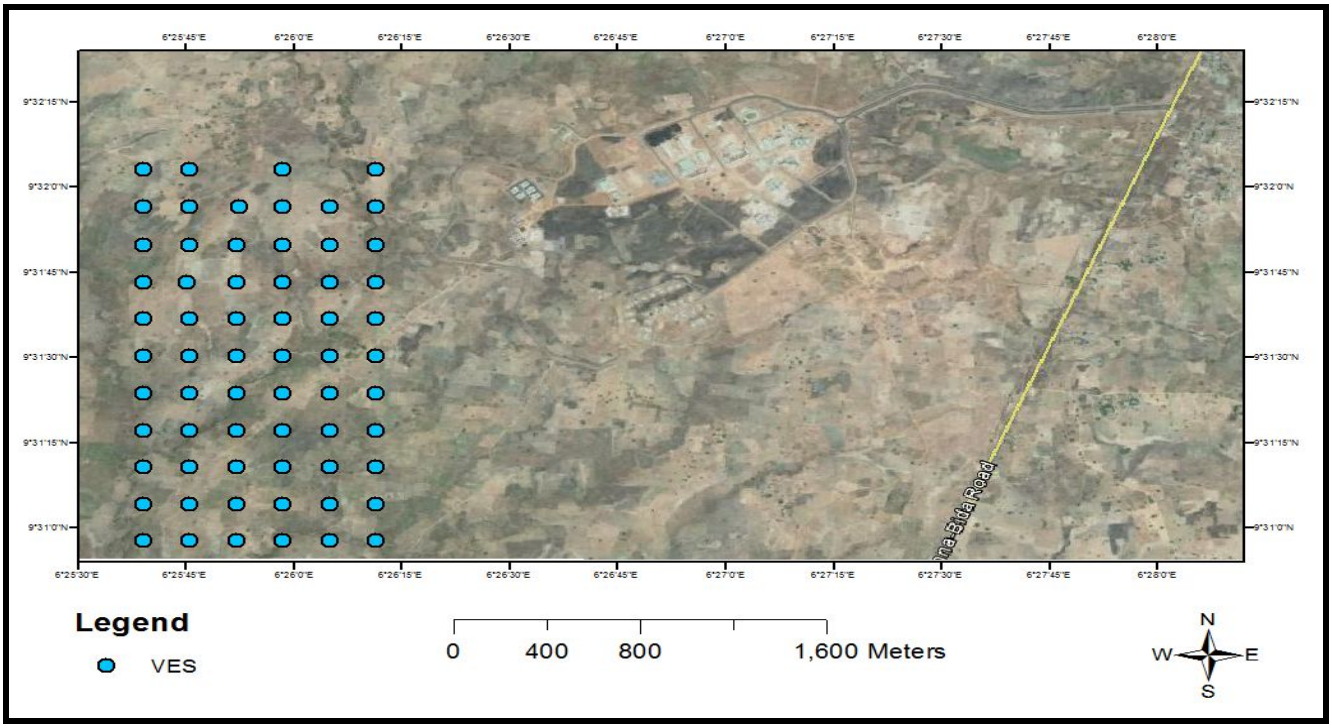


Fig.1: Satellite imagery overlay map showing the extent of project work in relation to Phase I.

The tadpole-shaped feature is Phase I, seen to the east of the VES green-dotted grid of the area of study and the Minna-Kateregi-Bida Road is seen as the linear slope in the bottom right of this figure.)

At 200m station-spacing, the schedule of the 2km^2 survey results in a 6x6 grid format (36 principal stations; see Fig.1) whilst at 100m station-spacing, the schedule of the 4km^2 survey results in a 21x21 grid format (441 principal stations); this can be made out in Fig.2. Thus the idea of the 2km^2 areal extent being "subsumed" in the 4km^2 areal extent is easily understood.

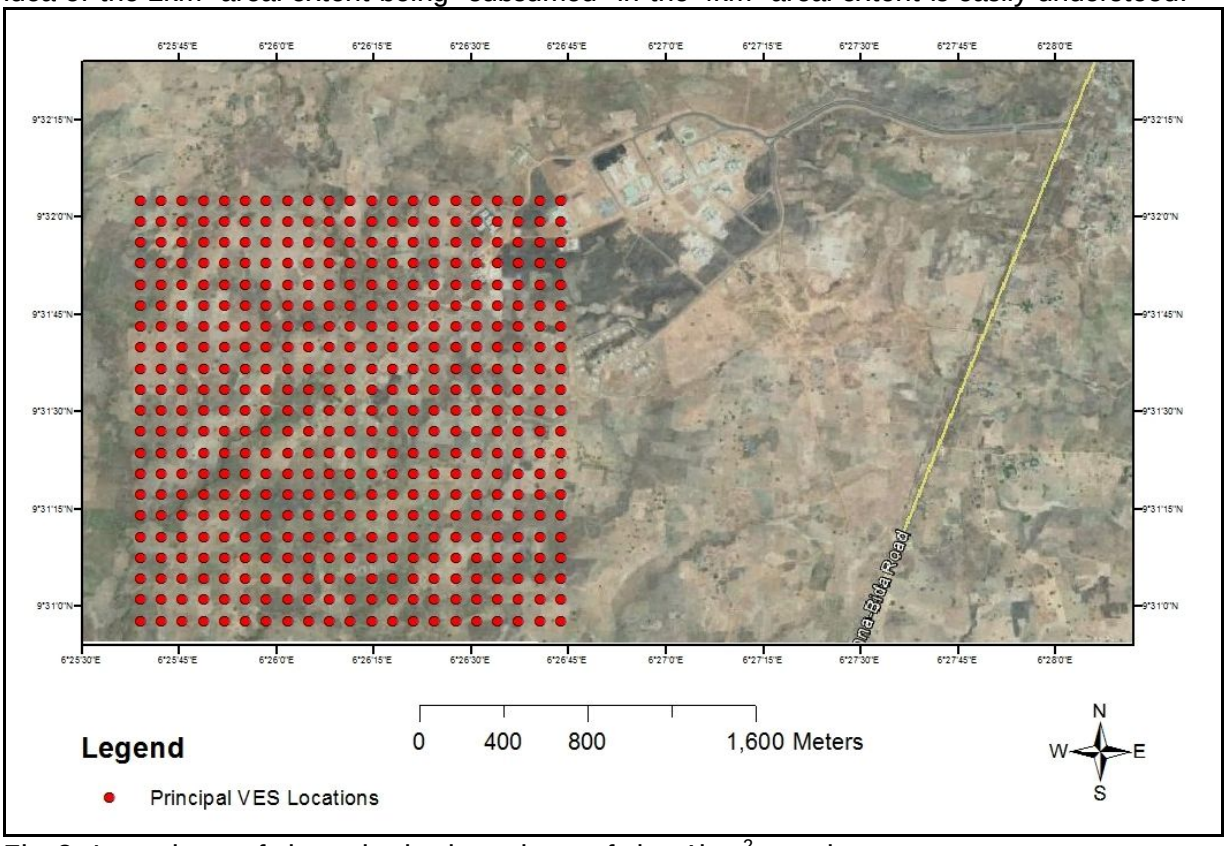


Fig.2: Locations of the principal stations of the 4km^2 areal extent

Well, it was mentioned that "only the tandem VES-IP survey in two-dimensional (2-D) mode has been completed to a reasonable degree at this 4km^2 areal extent". The meaning of this can be discerned in Fig.3, where only the principal survey stations for the 4km^2 areal extent that were occupied during the course of this survey have been colour-coded against the original red backdrop. Barriers due to wet-stream, outcrop, thicket, built-up area, instrumental error (that is, "Error 12" of the ABEM Terrameter 4000), and raw sewage precluded measurements at the red-coloured locations of Fig.3 except at the longitudinal traverse (LT) length of Number 11 where VES and IP data were collected in LT trend in 2011. Thus far, all aspects of surveys completed have been in the transverse traverse (TT) trend.

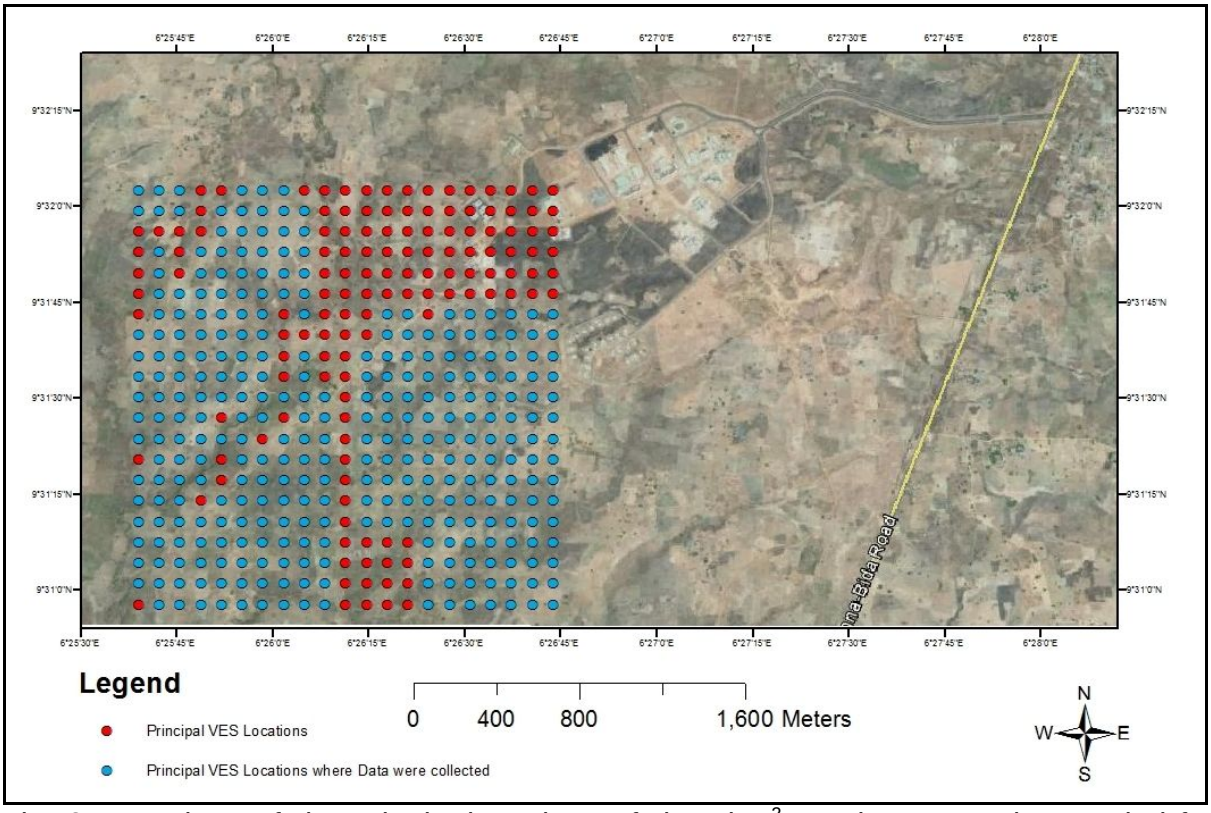


Fig. 3: Locations of the principal stations of the 4km^2 areal extent colour-coded for locations where data was collected for this survey

Accurate mapping and archival of surface and subsurface information must necessarily follow a full suite of methods designed to reduce errors in interpretation of field data, as well as providing the ability to correctly pinpoint likely prospects in the study area. Moreover, independent verification of the field data must be assured. In fact, Jonah (2015[a]); Jonah *et al.* (2015[b]); Jonah *et al.* (2015[c]); Jonah *et al.* (2015[d]); Jonah *et al.* (2015[e]); Jonah and Duromola (2014[a]), Jonah and Ayofe (2014[b]), Jonah and Bawa (2014[c]); Jonah *et al.* (2014[d]); Jonah *et al.* (2014[e]); Jonah *et al.* (2014[f]), Jonah *et al.* (2014[g]), Jonah *et al.* (2014[h]), Jonah *et al.* (2014[i]); Jonah *et al.* (2014[j]); Jonah *et al.* (2014[k]); Jonah and Jimoh (2013[a]), Jonah *et al.* (2013[b]), Jonah *et al.* (2013[c]), Jonah *et al.* (2013[d]), Jonah *et al.* (2011[a]), Jonah *et al.* (2011[b]), Jonah *et al.* (2011[c]); Jonah *et al.* (2011[d]) have always argued in favour of georeferencing field data and their concomitant tie-in to their specific GIS database.

Discussion

The ideas germane to the discussion of this present study have been enunciated in Jonah *et al.* (2015[b]) whence the following critical remarks were noted, viz: "the interpretation would be guided by the statement-of-fact enunciated on p. 222 of Kearey and Brooks (1984) to wit: the sources of significant IP anomalies are water-filled shear zones; it is understood from ABEM (1999) that IP results can distinguish between groundwater and clay. This property is significant because it constrains the IP method to be an effective discriminator when making deduction as to the presence of groundwater. According to Parasnis (1986:180) 'the advantage of IP soundings (as a complement to VES) is that they are able to distinguish between clay layers (high IP) and some other low-resistivity strata like salt-water beds (no IP).' Thus, where it is

suspected that groundwater may be present, recourse to the corresponding IP value recorded in *pari passu* at that depth would help dispel whatever doubt there may be." If measurements in *pari passu* were not implemented, then measurements completed at the corresponding depths of survey at a time lag should be used.

For the 2km^2 VES study completed at the Gidan Kwano Campus Phase II (Jonah *et al.* 2014[i]), upon making recourse to a dual empirical rule that guide the identification of groundwater prospects in the basement complex geology alongside a consideration of the iso-resistivity contour maps at depths, the following locations were tagged as "aquiferous:" TT1-3, TT1-4, TT2-1, TT2-2, TT2-3, TT2-4, TT2-5, TT2-6, TT3-1, TT3-2, TT3-3, TT3-4, TT4-1, TT4-2, TT4-3, TT4-5, TT5-1, TT5-2, TT5-3, TT5-4, TT5-5, TT5-6, TT6-1, TT6-5, TT6-6, TT7-1, TT7-5, TT9-1, TT9-2, and TT9-6. Upon imposing a first-stage constraint to this conclusion that is based on a consideration of the overburden thickness map, the following locations were flagged as "strongly aquiferous:" TT1-3, TT1-4, TT2-4, TT4-1, and TT4-3. Basically, this present study examines a second-stage constraint based on a qualitative consideration of IP data collected at corresponding points of the VES locations.

A transverse traverse (TT) is an east-west profiling scheme; this scheme was adopted for the 2km^2 and the 4km^2 surveys represented in Figs 1 and 2. In reality, for the 2km^2 schedule of 2013, data collection convention was from east to west: since the southernmost TT was occupied first, TT1-3 of Fig.1 is the third green dot to the left of the most extreme southeast dot; TT1-4 is one pace to the left of TT1-3. Based on this convention, it could easily be made out that TT11-2 and TT11-4 are the locations that are coincident with the top of unitary bodies of outcrops. It is known that TT1-1 is identified by the following georeferenced co-ordinates: N09^{0}30′57.80′′; E006^{0}26′11.40′′. Thus, at 400m to the west of TT1-1, TT1-3 is identified by the following georeferenced co-ordinates: N09^{0}30′57.80′′; E006^{0}25′58.44′′ and TT1-4 at 600m to the west of TT1-1 is identified by the following georeferenced co-ordinates: N09^{0}30′57.80′′; E006^{0}25′′51.96′′. TT2-4 is the fourth station of the second TT (counting from east to west, of course); the second TT is the profile line exactly 200m to the north of TT1 in Fig.1; TT2-4 is identified by the following georeferenced co-ordinates: N09^{0}31′04.28′′; E006^{0}25′51.96′′. TT4-1 is identified by the following georeferenced co-ordinates: N09^{0}31′17.24′′; E006^{0}26′11.40′′ and TT4-3 is identified by the following georeferenced co-ordinates: N09^{0}31′17.24′′; 006^{0}25′58.44′′.

However, for the 4km^2 schedule of 2014, data collection convention was from west to east; remembering that the station-spacing is 100m, the equivalent of TT1-3 is the seventh red dot to the right of the most extreme southwest red dot of Fig.2 and the seventh green dot to the right of the most extreme southwest green dot of Fig.3. TT1-4 is the fifth red dot to the right of the most extreme southwest red dot of Fig.2 and the fifth green dot to the right of the most extreme southwest green dot of Fig.3. In Fig.2, TT2-4 would be located on the third profile line exactly 200m to the north of TT1; actually, the fifth red dot on the third profile line from the west as can be made out in Fig.2 and also the fifth green dot on the third profile line from the west as can be made out in Fig.3. Now, considering Figs 2 and 3 still further, it should be obvious that there would be no difficulty "reading off" the positions of TT4-1 and TT4-3.

Qualitative Discussion of the Function of the Induced Polarisation Data for the Present Intercalated Survey: The IP tables for TT1-3, TT1-4, TT2-4, TT4-1, and TT4-3 are hereby presented as Tables 1 to 5. For the qualitative discussion herein, examination of each of the separate IP tables of values would be done only to a TD of 40m. This 40m-window

restriction is due to the fact that, in the larger basement complex region of which the present area of study is but a small constituent, the thicknesses of the different phases of overburden materials never exceed 35m (Jimoh, 1998).

Table 1: IP data record sheet for TT1-3

TYPE OF SURVEY:...Induced Polarisation……MODE:....Time Domain... ARRAY: ……Schlumberger……..

PLACE:...Gidan Kwano Campus....WEATHER:.. Partly Sunny... EQUIPMENT:.ABEM Terrameter SAS 4000

LOCATION: (i) N:.. $09^0$30′57.80′′.....(ii) E:.... $006^0$25′58.44′′.....ELEVATION:..... 192m .....

OPERATOR:...SJ.....RECORDER:...SJ..... .....DATE:... 12/05/2014..... TIME:... 04:39 P.M....

TRANSVERSE TRAVERSE DESIGNATION:... TT1-3..... GPS UNIT:... Garmin GPSmap76.....

Ab/2 (Current)	Mn/2 (Potential)	GEOM. Factor, K	Chargeability	Standard Deviation	Current (I)	Stacks
1	.50	2.36	1.08	0.02	100mA	4
2	.50	11.8	2.34	0.01	100mA	2
3	.50	27.8	2.81	0.17	100mA	4
5	.50	77.8	3.08	0.42	100mA	4
6	.50	112	2.97	0.27	100mA	4
6	1.00	55	3.05	0.32	100mA	4
8	1.00	99	2.99	0.43	100mA	4
10	1.00	156	2.79	0.22	100mA	4
10	2.50	58.9	-4.24	0.39	100mA	4
15	2.50	137	-2.23	0.01	100mA	4
20	2.50	245	-1.00	0.16	100mA	4
30	2.50	562	-38.20	1.10	100mA	4
40	2.50	1001	-49.70	2.90	100mA	4
40	7.50	323	-21.70	0.87	100mA	4
50	7.50	512	-8.86	0.57	100mA	4
60	7.50	742	-8.92	0.46	100mA	4
70	7.50	1014	-24.20	1.70	100mA	4
80	7.50	1329	-3.20	0.43	100mA	4
80	15.00	647	1.71	0.42	100mA	4
90	15.00	825	1.90	0.14	100mA	4
100	15.00	1024	2.45	0.39	100mA	4

Table 2: IP data record sheet for TT1-4

TYPE OF SURVEY:...Induced Polarisation……MODE:....Time Domain... ARRAY: ……Schlumberger……..

PLACE:...Gidan Kwano Campus...WEATHER:...Partly Sunny ... EQUIPMENT:.ABEM Terrameter SAS 4000

LOCATION: (i) N:.. $09^0$30′57.80′′.....(ii) E:.. $006^0$25′′51.96′′.....ELEVATION:..... 200m .....

OPERATOR:...SJ.....RECORDER:...SJ..... DATE:... 14/05/2014..... TIME:... 11:04 A.M ...

TRANSVERSE TRAVERSE DESIGNATION:... TT1-4..... GPS UNIT:... Garmin GPSmap76.....

Ab/2 (Current)	Mn/2 (Potential)	GEOM. Factor, K	Chargeability	Standard Deviation	Current (I)	Stacks
1	.50	2.36	1.55	0.00	100mA	2
2	.50	11.8	0.92	0.07	100mA	4
3	.50	27.8	-2.48	1.30	100mA	4
5	.50	77.8	0.92	0.07	100mA	4
6	.50	112	1.42	0.08	100mA	4
6	1.00	55	4.77	1.20	100mA	4
8	1.00	99	1.88	0.13	100mA	4
10	1.00	156	1.79	0.27	100mA	4
10	2.50	58.9	1.67	0.16	100mA	4
15	2.50	137	1.33	0.24	100mA	4
20	2.50	245	1.38	0.13	100mA	4
30	2.50	562	1.47	0.22	100mA	4
40	2.50	1001	1.77	0.38	100mA	4
40	7.50	323	3.40	1.30	100mA	4
50	7.50	512	2.37	0.40	100mA	4
60	7.50	742	2.29	0.49	100mA	4
70	7.50	1014	2.92	0.59	100mA	4
80	7.50	1329	2.54	0.41	100mA	4
80	15.00	647	2.38	0.36	100mA	4
90	15.00	825	2.17	1.10	100mA	4
100	15.00	1024	2.61	0.63	100mA	4

Table 3: IP data record sheet for TT2-4

TYPE OF SURVEY:...Induced Polarisation.....MODE:....Time Domain... ARRAY: .....Schlumberger.....

PLACE:...Gidan Kwano Campus.... WEATHER:... Sunny ..... EQUIPMENT:.ABEM Terrameter SAS 4000

LOCATION: (i) N:.. $09^0 31' 04.28''$.....(ii) E:..... $006^0 25'' 51.96''$.....ELEVATION:.....201m.....

OPERATOR:...SJ.....RECORDER:...SJ..... .....DATE:... 17/05/2014..... TIME:..... 12:50 P.M ...

TRANSVERSE TRAVERSE DESIGNATION:... TT2-4..... GPS UNIT:... Garmin GPSmap76.....

Ab/2 (M) (Current)	Mn/2 (M) (Potential)	GEOM. Factor, K	Chargeability	Standard Deviation	Current (I)	Stacks
1	.50	2.36	0.44	0.06	100mA	4
2	.50	11.8	0.19	0.42	100mA	4
3	.50	27.8	-0.24	0.28	100mA	4
5	.50	77.8	-0.44	0.83	100mA	4
6	.50	112	0.93	0.56	100mA	4
6	1.00	55	-5.25	4.20	100mA	4
8	1.00	99	-0.65	0.77	100mA	4
10	1.00	156	-35.4	14.0	50mA	4
10	2.50	58.9	-5.18	2.40	100mA	4

15	2.50	137	0.60	3.10	100mA	4
20	2.50	245	0.65	0.08	100mA	4
30	2.50	562	-0.07	0.28	100mA	4
40	2.50	1001	-3.40	0.62	100mA	4
40	7.50	323	2.84	0.20	100mA	4
50	7.50	512	10.5	0.35	100mA	4
60	7.50	742	2.77	0.00	100mA	4
70	7.50	1014	2.79	0.17	100mA	4
80	7.50	1329	-12.6	0.74	100mA	4
80	15.00	647	-5.82	0.42	100mA	4
90	15.00	825	-8.44	1.50	100mA	4
100	15.00	1024	-28.5	3.60	100mA	4

Table 4: IP data record sheet for TT4-1

TYPE OF SURVEY:...Induced Polarisation.....MODE:....Time Domain... ARRAY: ……Schlumberger……..

PLACE:...Gidan Kwano Campus.... WEATHER:..... EQUIPMENT:.ABEM Terrameter SAS 4000

LOCATION: (i) N:.... $09^0$31'17.2''.....(ii) E:... $006^0$26'11.4''.....ELEVATION:……..202m.....

OPERATOR:...SJ.....RECORDER:...SJ..... .....DATE:..... TIME:.....

TRANSVERSE TRAVERSE DESIGNATION:... TT4-1..... GPS UNIT:... Garmin GPSmap76…….

Ab/2 (Current)	Mn/2 (Potential)	GEOM. Factor, K	Chargeability	Standard Deviation	Current (I)	Stacks
1	.50	2.36	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
2	.50	11.8	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
3	.50	27.8	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
5	.50	77.8	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
6	.50	112	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
6	1.00	55	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
8	1.00	99	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
10	1.00	156	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
10	2.50	58.9	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
15	2.50	137	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
20	2.50	245	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
30	2.50	562	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
40	2.50	1001	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
40	7.50	323	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
50	7.50	512	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
60	7.50	742	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
70	7.50	1014	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
80	7.50	1329	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
80	15.00	647	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
90	15.00	825	1P DATA SET	AVAILABLE	ONLY IN	LT TREND
100	15.00	1024	1P DATA SET	AVAILABLE	ONLY IN	LT TREND

Table 5: IP data record sheet for TT4-3

TYPE OF SURVEY:...Induced Polarisation.....MODE:....Time Domain... ARRAY: ……Schlumberger……..

PLACE:...Gidan Kwano Campus.... WEATHER:...Partly Sunny... EQUIPMENT:.ABEM Terrameter SAS 4000

LOCATION: (i) N:.. $09^0 31' 17.24''$.....(ii) E:..... $006^0 25' 58.44''$.....ELEVATION:.....197m.....

OPERATOR:...SJ.....RECORDER:...SJ..... .....DATE:..... 25/06/2014..... TIME:... 12:30 P.M.....

TRANSVERSE TRAVERSE DESIGNATION:... TT4-3..... GPS UNIT:... Garmin GPSmap76.....

Ab/2 (M) (Current)	Mn/2 (M) (Potential)	GEOM. Factor, K	Chargeability	Standard Deviation	Current (I)	Stacks
1	.50	2.36	0.67	0.06	100mA	4
2	.50	11.8	0.33	0.02	100mA	4
3	.50	27.8	0.070	0.03	100mA	4
5	.50	77.8	-2.02	2.20	100mA	4
6	.50	112	-0.69	0.29	100mA	4
6	1.00	55	1.27	0.29	100mA	4
8	1.00	99	-0.40	0.04	100mA	4
10	1.00	156	0.67	0.05	100mA	4
10	2.50	58.9	1.00	0.07	100mA	4
15	2.50	137	1.38	0.01	100mA	4
20	2.50	245	1.10	0.19	100mA	4
30	2.50	562	1.00	0.88	100mA	4
40	2.50	1001	1.29	0.27	100mA	4
40	7.50	323	-1.86	1.60	100mA	4
50	7.50	512	0.82	0.31	100mA	4
60	7.50	742	1.20	0.14	100mA	4
70	7.50	1014	0.96	0.13	100mA	4
80	7.50	1329	1.20	0.11	100mA	4
80	15.00	647	1.11	0.18	100mA	4
90	15.00	825	1.02	0.10	100mA	4
100	15.00	1024	1.45	0.15	100mA	4

Qualitative Examination of IP Table for TT1-3 (see Table 1)

It is observed that a negative chargeability value of -49.70ms exists for TT1-3 at the 40m-depth mark of Table 1: according to ABEM (1999), negative IP values can only mean that the resistivity of the current layer is less than that of the layer just above it; this trend would be contrary to the theoretical expectation that resistivity should increase as the depth increases for any VES location. The chargeability is -38.20ms at the 30m-depth mark, -1.00 at the 20m-depth mark, -2.23 at the 15m-depth mark, -4.24 at the 10m-depth mark, and +2.99 at the 8m-depth mark. Parasnis (1986) pointed out that clay layers correspond to “high IPs” and salt-water beds correspond to “no IPs:” whilst an IP data set can distinguish between a clay bed and an aquifer, there is no indication of a prominent clay layer of “high absolute value of IP” in Table 1. Instead, what can be inferred in this table is a progressive decrease of resistivity values at depths through the benchmark depth of 40m down to the 80m-depth mark. In absolute value

terms, the values of IP at the 30m-depth mark is very close to that at the 40m-depth mark; interesting to note that the value at the 30m-depth mark is negative still. Suffice to point out here that in the study of Jonah *et al.* (2015[b]), TT1-3 of Jonah *et al.* (2014[i]), corresponding to the present TT1-3 under consideration, was flagged to have an aquifer drill window of 30m to 150m. Suffice, once more, to note that the station-spacing (corresponding to the maximum survey-able depth) of Jonah *et al.* (2014[i]) was 200m (>150m) and that for Jonah *et al.* (2015[c]) for which the IP values of Table 1 was extracted was 100m.

Qualitative Examination of IP Table for TT1-4 (see Table 2)

Considering the 40m-depth benchmark, the convenience of IP "negatives" pattern does not present itself in Table 2. Nonetheless, at the 3m-depth mark a chargeability value of -2.48ms exists; otherwise there is observed a stream of low-magnitude IP values throughout. In Jonah *et al.* (2015[b]), TT1-4 of Jonah *et al.* (2014[i]), corresponding to the present TT1-4 under consideration, was flagged to also have an aquifer drill window of 30m to 150m. The 30m to 100m interval of Table 2 are "low-IPs," basically. The point that is being made here is a referral from Jonah *et al.* (2015[b]), viz: "Since Parasnis (1986) pointed out that clay layers correspond to 'high IPs', and salt-water beds correspond to 'no IPs', *it can be inferred that freshwater beds correspond to 'low IPs*.'" Further, according to studies at the greater area of the Phase II Development, what is 'high' or 'low' IP is a subjective matter depending on the prevailing values of the current survey under analysis."

Qualitative Examination of IP Table for TT2-4 (see Table 3)

Considering the 40m-depth benchmark, a chargeability value of -3.40ms exists at this depth in Table 3. At the 30m-depth is an extremely low chargeability value of -0.07ms. In Table 3, the plethora of IP "negatives" pattern is spread through the shallow 3m-depth mark to the 100m-depth mark. In Jonah *et al.* (2015[b]), TT2-4 of Jonah *et al.* (2014[i]), corresponding to the present TT2-4 under consideration, was flagged to also have an aquifer drill window of 30m to 120m. Based on the point of argument being considered here, the 30m to the 40m interval and the 80m-depth mark downwards of Table 3 validates this position fairly well. Basically, what can be inferred in this table is a progressive decrease of resistivity values at depths through the benchmark depth of 40m down to the 100m-depth mark.

Qualitative Examination of IP Table for TT4-1 (see Table 4)

The available IP data-set for TT4-1 of the present study, corresponding to TT4-1 of Jonah *et al.* (2014[i]), was acquired in the LT format and thus in keeping with a strictly TT-based analysis the table could not be used for the present analysis. Nevertheless, Jonah *et al.* (2015[b]) flagged TT4-1 as having an aquifer drill window of 20m to 130m.

Qualitative Examination of IP Table for TT4-3 (see Table 5)

Considering the 40m-depth benchmark, a chargeability value of -1.86 exists at this depth in Table 5. Above this benchmark to the 10m-depth mark is a stream of positives IP values. This situation perfectly suits the line of argument that is being presented herein, meaning basically that a low-resistivity bed is discernible at the 40m-depth benchmark. In Jonah *et al.* (2015[b]), TT4-3 of Jonah *et al.* (2014[i]), corresponding to the present TT4-3 under consideration, was flagged to also have an aquifer drill window of 40m to 150m. The coincidence of this 40m depth mark is very apt indeed!

Conclusion

On the TT1-3 Prospect: The dual empirical protocols alongside the iso-resistivity contour maps and still alongside the overburden thickness analysis routes that identified TT1-3 as "strongly aquiferous" have been corroborated by the IP data analysis route which is the central argument of this present study. Even though a depth benchmark was fixed for the IP data analysis of Jonah *et al.* (2015[b]) and the present study, both works are underscoring that the 30m-depth mark should not be ignored as a good groundwater window for TT1-3. The nearness of the IP absolute values at the 30m-depth mark and at the 40m-depth mark of the present study surely mean that the same geological material is encountered at both these depths. Jonah *et al.* (2015[b]) "says" if drilling TT1-3, concentrate on the 30m to 150m interval for groundwater exploitation and the present study "says" if drilling TT1-3, do not ignore the 30m-40m interval and of course the 40m down to the 80m-depth mark interval for groundwater exploitation. Thus, TT1-3 is "very strongly aquiferous."

On the TT1-4 Prospect: A valid argument has been presented to indicate that TT1-4 is "very strongly aquiferous," too.

On the TT2-4 Prospect: A valid argument has been presented to indicate that TT2-4 is "very strongly aquiferous."

On the TT4-1 Prospect: Since the corresponding IP data set for TT4-1 is not available for the present analysis, it advised to stick to the "strongly aquiferous" label of TT4-1 as argued in Jonah *et al.* (2015[b]).

On the TT4-3 Prospect: A valid argument has been presented to indicate that TT4-3 is "very strongly aquiferous".

Recommendations

(i) On the TT1-3 Prospect. It is recommended that TT1-3, located at Lat $09^0$30′57.80′′ and Long $006^0$25′58.44′′ based on the Garmin GPSmap76 Global Positioning System unit, should be drilled for groundwater exploitation purpose.

(ii) On the TT1-4 Prospect. It is recommended that TT1-4, located at Lat $09^0$30′57.80′′ and Long $006^0$25′′51.96′′ based on the Garmin GPSmap76 Global Positioning System unit, should be drilled for groundwater exploitation purpose.

(iii) On the TT2-4 Prospect. It is recommended that TT2-4, located at Lat $09^0$31′04.28′′ and Long $006^0$25′51.96′′ based on the Garmin GPSmap76 Global Positioning System unit, should be drilled for groundwater exploitation purpose.

(iv) On the TT4-1 Prospect. It is recommended that the planned corresponding IP data set survey in TT mode be completed as soon as possible so it could be employed in this analysis.

(v) On the TT4-3 Prospect. It is recommended that TT4-3, located at Lat $09^0$31′17.24′′ and Long $006^0$25′58.44′′ based on the Garmin GPSmap76 Global Positioning System unit, should be drilled for groundwater exploitation purpose.

References

ABEM (1999). *Instruction manual: Terrameter SAS 4000/SAS 1000*, ABEM instrument AB, Sundbyberg (Sweden).

Jimoh, M. O. (1998). *Report on the six boreholes drilled at the main campus of the Federal University of Technology, Minna, for the Petroleum (Special) Trust Fund.* Cemaco Ventures Ltd., Minna.

Jonah, S. A. (2015[a]). *Ozone (O_3) level study at major traffic stalling points in the Federal Capital City (FCC)*. Unpublished Report, Federal University of Technology Minna Ventures Limited (FUTMIN Ventures), Minna, Nigeria.

Jonah, S. A., Akpan, E. U., Bakara, I. U., Tanimowo, B., Abdullahi, B., Nwachukwu, E. I., ... & Ejepu, J. S. (2013[c]). Geospatial analysis and Geographic Information System (GIS) mapping of a greenhouse gas at Minna, Nigeria. *Journal of Science, Technology, Mathematics, and Education (JOSTMED)*, 9(3), 69 - 81.

Jonah, S. A. & Ayofe, L. F. (2014[b]). Creation of a geographic information system for Minna, Niger State, Nigeria. *Journal of Information, Education, Science, and Technology (JIEST)*, 1(1), 237 – 254.

Jonah, S. A. & Bawa, S. C. (2014[c]). Measurements of the levels of environmental noise at major stalling traffic points in Minna, Niger State, Nigeria. *Journal of Information, Education, Science, and Technology (JIEST)*, 1(1), 255 – 268.

Jonah, S. A. & Duromola, S. A. (2014[a]). Determination of concentration of sulphur dioxide at major stalling traffic points in Minna, Niger State, Nigeria. *Journal of Information, Education, Science, and Technology (JIEST)*, 1(1), 224 – 236.

Jonah, S. A. & Jimoh, M. O. (2013[a]). Production of a topographic map and the creation of a six-layer Geographic Information System (GIS) for a fifteen square-kilometre (15 km^2) areal extent of the Gidan Kwano Campus of the Federal University of Technology, Minna, Niger State, Nigeria. *Journal of Science, Technology, Mathematics, and Education (JOSTMED)*, 9(2), 75 - 89.

Jonah, S. A. & Olasehinde, P. I. (2015[c]). Interpretation of two-dimensional vertical electrical sounding data of a 4km^2 tranche of new development, Gidan Kwano Campus Phase II, Federal University of Technology, Minna, Nigeria. *Journal of Information, Education, Science, and Technology (JOSTMED) in Press.*

Jonah, S. A. & Olasehinde, P. I. (2015[d]). On the consistently low-resistivity regimes of the central to the southwest portions of a 4km^2 tranche of New Development, Gidan Kwano Campus Phase II, Federal University of Technology, Minna, Nigeria. *Journal of Information, Education, Science, and Technology (JOSTMED): In Press*

Jonah, S. A. & Olasehinde, P. I. (2015[e]). Correlation of dry season and wet season geoelectrical values for the ABEM Terrameter SAS 4000 at coincident points at the Planned Phase II Development, Gidan Kwano Campus, Federal University of Technology, Minna, Nigeria. *Journal of Information, Education, Science, and Technology (JIEST).* In Press.

Jonah, S. A., Baba, E. A., & Umoh, S. E. (2014[d]). Measurement of the levels of carbon monoxide concentrations at major stalling traffic points in Minna, Niger State, Nigeria. *Journal of Science, Technology, Mathematics, and Education (JOSTMED):* 10(1), 15 - 29.

Jonah, S. A., Baba-Kutigi A. N., Uno, U. E., Dangana, M. L., Kolo, M. T., Ofor, N. P., ... & Kimpa, M. I. (2011[a]). Spatial analysis and geographic information system (GIS) mapping of noise pollution in Bosso Local Government Council, Niger State, Nigeria. *Environmental Technology and Science Journal (ETSJ).* 4 (1), 4 – 19.

Jonah, S. A., Baba-Kutigi, A. N., Uno, U. E., Kolo, M. T., Okunlola, I. A., Unuevho, C. I., ... & Taufiq, S. (2011[b]). Measurements of environmental noise levels and the creation of a unique geographical information system (GIS) layer map for environmental noise pollution in Chanchaga Local Government Council, Minna, Niger State. *Journal of Science, Technology, Mathematics, and Education (JOSTMED)*, 8(1), 82 - 107.

Jonah, S. A., Baba-Kutigi, A. N., Uno, U. E., Kolo, M. T., Okunlola, I. A., Unuevho, C. I., ... & Taufiq, S. (2011[c]). Measurements of carbon monoxide concentrations and the creation of a unique Geographical Information System (GIS) layer map for carbon monoxide pollution in Minna, Niger State. *Journal of Science, Technology, Mathematics, and Education (JOSTMED)*, 7(3), 57 – 76.

Jonah, S. A., Dania, R., Ezemonye, C. V., Fanisi, O., Ejiga, U., Benu, I. S., Banjo, G. Pius, A., Akpan, E. U., Bakara, I. U., Tanimowo, B., Abdullahi, B., Nwachukwu, E. I., Maishanu, I. H., James, G. O., Okunola, I. A., Jimoh, M. O., Amadi, A. N. & Ejepu, J. S. (2013[d]). Mapping concentrations of carbon dioxide over Central Kubwa, Abuja, using Geographic Information System. *Journal of Science, Technology, Mathematics, and Education (JOSTMED)*, 10(1), 40 - 55.

Jonah, S. A., James, G. O., Adeku, D. E., Ahmed, F., Alhassan, A., Hamza, S., Igbideba, O. I., Kwaghhua, F. I., Kyari, M., Macaulay, V. F., Olarewaju, S. I., Onyeodili, G., Popoola, G. B., Sofeso, O. A., Switzer, F. K. & Umoh, U. E. (2013[b]). A survey for groundwater at a lot at the Dan Zaria Academic Estate, Federal University of Technology, Minna, Central Nigeria. *Journal of Science, Technology, Mathematics, and Education (JOSTMED)*, 9(3), 26 – 38.

Jonah, S. A., James, G. O., Adeku, D. E., Ahmed, F., Alhassan, A., Hamza, S., Igbideba, O. I., Kwaghhua, F.I., Kyari, M., Macaulay, V. F., Olarewaju, S.I., Onyeodili, G., Popoola, G. B., Sofeso, O. A., Switzer, F. K. & Umoh, U. E. (2014[f]). Pre-drilling geoelectrical survey at a built-up compound at Barkin-Sale Ward, Minna, Niger State, Nigeria. *Journal of Information, Education, Science, and Technology (JIEST)*, 1(2), 86 – 97.

Jonah, S. A., James, G. O., Adeku, D. E., Ahmed, F., Alhassan, A., Hamza, S., Igbideba, O. I., Kwaghhua, F. I., Kyari, M., Macaulay, V. F., Olarewaju, S. I., Onyeodili, G., Popoola, G. B., Sofeso, O. A., Switzer, F. K. & Umoh, U. E. (2014[i]). Geoelectrical investigation for aquifer and geotechnical properties at the planned Gidan Kwano Campus Development Phase II, Minna, Nigeria. *Journal of Science, Technology, Mathematics, and Education (JOSTMED)*, 11(2), 81 - 100.

Jonah, S. A., Jimoh, M. O. & Umar, M. (2014[k]). A wet-season geoelectrical investigation for groundwater development at a built-up property at the Western Bye-Pass, Minna, Nigeria. *Journal of Information, Education, Science, and Technology (JOSTMED),* 11(1), 109 - 117.

Jonah, S. A., Okoro, N. N., Umar, M., Bakara, I. U. & Umoh, S. E. (2014[e]). Geographic information system mapping of raw sewage discharge points in Minna, Niger State, Nigeria. *Journal of Science, Technology, Mathematics, and Education (JOSTMED),* 11(1), 36 - 48.

Jonah, S. A., Okunlola, I. A., Amadi, A. N., Baba-Kutigi, A. N. & Umar, M. O. (2011[d]). Investigation of nitrogen dioxide indices and the creation of a unique geographic information system (GIS) layer map for nitrogen dioxide pollution in Minna, Niger State. *Environmental Technology and Science Journal (ETSJ),* 4 (1), 74 – 82.

Jonah, S. A., Olasehinde, P. I. & Umar, M. (2014[j]). Evaluation of geomorphological quality control of geo-electrical data at Gidan Kwano Campus, Federal University of Technology, Minna, Central Nigeria. *Journal of Information, Education, Science, and Technology (JIEST),* 2(1), 122 –134.

Jonah, S. A., Olasehinde, P.I., Jimoh, M. O., Umar, M. & Yunana, T. (2015[b]). An intercalated dual geoelectrical survey of an earlier study for groundwater at the planned Gidan Kwano Campus Development Phase II, Federal University of Technology, Minna, Nigeria. *Journal of Information, Education, Science, and Technology (JOSTMED),* 11(2), 32 - 50.

Jonah, S. A., Umoh, S. E., James, G. O., Adeku, D. E., Ahmed, F., Alhassan, A., … & Umoh, U. E. (2014[g]). A blind geoelectrical survey commissioned to affirm or deny the presence of aquifer at a compound at Minna, Central Nigeria. *Journal of Information, Education, Science, and Technology (JIEST),* 1(2), 20 – 38.

Jonah, S. A., Umoh, S. E., James, G. O., Adeku, D. E., Ahmed, F., Alhassan, A., …… & Umoh, U. E. (2014[h]). A wetland lot geoelectrical investigation for groundwater development at Bosso Estate, Minna, Central Nigeria. *Journal of Information, Education, Science, and Technology (JIEST)*, 1(2), 158 –171.

Kearey, P. & Brooks, M. (1984). *An introduction to geophysical exploration*. Oxford: Blackwell Scientific Publications.

Parasnis, D.S. (1986). *Principles of applied geophysics (4ed.)*, Chapman and Hall, London.

INVESTIGATION OF CONTAMINATION PLUMES AT MECHANIC ROAD, BOSSO WASTE DISPOSAL SITE USING GEOPHYSICAL AND GEOCHEMICAL APPROACH

[1]RAFIU ABDULWAHEED ADEWUYI & [2]ABU MALLAM
[1]Physics Department, Federal University of Technology, Minna, Nigeria
[2]Phyics Department, University of Abuja, Abuja
E-mail: iyiolararafiu@futminna.edu.ng Phone No: +234-803-654-4246

Abstract
Geophysical survey involving electrical resistivity method, soil sampling analysis and hydro-chemical was conducted around Mechanic road dump site in Bosso, Minna, Niger State, Nigeria with the aim to assess the degree and extent of impact of the waste dump site on the quality of the groundwater in the study area.Thirty Vertical Electrical Sounding survey werecarried out in Mechanic road, Bosso, Booso local government area of Niger state. The schlumberger array with a maximum electrode spread of 80 m was employed in all the points.Results from the sounding data indicates that the area is generally underlain by three to four geoelectric sections which include top soil, Sandy clay, weathered basement, and Fresh basement. Based on theresult obtained the fractured and the weathered basement makes the aquiferous zone within the study area. The resistivities of these zones vary from 12.7 to 475.2 Ωm, while the thickness varies from a value of 0.9 to 7.8 m. Depth to this zone variesfrom 0.9 to 8.6 m.The result of water analysedin this area is found to be contaminated by Lead, Chromium and Cadmium with level of contamination exceeds WHO regulated guidelines.The results of soil analysed also indicated that the soils collected in this survey were contaminated by Cd, Ni, Pb, Zn and Cr.

Keyword: Cadmium, Contamination, Geophysicalleachate, Waste disposal, Winrest

Introduction
Solid wastes are generated by domestic, commercial and industrial activities. Various methods of disposing solid wastes include open dumps, wasteland – farms containment ponds, containment in rocks and deep underground injection (Ismail & Hashim, 2006). The practice of landfill systems as a method for waste disposal in many developing countries is usually far from standard recommendations (Mull, 2005; Adewole, 2005). Landfills are sources of groundwater and soil pollution due to the production of leachate and its migration through refuse (Christensen *et al.,* 1993). After some years, a dumpsite undergoes biologically, chemically, and hydrologically-mediated changes resulting in a weathering process of the refuse and, consequently, become a source of pollutants (Al Sabahi *et al.,* 2009). Open dump has been in practice in Niger state. Disposed solid wastes get decomposed and degraded forming open dump gas and leachate. Leachate is formed by both intrinsic solid wastes moisture and water infiltration into the dump site; its generation and composition depends on factors such as climatic factors, open dump operation practice and waste nature (Manon *et al*., 2011). Leachate presence from dump sites leads to contamination of groundwater in the vicinity of the dumpsite as it percolates into the ground and traverses with groundwater. The migration might involve simple advection which is the movement of contaminants in porous media along with flowing groundwater at the seepage velocity. It might also involve diffusion which is a molecular mass transport process in which solutes move from areas of higher concentration to areas of lower concentration. The use of electrical method in groundwater and landfill is unique (Adabanija & Ajabi, 2014; Ehirim & Ofor, 2011; Fasuwon *et al*., 2011; Popoola & Fakunle, 2011; Iyoha *et al.,*

2013). The aim of this study is to determine the extents of groundwater pollution for future groundwater exploitation in and around Mechanic road, Bosso, Minaa, Niger state, Nigeria.

Geology of the Study Area

Minna is situated in the central part of Nigeria basement complex, surrounded by rugged terrain f granitic rocks. Minna is located between longitudes 6.42^0E and 6.75^0 E and latitude 9.42^0 N and 9 8^0 N. Minna area comprises of metasedimentary and meta-igneous rocks which have undergone polyphase deformation and metamorphism (Alab1, 2011). These rocks have been intruded by granitic rocks of Pan-African age. Five lithostratigraphic units have been recognized in Minna area (Figure 1). The schist which occur as a flat laying narrow southwest-northeast belt at the central part of Minna with small quartzite ridge parallel to it, the gneiss occur as a small suites at the northern and southern part of the area forming a contact with the granite. Feldspathic rich pegmatite is bounded to the east, with average width of 65meters and 100 meters long, the pegmatite host tourmaline (Alabi, 2011). Granitic rocks dominate the rock types in the area and vary in texture and composition.

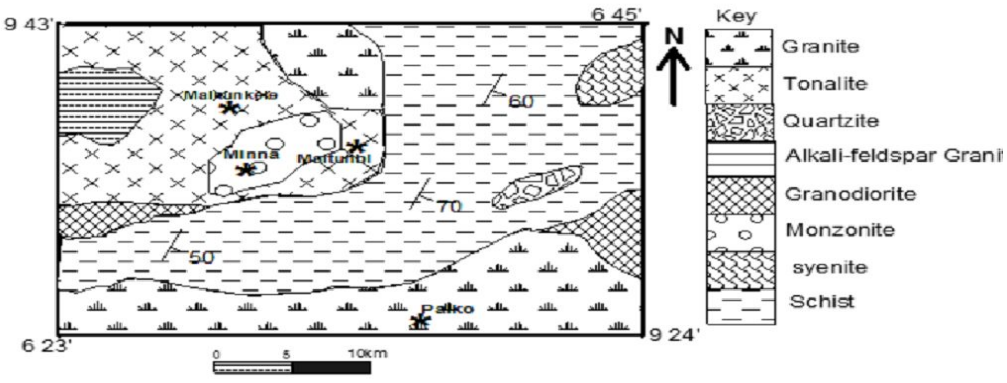


Figure 1: Geqologicaql map of Minna Area (modified after Alabi, 2011)

Material and Methods

The Schlumberger Configuration was used by applying current to the ground through two electrodes (A and B) and then measuring the resultant potential difference (V) between the potentials M and N. The centre point of the electrode array remains fixed but the spacing's of the electrodes was increased so as to obtain the information about the stratification of the ground. The schlumberger data are often taken in overlapping segment because at each step of AB spacing, the signals of the resistivity meter become weaker. Therefore, MN spacing was enlarged and two values for the same AB/2 were measured, one for the long MN spacing's. The schlumberger configuration was employed not only because it is faster and less likely to be influenced by lateral model and it requires a fewer number of field personnel as the only the current electrode A and B requires changes. A total of thirty VES points were engaged, twenty four of these were acquired around the refuse dump and six at an area free from refuse. Electrode spacing's AB/2 of 80 m wasused along the transverse. Data were acquired using surface geophysical equipment SAS 4000 terrameter set. Apparent resistivity values were determined by taking the product of the resistance as measured by the terrameter and the

geometrical factor a parameter which is dependent on the potential and the current electrode spacing's. The data obtained was later subjected to computer assisted iterative interpretation using Winrest software. This programme was used to perform quantitative analysis and interpretation of the field curves. The starting model and its corresponding resistivity are transformed, refined or modified by the programme to obtain a best fit relation to thefield data. The method of iteration was performed untilfitting error between field data and synthetic model curve becomes least and constant. Thus, the software yields the number, thickness and resistivity of the various layers.

Hydro-chemical Analysis

To carry out a comprehensive pollution assessment of the study area, hydro-chemical analysis of water samples collected from three hand dug wells around the dump site were carried out. The sampling wells were designated Well A, Well B and Well C and other Well 200 m away from refuse dump to serve as control. The physico-chemical parameters that are indicative of groundwater pollution such as Total dissolved Solid, Chloride, Nitrate, Sulphate, Lead, Iron, Calcium, Magnesium and Sodium were analyzed. Thecationsconcentrations were determined using Atomic Absorption Spectrophotometer (AAS). The results of the hydrochemical analysis of the groundwater samples from the study area are presented under results and discussion.

Soil Chemical Analysis

Chemical analysis was done on the soil samples collected close to and away from the dump site. The preliminary assessment of the extent of pollution with respect toexchangeable metals were carried out, using X-ray fluorescence. Soil samples from ninesampling points were obtained and analyzed for theirelemental concentrations. The sample points were designated as MR1 to MR6 with each sampling point separated by 10 m and MRC1 to MRC3 to serve as the controlpoints and was at a distance of 200 m away from MR6. The results of the chemical analysis are tabulated and presented under results and discussion.

Results and Discussion

Tables 1 to 6 show the VES results from Mechanic road refuse site for both dry and wet seasons as well as control site.

Table 1: General VES results from Profile A during dry season at the Mechanic Road refuse dump

VES NO	Number of resistivities **of layers(Ωm)**				**Thickness of layers(m)**				**Depth to bottom layers(m)**			
	ρ_1	ρ_2	ρ_3	ρ_4	t_1	t_2	t_3	t_4	d_1	d_2	d_3	d_4
1	26.5	12.6	6339.9		1.2	1.6	--		1.2	2.8	--	
2	29.3	17.4	6261.7		0.9	2.4	--		0.9	3.3	–	
3	6.0	15.1	5098.2		1.8	1.7			1.8	3.5	--	
4	27.7	17.1	5464.3		0.9	2.5	--		0.9	3.4	--	
5	25.3	18.3	5463.8		1.0	2.6	--		1.0	3.6	--	
6	24.1	18.2	5656.7		1.0	2.5	--		1.0	3.6	--	
7	25.7	19.4	5532.4		1.1	2.7	--		1.1	3.8	--	
8	28.4	18.1	5403.4		1.0	2.7	--		1.0	3.6	--	

The VES curves in this profile are characterised to be a three layer model. All VES curves for this profile are type H curves with configuration $\rho_1 > \rho_2 < \rho_3 = H$. The resistivity values for the first layer range between 24.1 Ωm and 29.3 Ωm, while the corresponding thickness range between 0.9m to 1.8 m and the corresponding depth also range between 0.9 m to 1.8 m. The lowest

resistivity is at VES6 and the highest at VES2. The resistivity values for the second layer range between 12.6 Ωm and 19.4 Ωm. The lowest resistivity is at VES7 and the highest is at VES1. The third layer resistivity range between 5098.2 Ωmand6339.9 Ωm. All the VES have cumulative depth that range between 2.8m and 3.8 m. All the VES in this profile could be contaminated because they are characterised with low resistivity ranging between 12.6 Ωm and 29.3 Ωm. The third layer with high resistivity ranging between 5098.2Ωmand6339.9 Ωm indicated fresh basement (Ehirim & Ofor, 2011) which is very shallow and therefore the underground water might be contaminated.

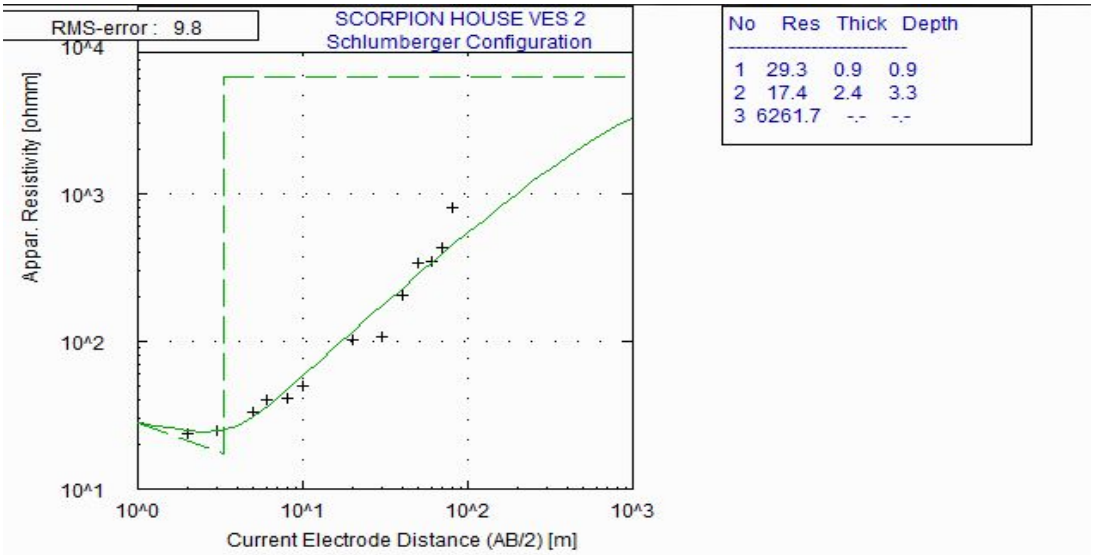


Figure 2: Typical VES curve along profile A during the dry season

Table 2: General VES results from Profile B during dry season at the Mechanic Road refuse dump

VES NO	Number of ressitivities of layers(Ωm)			Thickness of layers(m)			Depth to bottom layers(m)		
	ρ_1	ρ_2	ρ_3	t_1	t_2	t_3	d_1	d_2	d_3
1	31.7	253.1	1037.1	0.8	5.5	--	0.8	6.3	--
2	30.8	230.3	1638.9	0.8	5.8	--	0.8	6.6	–
3	31.6	255.5	1379.6	0.9	4.7		0.9	5.5	--
4	30.5	231.2	1640.2	0.8	5.6	--	0.8	6.4	--
5	30.4	251.1	2376.4	0.7	5.9	--	0.7	6.6	--
6	29.1	264.7	4407.3	0.7	6.8	--	0.7	7.5	--
7	28.9	235.9	1823.8	0.7	6.0	--	0.7	6.7	--
8	28.1	246.9	3517.7	0.6	7.8	--	0.7	8.5	--

The VES curves in this profile are characterised to be a three layer model. All the VES curves for this profile are A type curves with configuration $\rho_1 < \rho_2 < \rho_3$ =A. The resistivity values for the first layer range between 28.1 Ωm and 31.7 Ωm, while, the corresponding thickness range between 0.6m to 0.9m and the corresponding depth also range between 0.7 m to 0.9 m. The lowest resistivity is at VES8 and the highest at VES1. The resistivity values for the second layer range between 230.3 Ωm and 264.7 Ωm. The lowest resistivity is at VES4 and the highest is at VES6. The third layer resistivity values range between 1037.1 Ωm and 4407.3 Ωm. All the VES have cumulative depth that range between 5.5m and 8.5 m. The second layer resistivity value

is corresponding to sand/gravel (Fasuwon *et al.*, 2011) which is porous as a result of this; the leachate noticed at top layer will percolate in to the groundwater thereby contaminate it.

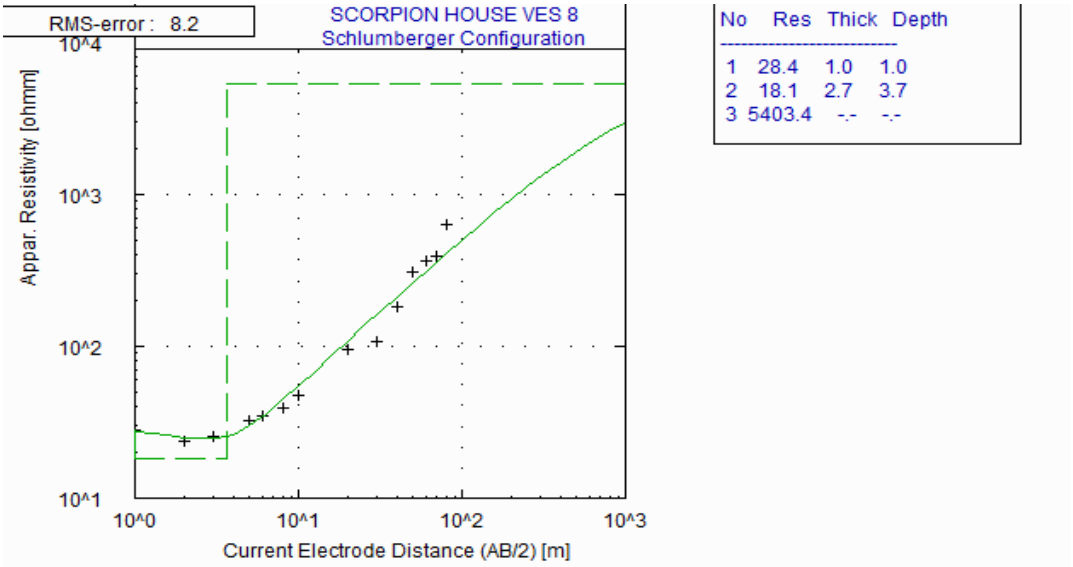


Figure 3: Typical VES curve along profile B during the dry season

Table 3: General VES results from Control site during dry season at the mechanic road refuse dump

VES NO	Number of ressitivities of layers(Ωm)				Thickness of layers(m)				Depth to bottom layers(m)			
	ρ_1	ρ_2	ρ_3	ρ_4	t_1	t_2	t_3	t_4	d_1	d_2	d_3	d_4
1	127.5	164.5	31.0	18022.7	0.7	0.7	2.6	--	0.7	1.5	4.0	--
2	127.7	147.2	28.6	17490.2	0.8	0.7	2.5	--	0.8	1.5	4.0	--
3	137.1	30.1	18577.5		1.9	2.0	--		1.9	4.0	--	
4	123.5	164.9	39.0	17615.6	0.8	0.8	2.9	--	0.8	1.6	4.5	--

The VES curves in this profile also have been delineated to be a three and four layer model. VES curves 1, 2 and 4 for this profile are HA type curves with configuration $\rho_1 > \rho_2 < \rho_3 < \rho_4 = H$ and VES curve 3 with configuration $\rho_1 > \rho_2 < \rho_3 = H$ curve. The resistivity values for the first layer range between 123.5 Ωm and 137.1 Ωm, while the corresponding thickness range between 0.7 m to 1.9 m and the corresponding depth also range between 0.7 m to 1.9 m. The lowest resistivity is at VES4 and the highest at VES3. The resistivity values for the second layer range between 30.1 Ωm and 164.9 Ωm. The third layer resistivity values range between 28.6 Ωm and 39.8 Ωm. The corresponding thickness and depths for the third layer range between 2.5 m and 2.9 m. The lowest resistivity is at VES2 and the highest at VES4. The resistivity values for the fourth layer range between 17490.2 Ωm and 18577.5 Ωm. All the VES have cumulative depth that range between 4m and 4.5 m. All the VES points in this profile are shallow as seen in the hand dug wells within the vicinity of the refuse dump. The topsoil in this profile correspond to sand and is free of leachate thus the groundwater might not be contaminated and low resistivity observed at the third layer may indicate aquifer zone (Alabi *et al.*, 2010).

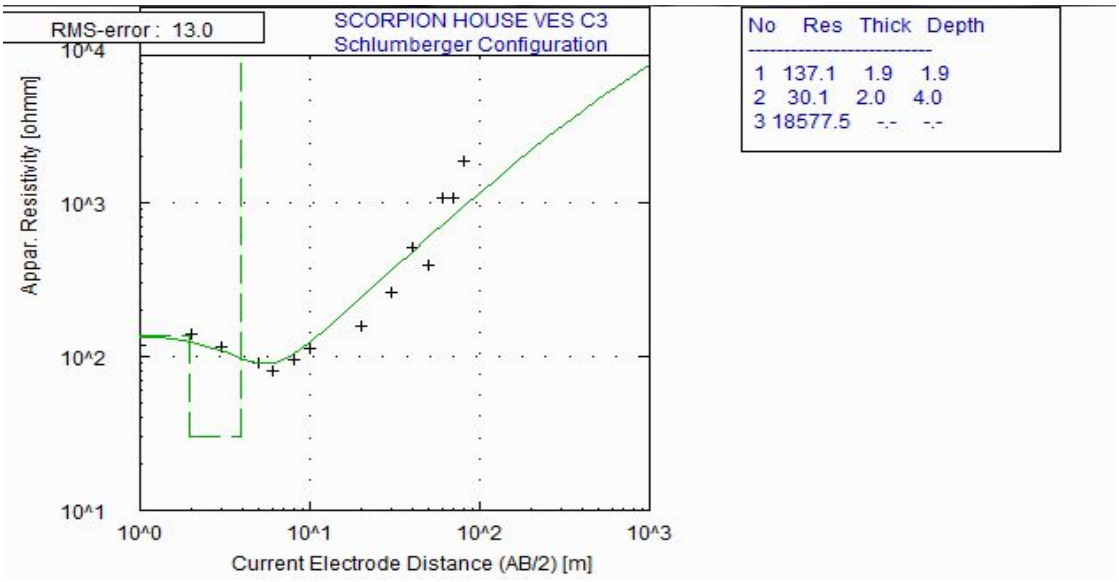


Figure 4: Typical VES curve along profile C during the dry season

Table 4: General VES results from Profile A during wet season at the Mechanic Road refuse dump

VES NO	Number of ressitivities of layers(Ωm)				Thickness of layers(m)				Depth to bottom layers(m)			
	ρ_1	ρ_2	ρ_3	ρ_4	t_1	t_2	t_3	t_4	d_1	d_2	d_3	d_4
1	23.7	12.8	421.6	5883.8	1.3	1.5	6.8	--	1.3	2.9	9.7	--
2	23.3	12.9	382.4	5853.0	1.4	1.6	6.7	--	1.4	2.9	9.7	--
3	23.3	12.8	384.7	5765.9	1.3	1.6	6.8	--	1.3	2.9	9.7	--
4	23.5	12.8	411.4	5782.9	1.3	1.5	9.8	--	1.3	1.5	9.8	--

The VES curves in this profile also have been delineated to be a four layer model. VES curves 1 to 4 for this profile are AH type curves with configuration $\rho 1 < \rho_2 > \rho_3 = K$ and $\rho_1 > \rho_2 < \rho_3 = H$ which equal $\rho_1 > \rho_2 < \rho_3 > \rho_4 = HK$ curve (Adeoti *et al.*, 2012). The resistivity values for the first layer range between 23.3 Ωm and 23.7 Ωm, while the corresponding thickness range between 1.3m to 1.4 m and the corresponding depth also range between 1.3 m to 1.4 m. The lowest resistivity is at VES2 and VES3 and the highest at VES1. The resistivity values for the second layer range between 12.8 Ωm and 12.9 Ωm. The third layer resistivity values range between 382.4Ωmand421.6Ωm. The corresponding thickness and depths for the third layer range between 6.7m and 9.8m. The lowest resistivity is at VES2 and the highest at VES1. The resistivity values for the fourth layer range between 5765.9 Ωm and 5883.8 Ωm. All the VES have cumulative depth that range between 6.7 m and 9.8 m. All the VES points in this profile have low resistivity which indicates leachate (Adabanija and Ajabi, 2014) to the second layer and this could pollute the groundwater within the vicinity of the refuse dump not more than 3 m.

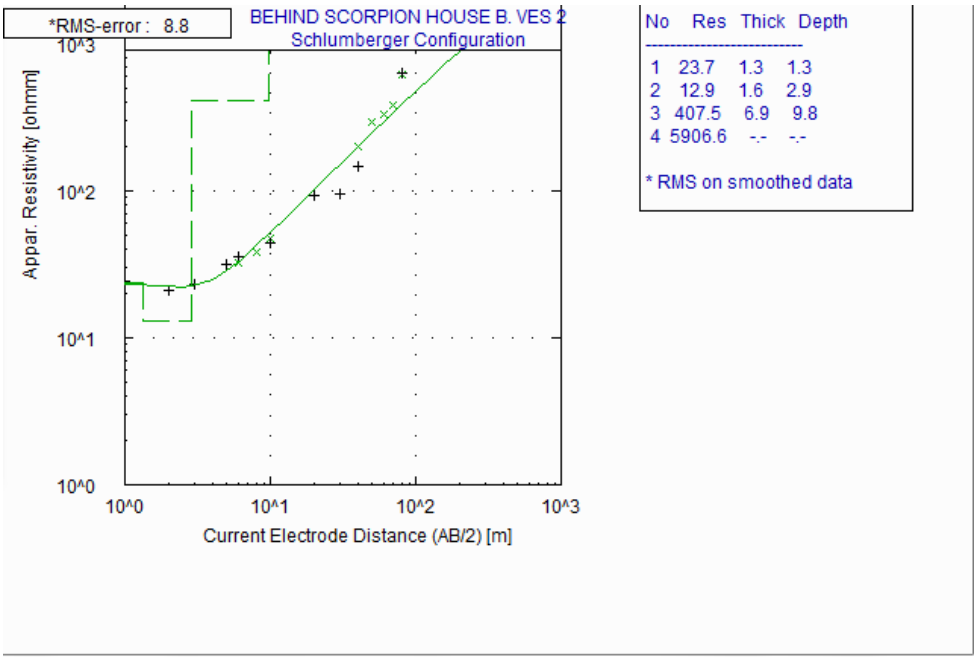


Figure 5: Typical VES curve along profile A during the wet season

Table 5: General VES results from Profile B during wet season at the Mechanic Road refuse dump

VES NO	Number of ressitivities of layers(Ωm)				Thickness of layers(m)				Depth to bottom layers(m)			
	ρ_1	ρ_2	ρ_3	ρ_4	t_1	t_2	t_3	t_4	d_1	d_2	d_3	d_4
1	23.9	13.2	447.7	5965.4	1.3	1.5	6.9	--	1.3	2.9	9.8	--
2	23.7	12.9	407.5	5906.6	1.3	1.6	6.9	--	1.3	2.9	9.8	--
3	24.1	12.7	475.2	6012.1	1.3	1.5	6.9	--	1.3	2.8	9.7	--
4	23.5	12.5	377.8	5772.8	1.3	1.6	6.8	--	1.3	2.9	9.7	--

The VES curves in this profile also have been delineated to be a four layer model. VES curves 1 to 4 for this profile are AH type curves with configuration $\rho 1 < \rho_2 > \rho_3 = K$ and $\rho_1 > \rho_2 < \rho_3 = H$ which equal $\rho_1 > \rho_2 < \rho_3 > \rho_4 = HK$ curve. The resistivity values for the first layer range between 23.5 Ωm and 24.1 Ωm, while the corresponding thickness for all the VES points is 1.3 m and the corresponding depth also is 1.3 m.The lowest resistivity is at VES4 and the highest at VES3. The resistivity values for the second layer range between 12.5 Ωm and 13.2 Ωm. The third layer resistivity values range between 377.8 Ωm and475.2 Ωm. The corresponding thickness and depths for the third layer range between 6.8 m and 6.9 m. The lowest resistivity is at VES4 and the highest at VES3. The resistivity values for the fourth layer range between 5772.8 Ωm and 6012.1 Ωm. All the VES have cumulative depth that range between 9.7 m and 9.8 m. All the VES points in this profile have low resistivity which indicates leachate to the second layer and this might pollute (Popoola and Fahunle, 2011) the ground water within the vicinity of the refuse dump up to 3 m.

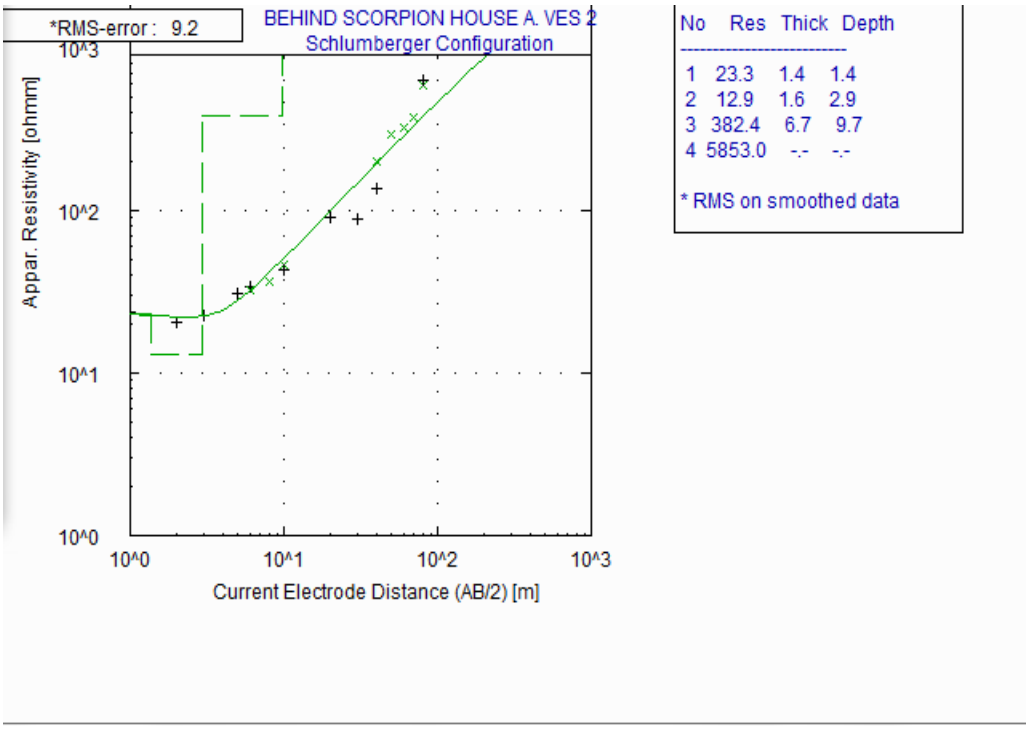


Figure 6: Typical VES curve along profile A during the wet season

Table 6: General VES results from Control site during wet season at the Mechanic Road refuse dump

VES NO	Number of ressitivities of **layers(Ωm)**				**Thickness of layers(m)**				**Depth to bottom layers(m)**			
	ρ_1	ρ_2	ρ_3	ρ_4	t_1	t_2	t_3	t_4	d_1	d_2	d_3	d_4
1	127.0	114.0	24.4	14861.0	0.8	0.7	2.9	--	0.8	1.5	4.4	---
2	127.9	112.5	24.9	14987.3	0.9	0.7	2.9	--	0.9	1.5	4.4	--

The VES curves in this profile also have been delineated to be a four layer model. VES curves 1 and 2 for this profile are QH type curves with configuration $\rho 1 > \rho_2 > \rho_3$ = Q and $\rho_1 > \rho_2 < \rho_3$ =H which equal $\rho_1 > \rho_2 > \rho_3 < \rho_4$ = QH curve. The resistivity values for the first layer range between 127.0 Ωm and 127.9 Ωm, while the corresponding thickness range between 0.8 m to 0.9 m and the corresponding depth also range between 0.8m to 0.9 m. The lowest resistivity is at VES1 and the highest at VES2. The resistivity values for the second layer range between 112.5 Ωm and 114.0 Ωm, while the corresponding thickness for both VES points is 0.7 m and the corresponding depth is also 1.5m. The lowest resistivity is at VES and the highest at VES1. The third layer resistivity values range between 24.4 Ωmand24.9 Ωm, while the corresponding thickness for both VES points is 2.9 m and the corresponding depth is also 4.4 m. The lowest resistivity is at VES1 and the highest at VES2. The resistivity values for the fourth layer range between 14861.0 Ωm and 14897.3 Ωm. Both VES have cumulative depth 4.4 m.The groundwater in this area is free from pollutant as the topsoil is made of thin layer while the second layer and the layer are made of clay soil. All the VES points in this profile are shallow as seen in the hand dug wells within the vicinity of the refuse dump.

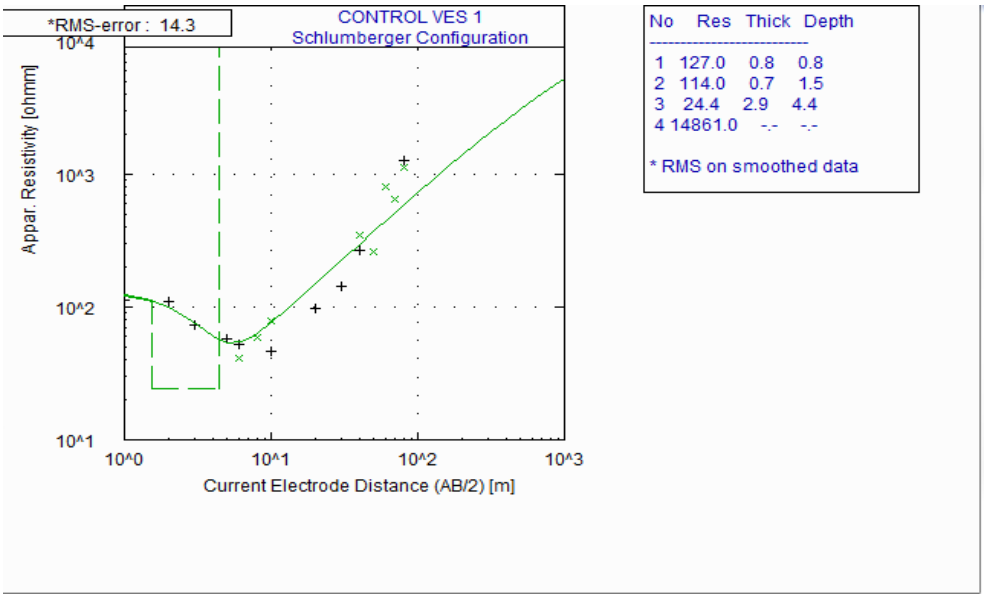


Figure 7: Typical VES curve along profile A during the wet season

The temperature for the groundwater in the study area ranged between 22.1 ^{O}C and 22.7 ^{O}C which is below WHO limits and the control well has a temperature of 28.3 ^{O}C. The Groundwater pH value for Mechanic Road wells averaged 7.53, while pH value for control well is 7.72. The pH values for both wells as well as control well meet the WHO standard. The value of alkalinity for wells A and B are above WHO limits, while the value for Well C is within allowable limits. The Total Dissolve Solid and Total Hardness are lower than WHO allowable limit. Water in this area is found to be contaminated by Lead, Chromium and Cadmium with level of contamination exceeds WHO regulated guidelines, this is similarly to work of Jegede e*t al.,* 2011.

Table 7: Physico-Chemical Analysis of Hand Dug Wells in Mechanic Road refuse dump, Minna

Parameter	Unit	Well A	Well B	Well C	Control Well	WHO
Temp	^{O}C	22.1	22.7	22.4	28.3	35-40
pH		7.52	7.52	7.54	7.72	6.5-9.2
Conductivity	µS/cm	740	741	809	92	100
Alkalinity	mg/l	500	380	180	100	200
Acidity	mg/l	38	30	26	42	NA
TDS	mg/l	1000	1119	1476	486	500-550
Total Hardness	mg/l	66	58	64	53	500
Zinc	mg/l	0.085	0.577	0.085	0.003	3.0
Lead	mg/l	0.923	0.769	0.823	0.104	0.001
Manganese	mg/l	0.157	0.229	0.229	0.004	0.5
Iron	mg/l	0.676	0.834	0.534	0.024	0.3
Copper	mg/l	0.250	0.100	0.300	0.000	2.0
Chromium	mg/l	1.250	1.400	0.860	0.000	0.05
Nickel	mg/l	0.036	0.029	0.100	0.000	NA
Cobalt	mg/l	0.010	0.029	0.035	0.000	NA
Cadmium	mg/l	0.0364	0.061	0.064	0.001	0.003

The heavy metals investigated in this study include: Zinc, Lead, Manganese, Iron, Copper, Chromium, Nickel, Cobalt and Cadmium. Based on the results obtained, there was a gradual decrease in the concentration of heavy metals from the centre of the dumpsite to the bottom of the slope. In most cases from locations (1 - 6), there was a significant difference between the concentrations of most metals at the centre of the dumpsite to the bottom of the slope. The variation in different parameters values in this study may be attributed to the fluctuations in waste type and characteristics (Abd El-Salam & Abu-Zuid, 2014).

Researches carried out by Udeme (2001) and Akaeze (2001) for soils along Aba-Ikot Ekpene road in Uyo metropolis (AkwaIbom State, Nigeria) at different sample locations revealed results that are comparable to those obtained in this study.The results indicated that the soils collected in this survey were contaminated by Cd, Ni, Pb, Zn and Cr.

Table 8: Physico-Chemical Analysis of Soil Samples in Mechanic Road refuse dump

Location	pH	Zn (mg/kg)	Pb (mg/kg)	Mn (mg/kg)	Fe (mg/kg)	Cu (mg/kg)	Cr (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg
MR1	6.56	6.81	38.46	29.29	6.76	50.00	12.50	30.00	8.57	0.93
MR2	6.69	5.52	28.85	21.44	5.07	42.00	10.50	25.00	5.7143	0.74
MR3	6.92	4.88	19.62	16.73	4.38	37.50	8.33	20.00	4.29	0.63
MR4	6.81	4.24	14.64	11.43	3.77	28.50	6.27	15.00	3.53	0.48
MR5	6.66	3.60	9.62	7.86	2.86	18.00	4.16	10.00	2.86	0.33
MR6	6.82	2.96	6.57	4.29	1.69	12.50	2.08	5.00	1.43	0.18
Min	6.52	2.96	6.57	4.29	1.69	12.50	2.08	5.00	1.43	0.18
Max	6.92	6.81	38.46	29.29	6.76	50.00	12.50	30.00	8.57	0.94
Mean	6.74	4.67	19.63	15.17	4.09	31.42	7.32	1.75	4.40	0.55
S.D	0.13	1.3883	12.14	9.24	1.76	14.43	39.11	9.35	2.49	0.49
MRC1	6.18	1.5990	0.00	3.85	1.47	4.00	2.83	0.00	1.43	0.03
MRC2	6.21	1.84	0.00	5.83	1.19	0.70	0.00	0.00	1.43	0.07
MRC3	6.27	1.64	9.62	2.97	0.00	0.00	5.86	0.00	0.00	0.18
Min	6.18	1.60	0.00	2.97	0.00	0.00	0.00	0.00	0.00	0.03
Max	6.27	1.84	9.62	5.83	1.47	4.00	5.86	0.00	1.43	0.18
Mean	6.22	1.69	3.21	4.22	0.89	1.57	2.90	0.00	0.95	0.09
S.D	0.05	0.13	5.55	1.46	0.78	2.14	2.93	0.00	0.828	0.08

MR: Mechanic Road, MRC: Mechanic Road Control

Conclusion

Results from the sounding data indicates that the area is generally underlain by three to four geoelectric sections. Based on theresult obtained the fractured and the weathered basement makes the aquiferous zone within the study area. The resistivities of these zones varies from 12.7 to 475.2 Ωm, while the thickness varies from a value of 0.9 to 7.8 m. The formation do not show good aquifer protective capacity, thereby, they are vulnerable to any near surface pollution. The hyeogeologic features of the site showed that contaminants from the refuse disposal infiltrate through the permeable soil in to the vulnerable aquifers. This implies that the soil and groundwater might have been contaminated to a depth not less than 8.6 m. The result of water analysedin this area is found to be contaminated by Lead, Chromium and Cadmium with level of contamination exceeds WHO regulated guidelines.The results of soil analysed also indicated that the soils collected in this survey were contaminated by Cd, Ni, Pb, Zn and Cr.

References

Abd El- Salam, M. M. & Abu-Zuid, G. I. (2014). Impact of landfill leachate on the groundwater quality: A case study in Egypt. *Journal of Advanced Research.* In press.

Adabanija, M. A. & Alabi, T. A. (2014). An integrated approach to mapping the concentration and pathway of leachathe plumes beneath a dump South-west in Nigeria. *International Journal of Scientific and Engineering Research, 5(1).*

AdeotiL, A. O. M., Uchegbulam, O. & Adegbola, R. B. (2012), Geoelectrical Investigation of the GroundwaterPotential in Mowe, Ogun State, Nigeria. *British Journal of Applied Science & Technology, 2(1), 58 - 71,* SCIENCEDOMAIN *international* www.sciencedomain.org

Akaeze, C. S. (2001). *Solid waste analysis, characterization and management along Abak/Ikot Ekpene roads of Uyo metropolis.* A research project, Dept. Chem. Biochem. Univ. Uyo. Nigeria.

Alabi, A . A., Bello, R., Ogungbe, A. S. & Oyerinde, H. O. (2010). Determination of groundwater potential in Lagos State University, Ojo; Using geoelectric methods (vertical electrical sounding and horizontal profiling). *Report and Opinion; 2(5).*

Bear, J. & Verruijt, A. (1992). *Modelling groundwater flow and pollution*. D. Reidel publishing company, Dordrecht Ed. 247 – 300

Ehirim, C. N. & Ofor, W. (2011). Assessing aquifer vulnerability to contaminants near solid waste landfill sites in a coastal environment, Port-Harcourt, Nigeria, *Trends in Applied Sciences Research,* 6 (2).

Fasunwon, O. O., Jaiyeola, G. B. & Adesugba, F. F. (2010). Impacts of a dumpsite on the neibourhood of a part of Southwestern Nigeria. *Research Journal of Agricultere and Biological Sciences,* 6(3).

Ikem, A., Osibanjo, O., Sridhar, M. K. C. & Sobande, A. (2002). Evaluation of groundwater quality characteristics near two waste sites in Ibadan and Lagos, Nigeria. *Water, Air, and Soil Pollution*, 140.

Ismail, Z. & Hashim, R. (2006). Seepage of contaminants from waste containment. *Journal of Environmental Hydrology, 14, 2.*

Iyoha, A., Akhirevbulu, O. E., Amadasun, C. V. O. & Evbumwan, I. A. (2013). 2D resistivity imaging investigation of solid waste landfill sites in Ikhueniro Municipality, Ikpoba Okha Local Government Area, Edo State. *Journal of Resources Development and Management,* 1.

Marcovecchio, J. E., Botte, S. E. & Freije, R. H. (2007). Heavy metals, major metals, trace elements. In L. M. Nollet: *Handbook of water analysis, 2nd Ed*. London: CRC Press, p. 275-311.

Popoola, I. O. & Fakunle, M. A. (2011). Investigation of leachate migration from major public refuse dump site (Ajakanga) in Ibadan, Nigeria. *Nigerian Journal of Physics (NJP),* 22 (1).

Udeme, A. E. (2001). *Solid waste analysis and characterization.* Department of Chemistry, University of Uyo.

Vodela, J. K., Renden, J. A., Lenz, S. D., Mcelhenney, W. H. & Kemppainen, B. W. (1997). Drinking water contaminants*. Poultry Science*, 76.

INVESTIGATION OF THE PHYTOCHEMICAL AND NUTRITIONAL POTENTIALS OF LOCALLY PREPARED AQUEOUS EXTRACT OF *SORGHUM VULGARE'S* STALK

[1]SALAU, RASAQ BOLAKALE, [2]AMINU MUHAMMAD, [1]BISIRIYU, M. T., [1]MOMOH, B. A.
[2]BISHIR USMAN & [3]AHMED SALISU
[1]Department of Chemistry, Federal University of Technology, P.M.B 65, Minna, Nigeria
[2]Department of Pure and Industrial Chemistry, Bayero University, Kano, Nigeria
[3]Department of chemistry, Umar Musa Yar'adua University, Katsina, Nigeria
E-mail: rasaqsalau@futminna.edu.ng Phone No: +234-905-349-1924

Abstract
Sorghum vulgare is a beneficial plant whose stalks are still under-explored. The need to examine its nutritional and medicinal values becomes critical as its stalk decoctions are becoming widespread local drink preparations. Samples of sorghum (guinea corn) were obtained from six selected farm lands in Minna, North central zone of Nigeria. They were dried, finely grounded and kept as both whole and extract samples. Extraction by decoction method was used. Proximate composition and elemental determinations were carried out on both sample types. Phytochemical screening were also carried out on only aqueous extract which is the only form in which the local drinks are prepared and consumed. The proximate shows prominent contents of ash, crude fibre, crude fat and carbohydrate values of whole and extract samples value which are (3.00%, 15%), (36.47%, Nil), (16.00%, 11.50%), (32.41%, 73.05%) respectively. Similarly the mean load of major essential elements: (Ca, Na, K and Mg) in mg/100g of the two forms showed (24.50, 40.30), (23.30, 15.70), (212.20, 142.90) and (14.00, 13.30). The mean load of trace essential elements: Fe, Zn, Mn and Cu gives (52.00, 25.00), (5.10, 5.60), (2.80, 2.70), and (0.70, 0.30) respectively. The aqeous extract showed prominent presence of alkaloid, cardiac glycoside, tannins and saponins while flavonoid was moderately present. The overall studies show that sorghum stalk possibly is not only capable of supplying nutrients but also could be a potential part of medicinal therapeutic formations.

Keywords: *Sorghum vulgare, nutritional, medicinal, decoction, phytochemical*

Introduction
Sorghum vulgare is commonly known as guinea corn plant. It is an economic crop because of the utility of all parts of the plant. Its grain is ranked the fifth position as the most cultivated cereal all over the world apart from wheat, rice maize and barley (Ghasemi *et al*., 2012). The record by FAO (2015) shows the production of sorghum is on rapid increase within the decade in Africa as at 2015. Sorghum is widely cultivated in West African sub-region.

The stalk of *sorghum vulgare*, locally called *'poporo'* in south west part of Nigeria, when soaked in hot water yields an extract that has been used as food as well as colorant (Ayub *et al*, 2010). It is also taken as refreshing and medicinal drink. Previous study of sorghum plant carried out by Sonon and Bolsen (1996) revealed the presence of nutrients in sorghum plant as food additive or drink in extracted form. Similarly, the medicinal potential of any part of sorghum can be deduced from the result of extensive phytochemical studies of the entire plant as observed by Lewington (1990), Sofowora (1993), Muhammad and Amusa (2005) and Nydia *et al*. (2013). Their overall findings, buttressed the presence of some phytochemicals such as alkaloids, saponins and tannins in different parts of the sorghum plant.

The fact that sorghum stalk is largely available and widely used in food and as indigenous medicament and herbal remedies makes the evaluation of the nutrient and chemical content worth studying. The two local modes by which sorghum stalk is analyzed are the solid particles (ground whole stalk of the plant) and liquid (hot water extract from soaked plant stalk). This study evaluated comparatively, the water extract of the sorghum stalk which is the mode in which the plant is actually consumed and the whole sorghum stalk powder for their nutritional and phytochemical contents.

Materials and Methods

Collection and Preparation of Sample

The sorghum stalks were collected from six different farms situated around Chanchaga and Dutsen Kura in Minna, Niger state, North Central zone of Nigeria. The samples were obtained within June and July of the year. The Chemistry laboratory of the Federal University of Technology, Minna, Niger State of Nigeria was used for the laboratory practical. The collected samples were chopped into smaller bits by stainless steel knife and weighed. The chopped samples were put in crucibles and covered by perforated aluminum foil and transferred to oven for drying at 110^0C for 72 hours. The samples were weighed at different intervals until constant weight are obtained. The final weights were taken. The dried stalks were blended in an electric blender until dry fine particles were obtained. The powdered samples were then put in a transparent nylon, labeled and kept for further use. Decoction method was used for extraction. The liquid extract of each of the sample was prepared by boiling 20g of the fine samples in 200 cm^3 of distilled water for 30 minutes and allowed to steep for 24 hours. The aqueous extracts were then filtered to obtain extracts which were labeled and used for further analyses.

Proximate Analysis of Sample

The proximate composition analysis was done to estimate the ash, protein, crude fat, fibre, and carbohydrate of the samples. The moisture content was not done on the aqueous extracts due to their infinitum water content. The crude fat content was obtained using soxhlet apparatus and extracting with petroleum ether (boiling point 60-90 ^{0}C) based on the recommendation in (Method 945.16) of Association of Official Analytical Chemists' methods (AOAC, 2005). Determination of the nitrogen content was done by micro Kjeldahl method as described by Pearson (1976). The protein contents were obtained by the conversion from nitrogen content (Pearson, 1976) which was multiplied by a factor of 6.25. Carbohydrate was determined by difference of the sum of other compositions from whole percentage. The moisture, ash and fibre content determinations were carried out (method 985.29) of the Association of Official Analytical Chemists' methods (AOAC, 2005).

Digestion of Sample for Mineral Analysis

Wet acid digestion procedure was followed in digesting the samples. 2.00g of each of the dried samples and 10.00g of aqueous extract were separately weighed into beakers. 5cm^3 of perchloric acid was added followed by 20cm^3 of nitric acid. A few glass beads was added as anti-bumping agents. The mixture was heated on a hot plate at a temperature range of 120^0C to 200^0C. The mixture was swirled with occasional addition of 5cm^3 of nitric acid until a clear digest solution was obtained. The mixture was allowed to cool and was filtered through acid wash filter paper into a 100cm^3 volumetric flask and made up to the mark. The filtrate was transferred into a polyethylene container temporarily before subsequent determination of the mineral contents.

Instrumental Determination of Minerals

Atomic absorption Spectrophotometer (BUCK scientific ACCUSYS 211 model no210 VGP) was used to determine Calcium, Zinc, Magnesium, Manganese, Copper and Iron. Flame photometer (model JENWAY PFP7) was used to determine the concentration of Potassium and Sodium in the samples.

Qualitative Phytochemical Examination

The aqueous extracts of the sorghum stalk was subjected to the following standard tests as described in Amadi *et al*. (2004):

Alkaloids

Mayer's / Hager's test: 2 cm^3 of each water extract of sorghum stalk was hydrolysed with hydrochloric acid, filtered and divided into two portions. The first portion was treated with 1cm^3 of a Potassium Mercuric Iodide (Mayer's reagent) in water-bath, while the second portion was reacted with saturated picric acid solution (Hager's reagent). The developments of yellow precipitates in both tests indicate positive result for alkaloids.

Flavonoids

NaOH, Lead acetate: Few drops of sodium hydroxide was added to 5 cm^3 of each of the sorghum extracts. Hydrochloric acid was then added to acidify and hence, yellow precipitate disappeared to give clear the coloration that indicated positive result for flavonoids.

Shinoda test: Lead Acetate Test was performed by treating the water extracts of the sodium stalk with few drops of lead acetate solution. Yellow precipitate was formed. Magnesium ribbon was dropped in another 5 cm^3 portion of the water extract of sorghum stalk followed by drop-wise addition of hydrochloric acid. The yellow precipitate turned to red colour to indicate a positive result for flavonoid.

Carbohydrates

Molisch's test : 5 cm^3 of distilled water was added to the water extract of sorghum stalk and then filtered. Two drops of alcoholic α- naphthol solution was then added. Violet ring was formed at the junction to indicate positive result for carbohydrate.

Benedict's test: 5 cm^3 of distilled water was added to the water extract of sorghum stalk and then filtered. Few drops of Benedict's reagent were then added. Orange red precipitate appeared to indicate positive result for sugar.

Fehling test: 5 cm^3 of distilled water was added to the water extract of sorghum stalk and then filtered. Few drops of Fehling's reagent were then added to indicate positive result for reducing sugar.

Cardiac glycosides

Ferric Chloride test: 3 cm^3 of dissolved $FeCl_3$ in glacial acetic acid was added to 2 cm^3 of the water extract of the sorghum stalk was dissolved and left to stand for a minute. Conc. H_2SO_4 was later added along the sides of the test tube containing the mixture. Blue colour appeared in acid layer to indicate positive result for cardiac glycosides.

Tannins

Gelatin test: 3 cm^3 of the water extract was diluted with 5cm^3 of distilled water. Few drops of 1% of gelatinous sodium chloride solution were then added. A gelatinous precipitate was formed to indicate the result for tannins.

Ferric Chloride test: 3cm^3 of the water extract was mixed with 5cm^3 of distilled water. Then two drops of 10% ferric chloride were added to the mixture. Intense green colour was formed that indicated the result for tannins.

Saponins

Froth test: 5 cm^3 portion of the water extract was treated with 25 cm^3 of distilled water. The mixture was vigorously shaken in a calibrated cylinder. Frothing occurred and then later formed 1 cm^3 layer to indicate positive result for saponin.

Foam test: 2 cm^3 portion of the extract was shaken with 5 cm^3 of distilled water. The mixture was vigorously shaken in a calibrated cylinder. Persistent foaming for several minutes was observed to indicate positive result for saponin.

Discussions

Proximate Composition

Table 1: The mean proximate contents (%) of both water extract and whole powdered sorghum stalks

Content	WS	ES
Moisture	6.00 ±0.25	D
Ash	3.00±0.12	15.00±0.38
Crude fat	16.00±0.31	11.50±0.62
Crude fibre	36.47±0.43	N.D
Crude protein	6.12±0.10	0.45±0.05
Carbohydrate	32.41±0.51	73.05±0.76

WS: Whole Sample, ES: Water Extract Sample, D: Disregarded, ND: Not Detected. Results are presented as means of six replicates (n=6)

The results in Table 1 represent the percentage proximate composition of both water extract and the ground whole stalk samples. The proximate composition of the water extract was devoid of fibers and by virtue of its being water based with water at infinitum, the moisture composition was disregarded. However, its ash content (15.00± 0.25) was quite substantial relative to that of the whole stalk (3.00±0.12). The ash value is also higher than what was obtained by Oyetayo and Ogunrotimi (2012) for whole sorghum leaf. The medicinal plants: *Xylopia aethiopica, Blighia sapida* and *Parinari polyandra* (Abolaji *et al*, 2007) also have values (2.53±1.20 to 4.37±0.85) which are comparable with that obtained for whole stalk in the study but still lower than that of the aqueous extract. This substantial constituent of ash depicts the aqueous extract as a nutritional potential source of mineral elements. The water extracted

sample has more appreciable carbohydrate content as well as comparable crude fat than that of the whole stalk samples. The value reported by Agoreyo *et al* (2012) of similar plants of the round and oval varieties of unripe fruits of *Solanum melongena*. The water extracted sorghum sample is by this, a good source of energy nutrients as demonstrated by Aremu et al (2006 and 2007). However, the set back of the sorghum extract lied in its poor content of protein and fibres which are quite substantial in its whole stalk stuff.

Mineral Analysis

Table 2: The mean mineral content (mg/100g) of both water extract and whole powdered sorghum stalks

Elements	WS(mg/100g)	ES(mg/100g)
Ca	45.30±0.33	40.30±0.23
Na	23.30±0.28	15.70±0.14
K	212.20±0.55	142.90±0.48
Mg	14.00±0.12	13.30±0.15
Fe	52.00±0.51	25.00±0.49
Zn	5.60±0.15	5.10±0.13
Mn	14.00±0.24	2.80±0.10
Cu	0.70±0.11	0.30±0.09

WS: Whole Sample, ES: Water Extract of Sample.
Results are presented as means of six replicates (n=6)

The results of the mineral contents of water extract and whole stalk samples were shown in Table 2. In both samples, potassium has the highest presence (142.90±0.48 and 212.20±0.55 mg/100g) respectively. The value obtained for water extract compares well with the value reported by Salau (2012a) for Ginger fruit juice (100.60 – 113.80 mg/100g). As expected, the values of the mineral elements of the whole stalk sample are generally higher than the water extract especially potassium, iron and manganese. However, the overall values of mineral elements obtained portrayed the water extract samples as nutritious because of the presence of these beneficial elements (Aremu *et al*, 2005). Manganese and copper are in trace quantities which are typical of many stuff of edible plants origin (Oyetayo & Ogunrotimi, 2012; Abolaji *et al*, 2007). Their values in the water extract samples still shows that its consumption would be a source of these essential trace elements. These elements were found to be only detectable in local soya milk preparations as well as cow milk (Salau, 2012b). The value of iron obtained for the aqueous extract could satisfy the adequate intake (A.I.) of 8-30 mg as recommended by CDC-MMWR (1998). The investigation by Oladiji, *et al* (2007) on the water extract of Sorghum stem bark indicated its efficacy in the management of iron deficiency in a local set up.

Phytochemical Screening of Sample Extract

Table 3: The phytochemical constituents of the aqeous extract of sorghum stalk

S/No	Phytochemicals	Degree of phytochemicals' presence
1	*Alkaloid*	
	Mayer's Reagent	+ + +
	Hager's Reagent	+ + +
2.	*Flavonoid*	
	Alkaline Reagent	+
	Lead Acetate Test	+ +
	Shinoda Test	+ + +
3	*Carbohydrate*	
	Molisch's Test	+ +
	Benedict's Test	+
	Fehling's Test	+
4.	*Cardiac glycoside*	
	Keller-Kiliani Test	+ + +
5.	*Tannin*	
	Gelatin	+ + +
	Ferric Chloride Test	+ + +
6.	*Saponin*	
	Froth Test	+ +
	Foam Test	+ +

+ + + =Highly present, + + = Moderately present, + = Fairly

The screening of the aqueous extract of the *Sorghum vulgare,* in Table 3, revealed the presence of alkaloids, cardiac glycosides and tannins in relatively high degree. These chemical contents are comparable to reports made by (Mamta & Jyoti (2012), Prachant et al (2011) and Edeoga *et al* (2005) on plants parts suspected to be of medicinal importance. The presences of other phytochemicals: saponins, flavonoids and carbohydrate are to lesser degree. The activities of these phytochemicals have proved relevant in pharmaceutical formulations, therapeutic purposes as well as medical prophylaxis (Sofowora, 1993). Alkaloids, tannins, flavonoids and saponins are known to be antimicrobial, antidiarrheal and anthelmintic in activities (Remington, 2005). Cardiac glycoside is especially beneficial as antidiarrheal. The presence of these phytochemicals indicates how beneficial the common local water extract of guinea corn stalk could be.

Conclusion

The results of this study revealed that aqueous extract of sorghum stalk has substantial nutritive values when extracted which is the form in which people consume it. It was observed that the iron, sodium, potassium, calcium and magnesium contents were high. *Sorghum vulgare* decoction is therefore a potential mineral source. It could be especially relevant in the management of anaemia based on its richness in iron which is an active element in the

haemoglobin and red blood cells formation. Prominent calcium presence and its presence in reasonable amount in the extract, is a material for strong bones and teeth structure. Calcium is contained in marrows where red blood cells are built. *Sorghum vulgare* was also found to contain phytochemicals of medicinal importance such as: flavonoids, tannins, alkaloids and saponins. All these phytochemicals, collectively, play crucial roles as antimicrobial, anthelmintic and antidiarrheal agents. The *Sorghum vulgare* stalk decoction drink, as locally prepared, has a great nutritional and medicinal potential. It will also find great utilities in the pharmaceutical a well as food and feed industries.

References

Abolaji, O. A., Adebayo, A. H. & Odesanmi, O. (2007). Nutritional quality of three medicinal plant (Xylopia aethiopica, Bilghia sapida & Parinari polyandra) commonly used by pregnant women in western part of Nigeria. *Pakistan Journal of Nutrition,* 6(6), 665 - 668.

Agoreyo, B. O., Obansa, E. S. & Obanor, E. O. (2012). Comparative nutritional and phytochemical analyses of two varieties of Solanum melongena. *Science World Journal* 7 (1), 5 – 8.

Amadi, B. A., Agombo, E. N. & Ibegbulen, A. (2004). *Research methods in biochemistry*. Owerri: Supreme Publishers. Pp89-115.

AOAC (2005). Association of Official Analytical Chemists. Official method of analysis. Washington D. C

Aremu, M. O., Olonisakin, A, Opaluwa, O. D., Mohammed, Y, & Salau, R. B. (2007). Nutritional qualities assessment of tilapia fish (Tilapia quineensis). *Indian Journal of Multidisciplinary Research,* 3(3), 443 - 456.

Aremu, M. O., Olonisakin, A., Otene, I. W. & Atolaye, B. O. (2005). Mineral content of some agricultural products grown in the middle belt of Nigeria. *Oriental Journal of Chemistry,* 21, 419 - 426.

Aremu, M. O., Olaofe, O. & Akintola, E. T. (2006). A comparative study on the chemical amino acid of some Nigerian under –utilized legume flours. *Pakistan Journal of Nutrition*, 5, 34 - 38.

Ayub, M., Nadeem, M., Thir, M., Ghafoor, A., Ahmed, Z. & Naeem, M. (2010). Comparative studies on the growth, forage yield and quality of sorghum (sorghum bicolor L.) varieties under irrigated conditions of Faisalabad. *Journal of Life and Social Sciences*, 8(2), 94-97.

CDC-MMWR (1998), Centers for disease control – morbidity and mortality weekly report. Recommendations to prevent and control iron deficiency in the United States; 47 (No. RR-3) p. 5.

Edeoga, H. O., Okwu, D. E. & Mbaebie, B. O. (2005). Phytochemical constituents of some Nigerian medicinal plants. *African Journal of Biotechnology,* 4 (7), 685 - 688.

FAO (2015). Food and Agriculture Organization of the United Nations. *Food outlook, Biannual Reports on Global Food Markets.* October, 1, 2015. Rome.

Ghasemi, A., Karim. M. H. & Ghasemi, M. M. (2012). Green fodder yield performance of different varieties of sorghum grown in an arid region. *International Journal of Agriculture and Crop Sciences,* IJACS, 4(13), 839-843. Available at www.ijagcs.com

Lewington, A. (1990). *Plants for people*. Natural history museum. London. Pp 135-167.

Mamta, S. & Jyoti, S. (2012). Phytochemical screening of *Acorus calamus* and *Lantana camara*. *International Research Journal of Pharmacy*, 3(5), 324-326.

Muhammad, S. & Amusa, N. A. (2005). The important food crops and medicinal plants of North-western Nigeria. *Research Journal of Agriculture and Biological Sciences,* 1(3), 254 - 260.

Nydia, E. B. C., Patricia, I. T. C., Ana, I. L. O., Benjamin, R. W., Rosario, M. R. S. & Sergio, O. S. S. (2013). Effect of defatting and decortication on distribution of fatty acids, phenolic and antioxidant compounds in sorghum (*Sorghum bicolor*) bran fractions. *International Journal of Food Science and Technology,* 48(6), 1115 – 1338.

Oladiji, A. T., Jacob, T. O. & Yakubu, M. T. (2007). Anti-anaemic potentials of aqueous extract of *Sorghum bicolor* (L.) moench stem bark in rats. *Journal of Ethnopharmacology,* 111, 651 – 656.

Oyetayo, F. L. & Ogunrotimi, A. I. (2012). Guinea corn (Sorghum vuulgare) leaf, a potential source of nutrients and phytochemicals. *Food and Public Health*, 2(6), 228 – 230.

Pearson, D. (1976). *Chemical analysis of food*, *7th Edition*. London: Churchill Livingstone.

Prashant, T., Bimlesh, K., Mandeep, K. & Harleen, K. (2011). Phytochemical screening and extraction: A review. *Internationale Pharmaceutica Sciencia*, 1(1), 98 - 106.

Remington, J. P. (2005). *The science and practice of pharmacy*, 21st edition. Lippincott: Williams and Wilkins.

Salau, R. B. (2012a). Nutritional comparisons of milk from two cow specie and local preparations of Soya milk drinks. *IOSR Journal of Applied Chemistry*, 2 (6), 41 – 44.

Salau, R. B. (2012b). Comparative evaluation of analytical techniques for the quantification of potassium in fruit juices and corresponding beverages. J*ournal of Science, Technology, Mathematics and Education (JOSTMED),* 8(3), 9 - 15.

Sofowora, A. (1993). *Medicinal plants and traditional medicine in Africa*. Ibadan: Spectrum Books Limited.

Sonon, R. N. & Bolsen, K. K. (1996). Effects of cultivar and stage of maturity on agronomic characteristics, chemical composition, and nutritive value of forage sorghum silages. *Advanced Agricultural Research,* 5 (3),1 - 17.

A DUAL TOPOGRAPHIC-PETROGRAPHIC CONTROL FOR A 1KM^2 VES-IP STUDY COMPLETED AT THE GIDAN KWANO CAMPUS PHASE II DEVELOPMENT, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA

JONAH, S. A.; AKPOMIE, D. P.; EZEKWEBEKWE, L. O.; ISAH, E. A.; MUHAMMED, A. N.; MOMOH, A. A.; OKOYE, C. K.; OKPARA, K. K.; ONI, N. O., *ALADE, R. O.; *YAHAYA, G. A.; *ZUBAIR, R. O.; ONOJA, E. U. & DARAMOLA, O.
Department of Physics, Federal University of Technology, Minna, Nigeria
*Department of Geology, Federal University of Technology, Minna, Nigeria
E-mail: sajonah2003@yahoo.com Phone No: +234-806-468-7977

Abstract

It is usually not the norm, so far as studies carried out in the local basement complex geology of the Minna Area is concerned, to constrain the accuracy of the interpretation of VES data-set with the corresponding topographic and petrographic map of the specific area of study. Such approach would serve as a veritable tool of quality control (QC) of the interpretation of the acquired VES data-set. The aim of this study is to implement a valid quality control scheme for an earlier dual VES-IP study. The topographic survey proceeded along transverse traverses in a west-east, east-west zig-zag format until transverse traverse (TT) 51 was completed. The petrographic survey phase of this study was concerned with the study of the aspects of the different outcrops seen at the area of study in terms of their strike, dip, and other structural orientation. Over the 1km^2 area of study of interest here (Lat. 9^{0}30′57.8″ to 9^{0}31′30.3″ and Long. 6^{0}25′39.0″ to 6^{0}26′11.5″), it is observed that terrain or ground elevation progressively increases from south to north. An important observation herein, too, is that elevation increases from west to east. It is understood from the petrographic map that the area of study is underlain by a continuous body of granite that is intruded by a small body of schist. Examination of the landform map of the area of study positively correlates the conclusion of aquifer prospects drawn from the earlier survey and it is strongly recommended to drill these locations for groundwater exploitation.

Keywords: Topographic; Petrographic; Quality-control; Groundwater; Aquifer

Introduction

For the 100km^2 areal extent of the Gidan Kwano Campus (GKC), information on spatial topography is as gleaned from Adesoye (1996). Jonah and Jimoh (2013) discussed the production of a topographic map for a 15km^2 extent of the GKC, which at 100m station-spacing of the data collection process, was considered to be a refinement of that of Adesoye (1996) for that corresponding slice of ground. For the 8km^2 areal extent that is being touted as the ideal location for the Gidan Kwano Campus Phase II Development (Jonah *et al.* 2014A; 2014B; 2015A), Jonah *et al.* (2014B) have produced a site-specific topographic map, with its corresponding site-specific geomorphic map, still at 100m station-spacing of the data collection process, that give more information about landform regimes compared to what could be gleaned from Adesoye (1996). The 1km^2 areal extent area-of-study of this present study is subsumed in the 8km^2 areal extent that is being touted as the ideal location for the Gidan Kwano Campus Phase II Development. Over this 1km^2 areal extent, Jonah *et al.* (2015A) have completed a dual vertical electrical sounding (VES)-induced polarisation (IP) survey to locate aquifer prospects; whilst the rule adopted for the interpretation of the result of their survey followed standardized technical nuances, there was no surface geomorphological control to aid

their interpretation. This study is principally concerned with creating a topographic map, at 20m station-spacing of the data collection process to serve as a further aid in the interpretation of the dual VES-IP results of Jonah *et al.* (2015A).

Petrographic mapping, of the type that is being proposed for this study, whence subsurface aquifer information is tied directly to surface systematic description of the texture of rocks in order to constrain interpretation even further, is an entirely novel concept for the 100km^2 areal extent of the GKC. Suffice to point out, also, that there was no surface petrographic control to aid the interpretation of Jonah *et al.* (2015A). Thus, too, this study is principally concerned with creating a petrographic map to serve as a further aid in the interpretation of the dual VES-IP results of Jonah *et al.* (2015A).

The 1km^2 of interest here, subsumed in the Gidan Kwano Campus Phase II Development, is identified by the following georeferenced co-ordinates, viz: 09^{0}30′57.8′′N, 006^{0}25′39.0′′E (most extreme southwest); 09^{0}30′57.8′′N, 006^{0}26′11.5′′E (most extreme southeast); 09^{0}31′30.3′′N, 006^{0}26′11.5′′E (most extreme northeast); 09^{0}31′30.3′′N, 006^{0}25′39.0′′E (most extreme northwest). It is known that the area of study under consideration herein is part of the Nigerian Basement Complex (NBC).

It is usually not the norm, so far as studies carried out in the local basement complex geology of the Minna Area is concerned, to constrain the accuracy of the interpretation of VES data-set with the corresponding topographic and petrographic map of the specific area of study. Such approach would serve as a veritable tool of quality control (QC) of the interpretation of the acquired VES data-set. Jonah *et al.* (2014B) used the result of a topographic as a tool of QC for geoelectric data over an 8km^2 areal extent of the proposed Phase II Development of the Gidan Kwano Campus. As at the present, there is no evidence that a dual topographic-petrographic validation of the result of a dual VES-IP survey in the Minna Area has been undertaken.

The aim of this study is to implement a valid quality control scheme for an earlier dual VES-IP study completed at a 1km^2 tranche of the Gidan Kwano Campus Phase II Development, Federal University of Technology, Minna.

The objectives of this study are the following:

(i) The use of a purpose-specific topographic map to validate the result of a dual VES-IP study completed at a 1km^2 tranche of the Gidan Kwano Campus Phase II Development; herein, elevation values (that is, the "z" parameter) at designated principal stations of 20m over the 1km^2 areal extent under consideration would be collected. The full gamut of this "z" values would be contoured in order to create a site-specific topographic map; at 20m station-spacing, it is expected that the topographic map data field should produce a very detailed geomorphological profile of the area of study.

(ii) The use of a purpose-specific petrographic map to validate the result of a dual VES-IP study completed at a 1km^2 tranche of the Gidan Kwano Campus Phase II Development; herein, a systematic description of the major outcrops occurring at the area of study would be implemented by means of specifying the nature and structural aspects of the outcrops in terms of their strike, dip, joint character, fracture character, fault character (where applicable), and so on.

The result of Jonah *et al.* (2015A), to determine groundwater prospects over a 1km^2 slice of the Gidan Kwano Campus Phase II Development, was based on the conventional "first-stage" VES interpretation schedule. The conclusions drawn regarding groundwater prospects over this 1km^2 slice would be further strengthened when the result of this "first-stage" interpretation is tied to the result of the topographic map (resulting in a "second-stage" interpretation); tying this outcome further to the petrographic map would result in a "third-stage" interpretation scheme in order that the conclusions drawn may be truly relied on.

There are 51 transverse traverses of the 1km^2 areal extent of the area of study at 20m station-spacing for the topographic map data-collection phase. Each transverse traverse (TT) is 1km (1000m) long. At 20m station-spacing there are 51 measurement stations on each TT, thus the total number of measurement stations is 51 x 51 = 2601. Elevation information was collected from these 2601 stations in order to create the topographic map of this study. The petrographic phase of this study was determined by the number of major outcrops that occur over the area of study.

According to Jonah *et al.* (2014A; 2014B; 2015A; 2015B; 2015C), the location most suited for the Phase II Development at the Gidan Kwano Campus is an 8km^2 areal extent defined to be a perfect rectangle on the ground with its ends corresponding to the following georeferenced co-ordinates: $09^0$30′57.8′′N, $006^0$25′39.0′′E (most extreme southwest); $09^0$30′57.8′′N, $006^0$26′43.8′′E (most extreme southeast); $09^0$33′07.4′′N, $006^0$26′43.8′′E (most extreme northeast); $09^0$33′07.4′′N, $006^0$25′39.0′′E (most extreme northwest).

According to Obaje (2009), the Nigerian Basement Complex (NBC) is one of the three major litho-petrological components that make up the geology of Nigeria. The NBC forms a part of the Pan-African mobile belt and lies between the West African and Congo Cratons and south of the Tuareg Shield (Black, 1980). It is intruded by the Mesozoic calc-alkaline ring complexes (Younger Granites) of the Jos Plateau and is unconformably overlain by Cretaceous and younger sediments. The Nigerian basement was affected by the 600 Ma Pan-African orogeny and it occupies the reactivated region which resulted from plate collision between the passive continental margin of the West African craton and the active Pharusian continental margin (Burke & Dewey, 1972; Dada, 2006). The basement rocks are believed to be the results of at least four major orogenic cycles of deformation, metamorphism, and remobilization corresponding to the Liberian (2,700 Ma), the Eburnean (2,000 Ma), the Kibaran (1,100 Ma), and the Pan-African cycles (600 Ma). The first three cycles were characterized by intense deformation and isoclinal folding accompanied by regional metamorphism, which was further followed by extensive migmatization. The Pan-African deformation was accompanied by a regional metamorphism, migmatization and extensive granitization and gneissification which produced syntectonic granites and homogeneous gneisses (Abaa, 1983). Late tectonic emplacement of granites and granodiorites and associated contact metamorphism accompanied the end stages of this last deformation. The end of the orogeny was marked by faulting and fracturing (Gandu *et al.*, 1986; Olayinka, 1992). Within the basement complex of Nigeria four major petro-lithological units are distinguishable, namely:

(i) The Migmatite-Gneiss Complex (MGC)
(ii) The Schist Belt (Metasedimentary and Metavolcanic rocks)
(iii) The Older Granites (Pan African granitoids)
(iv) Undeformed Acid and Basic Dykes

Survey Methods

The Topographic Survey:- The essential idea herein is the collection of elevation values at 20m station spacing over the 1km^2 areal extent of the study area of interest. The survey proceeded along transverse traverses in a west-east, east-west zig-zag format until TT 51 was completed. It is expected that the 20m station spacing adopted for this study would yield a large data field with a concomitant high resolution of the ground being survey. The layout of this topographic survey is as shown in Fig.1.

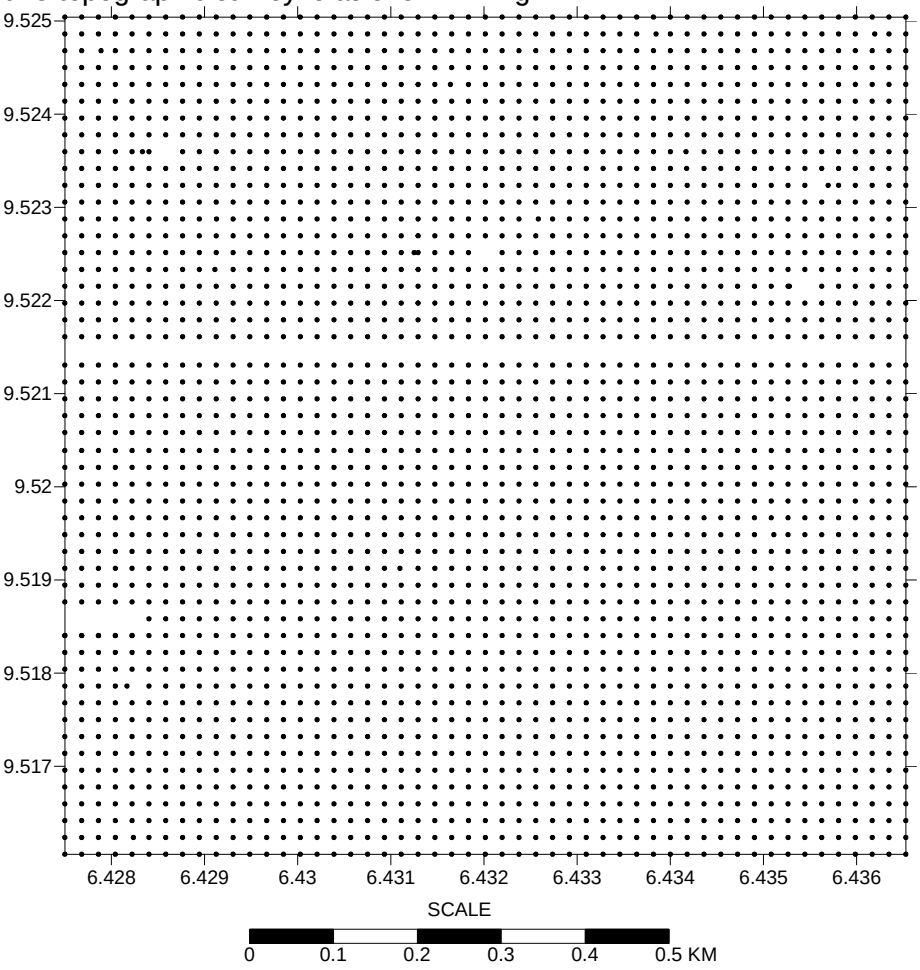


Fig.1: Layout of topographic survey: (The extent of the 1km^2 area of interest here is $09^0$30′57.8′′N, $006^0$25′39.0′′E or 9.516056; 6.4275 at the most extreme southwest; $09^0$30′57.8′′N, $006^0$26′11.5′′E or 9.516056; 6.4365 at the most extreme southeast; $09^0$31′30.3′′N, $006^0$26′11.5′′E or 9.52505; 6.4365 at the most extreme northeast; $09^0$31′30.3′′N, $006^0$25′39.0′′E or 9.52505; 6.4275 at most extreme northwest.)

The Petrographic Survey:- The petrographic survey phase of this study was concerned with the study of the aspects of the different outcrops seen at the area of study in terms of their strike, dip, and other structural orientation. Each of the outcrops encountered was designated by a sample number, a designation of its rock type, its ground location, its georeferenced location, its camera image code, as well as its strike, dip, and other structural aspects.

Results and Discussion

Summary of the Results of the Earlier 1km^2 Dual VES-IP Survey:- The result of the 1km^2 dual VES-IP survey is the subject of Jonah *et al.* (2015A). The field resistivity values of the VES component of the dual survey were initially subjected to the log-log plot routine of the Windows-compatible WinResist® software whence corresponding field curves for all the stations occupied were produced. As a point of emphasis, the field survey trend was in the east-west direction (i.e. transverse traverse or TT designation). At station spacing of 200m for a 1km x 1km areal extent of survey, there were a total of thirty-six (36) TT stations. The transverse traverse designations are in increasing order from south to north (i.e. TT1 to TT6); each profile unit designation is from east to west (as in TT1-1 to TT1-6). Each of the WinResist® log-log plot provides information on the numbers of layers, the average resistivity values of these layers, and their approximate thicknesses. In order to show the variation of resistivity on a constant plane across the area of study, it is instructive to produce resistivity maps at constant depths (i.e. the iso-resistivity maps). For this 1km^2 dual VES-IP study, the Surfer® 10 software was used to generate the iso-resistivity maps at 10m, 20m, 30m, 40m, 50m, 60m, 70m, 80m, 90m, and 100m. The Surfer® 10 package transforms the xyz dataset (longitude, latitude, and resistivity values) to create contour maps and other useful graphic maps.

The induced polarization component of the 1km^2 dual VES-IP survey was utilized on a quality control basis for the VES results. In this case, the interpretation was guided by the statement-of-fact enunciated on p. 222 of Kearey and Brooks (1984) to wit: the sources of significant IP anomalies are water-filled shear zones; it is understood from ABEM (1999) that IP results can distinguish between groundwater and clay. This property is significant because it constrains the IP method to be an effective discriminator when making deduction as to the presence of groundwater. According to Parasnis (1986:180) "the advantage of IP soundings (as a complement to VES) is that they are able to distinguish between clay layers (high IP) and some other low-resistivity strata like salt-water beds (no IP)." Thus, where it is suspected that groundwater may be present, recourse to the corresponding IP value recorded in *pari passu* at that depth would help dispel whatever doubt there may be.

The "Geoexplore Empirical Standardization for Minna Area" and the "Olasehinde Protocol." Presently, there exist dual empirical rules to determine the likely presence of groundwater in the basement complex geological province. These rules are the "Geoexplore Empirical Standardization for Minna Area" and the "Olasehinde Protocol." For the 1km^2 dual VES-IP study, the interpretation for aquifer prospects at the thirty-six VES locations was based on these rules. The "Geoexplore Empirical Standardization for Minna Area" states that ohmic resistance values of less than or equal to 0.3Ω at the 20m depth or greater (or, in resistivity terms, between 200Ωm and 300Ωm at the 20m depth and less than 200Ωm at depths greater than 20m) is indicative of possible groundwater prospect. The "Olasehinde Protocol" states that resistivity values between 180Ωm and 250Ωm at the 20m to 25m depth mark are indicative of possible groundwater prospect. It is instructive to point out here that even though the resistivities of rocks do not depend on water content only, these informal laws are enunciated "rules-of-thumb" that serve as effective guides to groundwater prospectors out in the field. On the bases of these dual protocols, therefore, TT1-1 is not considered an aquifer prospect; TT1-2 is a good showing up to the 150-m depth, TT1-3 is a good showing up to the 70-m depth, TT1-4 is a good showing up to the 50-m depth, TT1-5 is not considered an aquifer prospect, TT1-6 is a good showing up to the depth of the barrier encountered, TT2-1 is a good showing up to the 40-m depth, TT2-2 is a good showing up to the 80-m depth, TT2-3 is a good showing up to

the 50-m depth, TT2-4 is a good showing up to the 50-m depth, TT2-5 has incomplete information, TT2-6 is not a prospect. TT3-1 is a good showing up to the 60-m depth; TT3-2 is a good showing up to the 50-m depth, TT3-3 is a good showing up to the 40-m depth, TT3-4 is a good showing up to the 110-m depth, TT3-5 is a good showing up to the 60-m depth, TT3-6 is not a good showing, TT4-1 is a good showing to the 80-m depth, TT4-2 is a good showing to the 80-m depth, TT4-3 is a good showing to the 80-m depth, TT4-4 is a good showing to the 60-m depth, TT4-5 is a good showing to the 50-m depth, TT4-6 is not a good showing. TT5-1 is a good showing to the 40-m depth; TT5-2 is a good showing to the 40-m depth, TT5-3 coincided with a wet stream barrier, TT5-4 is a good showing to the 120-m depth, TT5-5 is a good showing to the 50-m depth, TT5-6 is not a good showing, TT6-1 is not a good showing, TT6-2 is not a good showing, TT6-3 is not a good showing, TT6-4 would not be a good showing down to the 30m, TT6-5 is a good showing to the 70-m depth, and TT6-6 is a good showing to the 50-m depth.

The WinResist® Plots: The WinResist® plots were vital guides to determining the numbers of layers at each survey location and, most important of all for this survey, for extracting information on the depth to basement used in the production of the isopach map (Jonah *et al.* (2015A).

The Iso-Resistivity Maps at Depths: The lowest resistivity value of 20Ωm can easily be made out on the 10m-depth map at TT5-4. On the 20m-depth map, TT5-2 to TT5-5 form a linear spread of progressively decreasing resistivity from 100Ωm to 20Ωm. TT4-2 to TT4-5, TT3-2 to TT3-5, and TT2-2 to TT2-5 also mirror this pattern. On the 30m-depth map, TT5-4 stands out as the lowest-resistivity region at 60Ωm in a "sea" of ohmic spikes. On the 40m-depth map, TT5-4, TT2-5, and TT1-2 stand out as the lowest-resistivity regions. TT5-4 and TT1-2 are made out still as the lowest resistivity regions on the 50m-depth map; the resistivity value at TT2-5 increases over this 10m-window enormously. TT4-1 to TT4-4 and TT3-1 to TT3-4 form a region of "associate low-resistivity" at this depth, too. The trend of Fig.4.5 is continued for the 60m-depth map; the new "entrant" here is TT1-3 and TT2-2. For the 70m-depth map, the resistivity trend of the 60m-depth is exactly imaged here. For the 80m-depth map, for the 90m-depth map, and for the 100m-depth map, the resistivity trend of the 60m-depth map is exactly imaged here, too (Jonah *et al.* (2015A).

The Isopach Map: The regions of low resistivity values at depths correlate strongly with the regions of contour closures observed on the isopach map (Jonah *et al.* (2015A).

Extraction of Aquifer Information for the 1km^2 Dual VES-IP Survey:- For the dual VES-IP survey, it can be inferred that based on the dual empirical protocol scheme, the following VES locations are considered good prospects for groundwater: TT1-2, TT1-3, TT1-4, TT1-6, TT2-1, TT2-2, TT2-3, TT2-4, TT3-1, TT3-2, TT3-3, TT3-4, TT3-5, TT4-1, TT4-2, TT4-3, TT4-4, TT4-5, TT5-1 TT5-2, TT5-4, TT5-5, TT6-5, and TT6-6. However, if prevailing economic circumstances dictates that only a very limited number of VES locations could be drilled for boreholes at the area of the present survey and imposing a constraint involving analysis of the iso-resistivity contour maps, then the highly prospective VES locations would be TT5-4, TT1-2, TT1-3, and TT2-2. Now, for the recognised highly prospective VES locations of TT5-4, TT1-2, TT1-3, and TT2-2, how would it be certain that it was freshwater and not clay that is responsible for the observed low resistivity regime at depth? Recourse is made here to the qualitative discussion of the function of the induced polarisation data. Herein, examination of

the individual IP tables of values would be undertaken for TT5-4, TT1-2, TT1-3, and TT2-2. This qualitative examination of each of the separate IP tables of values would be done only to a TD of 40m. This 40m-window restriction is due to the fact that, in the larger basement complex region of which the present area of study is but a small constituent, the thicknesses of the different phases of overburden materials never exceed 35m (Jimoh, 1998).

Qualitative Examination of IP Table for TT5-4 (09°31**′23.7′′; 006°25′51.9′′**): It is observed that a negative chargeability value of -55.4ms exist for TT5-4 at the 40m-depth mark: according to ABEM (1999), negative IP values can only mean that the resistivity of the current layer is less than that of the layer just above it; this trend would be contrary to the theoretical expectation that resisitivity should increase as the depth increases for any VES location. Interestingly, above this 40m-depth mark layer for TT5-4, the absolute IP value of 178ms is much greater than the absolute value of 55.4ms at the 40m-depth. Since Parasnis (1986) pointed out that clay layers correspond to "high IPs", and salt-water beds correspond to "no IPs", it can be inferred that freshwater beds correspond to "low IPs." However, according to Mr. Jonah (personal communication), in his work since 2011 at the greater area of the Phase II Development, what is "high" or "low" IP is a subjective matter depending on the prevailing values of the current survey under analysis. This being the case, the absolute IP value of 178ms at the 30m-depth mark is "high" compared to the absolute value of 55.4ms at the 40m-depth mark (i.e. "low IP"). Based on this reckoning, TT5-4 is a very strong candidate for groundwater prospect at the 40m-depth mark, and the iso-resistivity maps have also indicated a continuation of low-resistivity trend at depths beyond this 40m-depth mark.

Qualitative Examination of IP Table for TT1-2 (09°30**′ 57.8′′; 006°26′4.9′′**): At the 40m-depth mark, a chargeability of -9.19ms is observed in contrast to an absolute "high" IP value of 106ms at the 5m-depth mark. The deduction that the clay bed lies atop the water-bearing strata in this situation is not misplaced. Based on this reckoning, TT1-2 is a very strong candidate for groundwater prospect at the 40m-depth mark, and the iso-resistivity maps have also indicated a continuation of low-resistivity trend at depths beyond this 40m-depth mark.

Qualitative Examination of IP Table for TT1-3 (09°30**′57.8′′; 006°25′58.4′′**): The corresponding observation for the TT1-2 VES table of the TT1-3 location can be made out at the 5m-depth mark and at the 6m-depth mark. The iso-resistivity maps have indicated a continuation of low-resistivity trend at depths beyond the 40m-depth mark for this VES location.

Qualitative Examination of IP Table for TT2-2 (09°31**′04.3′′; 006°26′4.9′′**): The corresponding observation for the TT1-2 VES table of the TT2-2 location can be made out at the 6m-depth mark and at the 8m-depth mark. The iso-resistivity maps have indicated a continuation of low-resistivity trend at depths beyond the 40m-depth mark for this VES location. Summarising, it is recognized that the aquifer prospects identified from the 1km^2 dual VES-IP survey are the following:

TT5-4: 09°31′23.7′′; 006°25′51.9′′ ≡ 9.523^0; 6.431^0
TT1-2: 09°30′ 57.8′′; 006°26′4.9′′ ≡ 9.516^0; 6.435^0
TT1-3: 09°30′57.8′′; 006°25′58.4′′ ≡ 9.516^0; 6.433^0
TT2-2: 09°31′04.3′′; 006°26′4.9′′ ≡ 9.518^0; 6.435^0

Examination of the Results of the Present Survey

The Topographic Map:- The topographic map for this study was produced by the aid of the Surfer-11® and Rockworks2006® applications. The "raw" elevation data in Microsoft Word® was converted into Microsoft Excel® by the Rockworks2006® application by which route the co-ordinates in degrees, minutes, and seconds were converted into degree-decimals values for ready input into the Surfer-11® application. In the Surfer-11® environment, the degree-decimals values data-field was saved initially, then the saved data was gridded, and subsequently the gridded data was used to create the required two-dimensional and three-dimensional maps. The result of this exercise showing the two-dimensional map is presented as Fig.2.

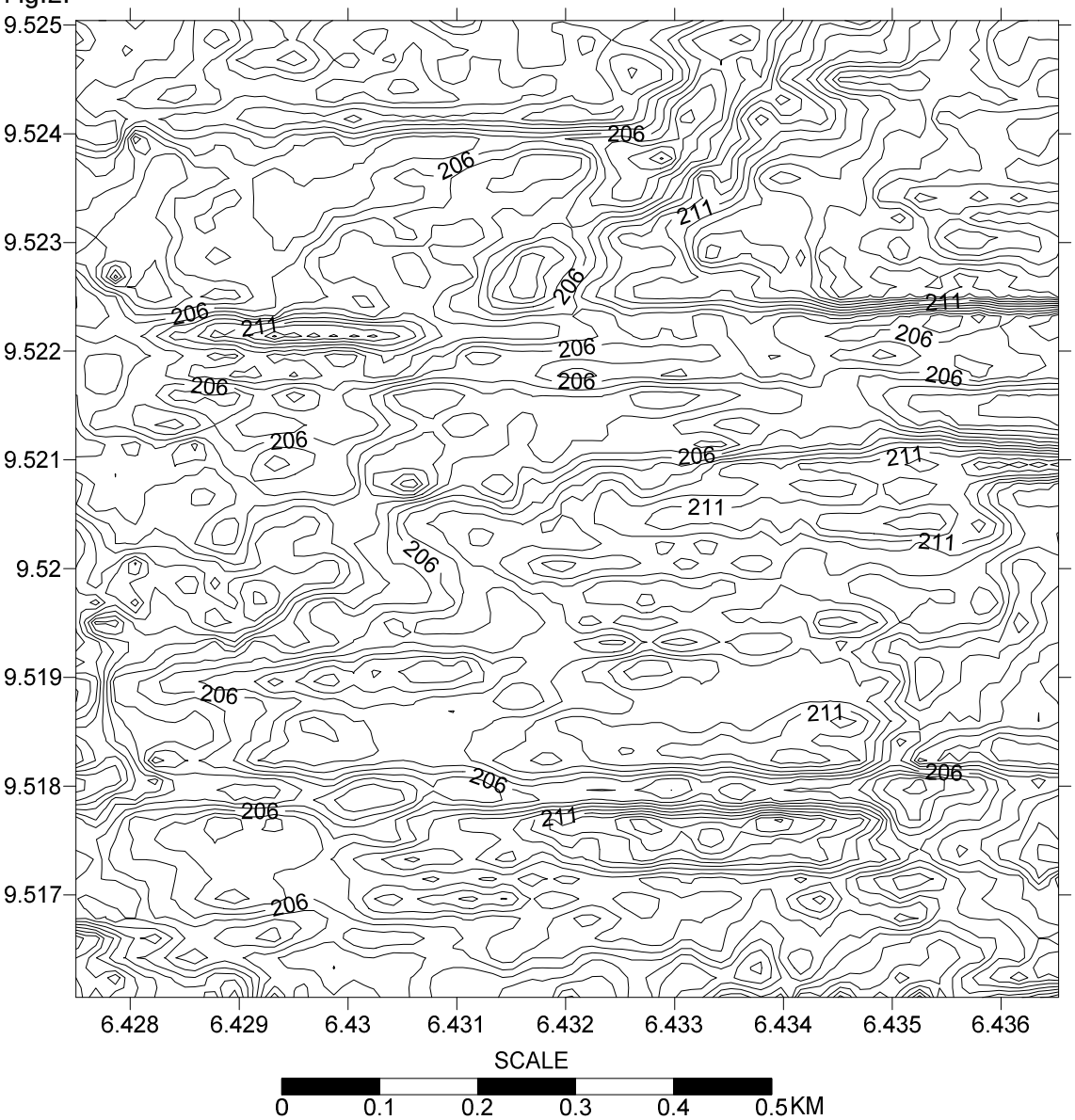


Fig.2: Topographic map of the area of study

The corresponding digital elevation model map is shown as Fig.3.

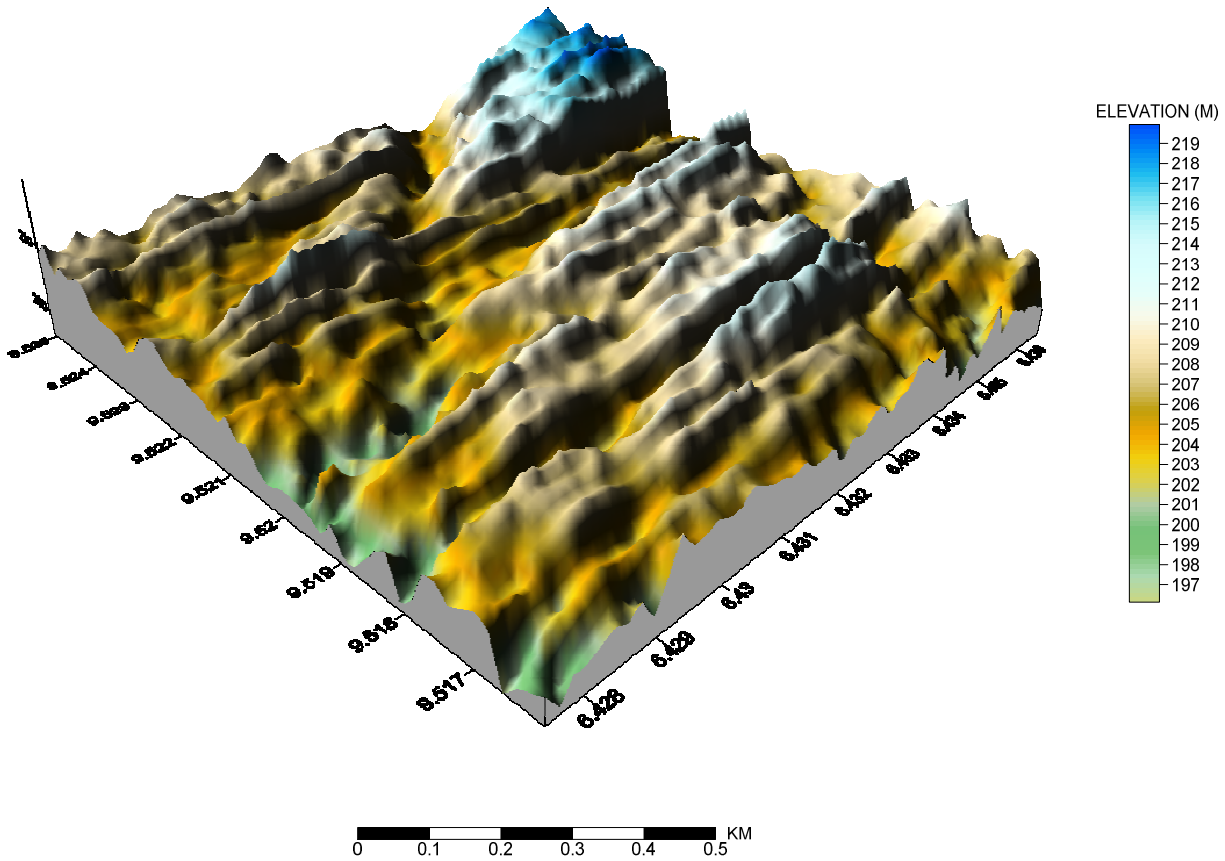


Fig.3: Digital elevation model map of the area of study

The Petrographic Map:- Production of the petrographic map was rather straightforward; information obtained from the recorded sample data set (rock type, plate location, GPS location, strike, description, etc.) was embedded into Microsoft Word® and transferred to the Surfer-11® to produce the petrographic map. On this map, there is a key representing different rock types. The result of this exercise is presented as Fig.4.

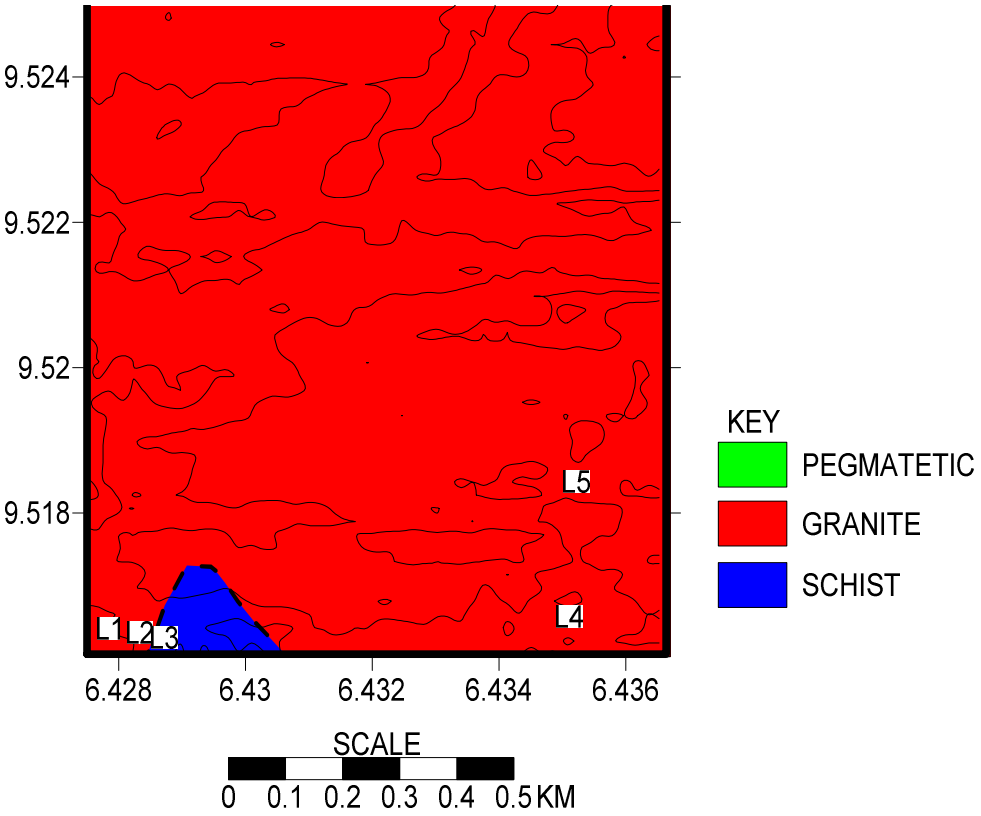


Fig.4: Petrographic map of the area of study

Discussion of Result of the Present Survey

The Topographic Map:- Over the 1km^2 area of study of interest here, it is observed that terrain or ground elevation progressively increases from south to north; this can be made out in Fig.2. An important observation herein, too, is that elevation increases from west to east. On the three-dimensional (3-D) digital elevation model (DEM) map of Fig.4, the elevation information of Fig.3 translates to an understanding that the landform of the 1km^2 area of study gently slopes from north to south and from east to west.

The Petrographic Map:- The petrographic survey proceeded in accordance with the basic requirement of this kind of survey: "*petrographic descriptions start with the field notes at the outcrop and include macroscopic description of hand specimens:*" en.wikipedia.org. It is understood from the petrographic map of Fig.4 that the area of study is underlain by a continuous body of granite that is intruded by a small body of schist.

Conclusion and Recommendation

Conclusions Drawn from Topographic Map:- The gentle slopes of the landform, north-to-south and east-to-west, observed in Figs 2 and 3 can only mean that there is a residual southwest slope of the area of study; the implication of this fact for groundwater prospects, by intuitive deduction, is that if conclusions concerning locations of aquifers that are drawn from a geophysical survey identifies prospects at the southwest corner of the area of study, then these conclusions must not be ignored. Intuitive deduction aside, what is most important out in the field is the conclusion drawn based on the results that are got from a proper field survey. Recall

that it was observed that the previous 1km^2 dual VES-IP survey identified aquifer prospects at the following locations:
TT5-4: 09°31′23.7′′; 006°25′51.9′′ ≡ 9.523^0; 6.431^0
TT1-2: 09°30′ 57.8′′; 006°26′4.9′′ ≡ 9.516^0; 6.435^0
TT1-3: 09°30′57.8′′; 006°25′58.4′′ ≡ 9.516^0; 6.433^0
TT2-2: 09°31′04.3′′; 006°26′4.9′′ ≡ 9.518^0; 6.435^0

Fig.3 is a veritable platform by which validation of the conclusion drawn from the 1km^2 dual VES-IP survey can be made. Consider, first, TT5-4 at 9.523^0; 6.431^0: where is this point located on Fig.4? The point 9.523^0; 6.431^0 is located smack in a depression, not at the exact southwest corner of the area of study, but at a location much closer to the northeast; this location is a valley morphology. Because of this fact, it is concluded that TT5-4: 09°31′23.7′′; 006°25′51.9′′ ≡ 9.523^0; 6.431^0 remains a strong candidate for drilling for groundwater prospect.

Consider TT1-2 at 9.516^0; 6.435^0: on Fig.4, it is seen that TT1-2 is a depression along the first profile line, quite close to the east than the exact southwest but located on a fertile depression far away from any observable outcrop, more like a sediment-filled ancient valley. Because of this fact, it is concluded that TT1-2: 09°30′ 57.8′′; 006°26′4.9′′ ≡ 9.516^0; 6.435^0 remains a strong candidate for drilling for groundwater prospect.

Consider TT1-3 at 9.516^0; 6.433^0: on Fig.4, it is seen that TT1-3, which is 200m to the west of TT1-2 on the same profile line is still identified with the fertile depression of TT1.2. Because of this fact, it is concluded that TT1-3: 09°30′57.8′′; 006°25′58.4′′ ≡ 9.516^0; 6.433^0 remains a strong candidate for drilling for groundwater prospect.

Consider TT2-2 at 9.518^0; 6.435^0: the latitude line of 9.518^0 slices through the landform of the area of study as a continuous local depression and the point of 9.518^0; 6.435^0 is far removed from the exact southwest corner of the area of study, located at the eastern flank. This location being in a valley morphology, it is concluded that TT2-2: 09°31′04.3′′; 006°26′4.9′′ ≡ 9.518^0; 6.435^0 remains a strong candidate for drilling for groundwater prospect.

This “valley morphology” concept herein well means locations at the area of study where local rock emplacements may have been significantly eroded and sand cover has accumulated over time.

It is interesting to point out that, against intuitive deduction, none of the prospect locations identified from the earlier 1km^2 dual VES-IP survey fall smack at the exact southwest corner of the area of study.

Conclusions Drawn from Petrographic Map:- The schist body intrusion into the granitic substrate of the area of study does not coincide with any prospect locations identified from the earlier 1km^2 dual VES-IP survey. What this means is that, barring significant sand thicknesses as the constituent bodies of aquifers at the locations identified herein, it follows that the sources of groundwater at the points identified would be fracturing of the mass of the granitic rock at depths.

Recommendation:- It is strongly recommended that all of the aquifer prospects identified from the previous 1km^2 dual VES-IP survey be drilled for groundwater exploitation at the planned Gidan Kwano Campus Phase II Development.

References

Abaa, S. I. (1983). The structure and petrography of alkaline rocks of the mada younger granite complex, Nigeria. *J Afr Earth Sci*, 3, 107 – 113.

ABEM (1999). *Instruction manual: Terrameter SAS 4000/SAS 1000*, ABEM Instrument AB, Sundbyberg (Sweden).

Adesoye, S.A. (1986). *Master Plan of the Federal University of Technology's Permanent Site. Minna*: Adesoye and Partners, Kaduna, Nigeria.

Black, R. (1980). Precambrian of West Africa. *Episodes,* 4,3 - 8.

Burke, K. C. & Dewey, J. F. (1972). Orogeny in Africa. In: T.F.J. Dessauvagie, A. J. Whiteman (eds), *Africa geology*, University of Ibadan Press, Ibadan, Pp. 583 – 608.

Dada, S. S. (2006). Proterozoic evolution of Nigeria. In: Oshi, O. (ed), *The basement complex of Nigeria and its mineral resources (A Tribute to Prof. M. A. O. Rahaman)*, Akin Jinad & Co., Ibadan, pp 29–44.

Gandu, A. H., Ojo, S. B. & Ajakaiye, D. E. (1986). A gravity study of the Precambrian rocks in the Malumfashi area of Kaduna State, Nigeria. *Tectonophysics*, 126, 181–194. Available at https://en.wikipedia.org/wiki/Petrography

Jimoh, M. O. (1998). *Report on the six boreholes drilled at the main campus of the Federal University of Technology, Minna, for the Petroleum (Special) Trust Fund.* Cemaco Ventures Ltd., Minna.

Jonah, S. A. & Jimoh, M. O. (2013). Production of a topographic map and the creation of a six-layer geographic information system (GIS) for a fifteen square-kilometre (15 km^2) areal extent of the Gidan Kwano Campus of the Federal University of Technology, Minna, Niger State, Nigeria. *Journal of Science, Technology, Mathematics, and Education (JOSTMED)*, 9(2), 75 - 89.

Jonah, S. A., James, G. O., Adeku, D. E., Ahmed, F., Alhassan, A., Hamza, S., Igbideba, O. I., Kwaghhua, F. I., Kyari, M., Macaulay, V. F., Olarewaju, S. I., Onyeodili, G., Popoola, G. B., Sofeso, O. A., Switzer, F. K. & Umoh, U. E. (2014A). Geoelectrical investigation for aquifer and geotechnical properties at the planned Gidan Kwano Campus Development Phase II, Federal University of Technology Minna, Nigeria. *Journal of Science, Technology, Mathematics, and Education (JOSTMED)*, 11(2), 81 - 100.

Jonah, S. A., Olasehinde, P. I., & Umar, M. (2014B). Evaluation of geomorphological quality control of geo-electrical data at Gidan Kwano Campus, Federal University of Technology, Minna, Central Nigeria. *Journal of Information, Education, Science, and Technology (JIEST),* 2 (1), 122 –134.

Jonah, S. A., Olasehinde, P. I., Jimoh, M. O., Umar, M. & Yunana, T. (2015A). An intercalated dual geoelectrical survey of an earlier study for groundwater at the planned Gidan Kwano Campus Development Phase II, Federal University of Technology, Minna, Nigeria. *Journal of Information, Education, Science, and Technology (JOSTMED)*, 11(2), 32 - 50.

Kearey, P. & Brooks, M. (1984). *An introduction to geophysical exploration*. Oxford: Blackwell Scientific Publications.

Obaje, N. G. (2009). *Geology and mineral resources of Nigeria*. In: Lecture Notes in Earth Sciences, Springer-Verlag, Berlin.

Olayinka, A. I. (1992). Geophysical siting of boreholes in crystalline basement areas of Africa. *J Afr Earth Sci*, 14,197–207.

Parasnis, D. S. (1986). *Principles of applied geophysics (4 ed.)*. London: Chapman and Hall.

DETECTION OF LEACHATE PLUMES MIGRATION USING VERTICAL ELECTRICAL SOUNDING METHOD AND PHYSICOCHEMICAL ANALYSIS AT KPANGUNGUN, MINNA, NIGER STATE, NIGERIA

[1]RAFIU ABDULWAHEED ADEWUYI & [2]ABU MALLAM
[1]Physics Department, Federal University of Technology, Minna, Nigeria
[2]Phyics Department, University of Abuja, Abuja, Nigeria
E-mail: iyiolararafiu@futminna.edu.ng Phone No: +234-803-654-4246

Abstract
The aim of this study is to use electrical resistivity method and heavy metal determination as indicators for groundwater pollution at a waste dump site to map leachate plumes and determine the extent of groundwater contamination at Public Dump Site in Kpagungun, Minna. Twenty VES points with an electrode spacing's of AB/2 80 m were occupied along three traverses. Surface data were acquired with an ABEM SAS 4000 terrameter set. Data were processed by conventional curve matching and computer iteration methods using Win Resist Software. VES data were plotted as pseudo sections to provide information on resistivity distribution and geo-electric sections were generated from VES interpretations which revealed second and third layers to be mainly clayey sand and lateritic soils of low resistivity values which varied with distance; an indication of leachate migration. The interpretation of electrical resistivity models revealed regions of very low resistivity (14.8 -25.3 Ωm) to be from an average depth of 4.5 m to an average depth of 17.8 m for profile A; and to a maximum depth of 11.3 m for profile B. These regions of very low resistivity could be contamination zones of the subsurface beneath the profiles resulting from leachate seeping into the soil and or groundwater from the waste dump. The result of the heavy metal determination reveal that concentration of heavy metals (water sample collected from hand dug well and soil sample collected at the waste dump site) was more than that of profile C (water sample collected from hand dug well away from the waste dump site). In terms of WHO, 2011 guideline for drinking water quality, Lead, Chromium and Cadmium are above the guideline values in both water samples.

Keywords: Contaminant; Groundwater; Refuse; Sample; Vertical Electrical Sounding

Introduction
There is an ever-increasing demand for fresh water resources to meet the requirements for industrial, agricultural and domestic needs. The over exploitation of groundwater resources and its contamination have put a stress on the available groundwater resources in the country at large and Minna in particular. However, pollution of groundwater resources can occur directly from municipal waste water, industrial discharges, agricultural waste, urban runoff, landfills or waste dump. There is the possibility that the groundwater within the premises of the refuse dump site could have been polluted. Therefore there is need to carry out a geo-electric investigation of the area around the Kpagungun waste dump site; delineate the lithological sequence, identify the aquifer units and use the resistivity values to assess the groundwater quality; evaluate the quality of the groundwater by carrying out chemical analysis of sampled hand dug wells and soil samples; and use it to assess the degree and extent of impact of the waste dump site on the quality of the groundwater in the study area.
Geophysical surveys are useful in the study of most subsurface geologic problems. Such surveys have found enormous applications in hydrogeological studies. Electrical resistivity method of

geophysical technique happens to be the most preferred methods in groundwater contamination studies and hydrogeologic investigations by Mazak *et al*. (1987) and Carpenter *et al*. (1990). However, Electrical resistivity surveys have been found very useful for mapping the resistivity structure of the complex subsurface geology (Singh *et al*., 1985) and the integrated use of hydrochemical and geophysical methods is often recommended (Matlas *et al*., 1994), (Kayabali *et al*., 1998), (Olayinka, and Olayiwola) and (Badmus *et al*., 2001).

Geology of the Study Area

Minna is located between longitude 6.25^{0}E and 6.45^{0}E and latitude 9.24^{0}N and 9.48^{0}N, it occupy the central portion of the Nigerian basement complex. The Minna area comprises of metasedimentary and meta-igneous rocks which have undergone polyphase deformation and metamorphism. These rocks have been intruded by granitic rocks of Pan-African age. Five lithostratigraphic units have been recognized in Minna area (Figure 1). The schist which occur as a flat laying narrow southwest-northeast belt at the central part of Minna with small quartzite ridge parallel to it, the gneiss occur as a small suitesat the northern and southern part of the area forming a contact with the granite. Feldspathic rich pegmatite is bounded to the east, with average width of 65meters and 100 meters long, the pegmatite host tourmaline. Granitic rocks dominate the rock types in the area and vary in texture andcomposition.

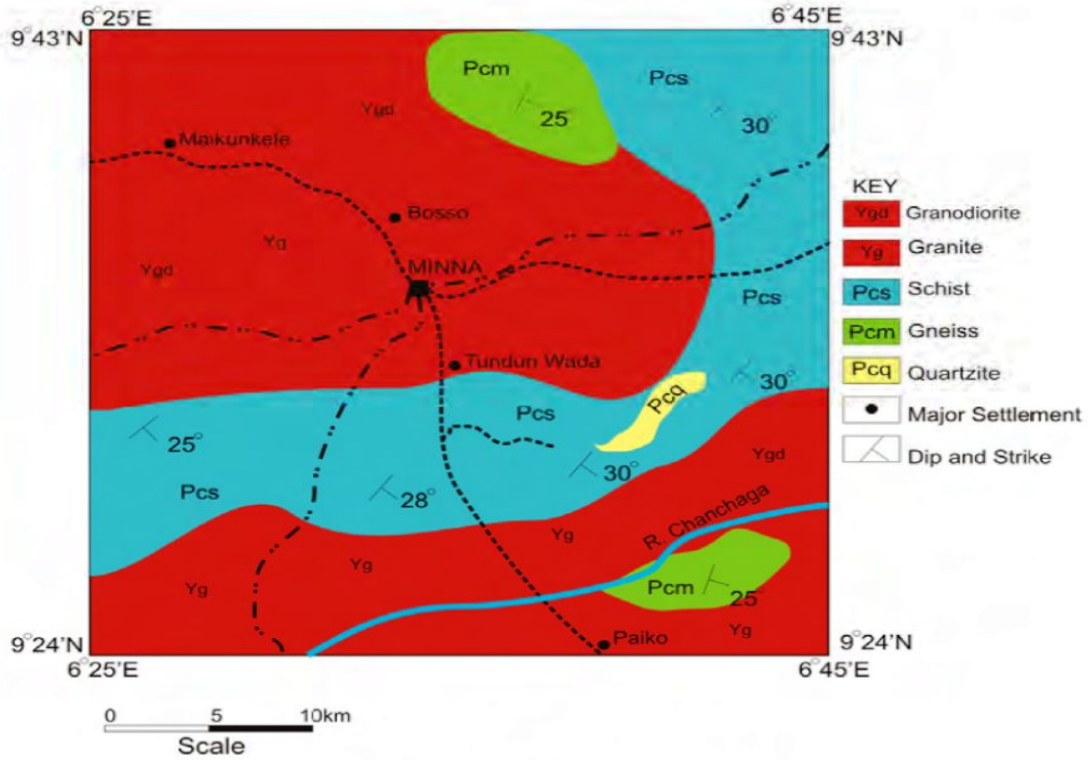


Figure 1: Geology of Minna (after Alabi 2011)

Materials and Methods

The resistivity data acquisition used in this survey was the SAS 4000 ABEM. A minimum of sixteen Schlumberger Vertical Electrical Soundings (VES) with maximum current electrode spacing of 80.0 m were conducted directly inside the dumpsite. Four VES point conducted 200.0 m away from the dumpsite at a location free from temporary dump site served as the control.

Sclumberger array configuration is adopted for this study. A set of nine soil samples were collected around refuse dump from surface and away from refuse disposal siteto a depth of 30 cm and four water sample from existing hand dug wells around the site were collected. Six soil samples inside the dump and three samples at distance of about 200 m away from the dump site and one water sample away from the dump site to serve as control. The cations concentrations were determined using Atomic Absorption Spectrophotometer (AAS). The temperature in (^{O}C) and electrical conductivity (µS/cm) of all groundwater samples were measured and recorded using a Jenway 4010 Conductivity meter. An Oyster Series pH meter calibrated using a buffer 7 solution was used to measure the pH of all groundwater samples. All these physical parameters were determined at time of sampling on the field.

These samples were analysed at laboratory. These heavy metals were analysed for the water samples and soil samples include: Cadmium, Lead, Iron, Calcium, Magnesium, Nickel, Copper, Manganese, Cobalt and Zinc.

Results and Discussion

Table 1 to 3 show the VES results from profile A, profile B and the control site at the Kpagungun refuse dump.

Table 1: General VES results from Profile A during dry season at the Kpagungun Refuse dump

VES NO	**Number of ressitivities of layers(Ωm)**					**Thickness of layers(m)**					**Depth to bottom layers(m)**				
	ρ1	ρ2	ρ3	ρ4	ρ5	t1	t2	t3	t4	t5	d1	d2	d3	d4	d5
1	26.1	20.9	154.0	4241.5		1.0	1.0	2.5	--		1.0	2.1	4.5	--	
2	28.5	101.4	309.0	5296.3		2.0	5.2	4.9	--		2.0	7.2	12.1	--	
3	28.2	14.8	280.4	13956.2		0.9	1.3	3.4	--		0.9	2.2	5.6	--	
4	28.3	15.1	379.9	13735.7		1.0	1.3	3.6	--		1.0	2.2	5.8	--	
5	25.2	25.3	336.3	5695.7		0.8	0.7	14.7	--		0.8	1.5	16.1	--	
6	24.4	20.4	352.2	5347.6		0.7	0.7	14.8	--		0.7	1.4	16.2	--	
7	22.7	240.2	217.0	3968.9		1.4	9.7	6.7			1.4	11.1	17.8	--	
8	22.2	229.2	199.9	4132.4		1.4	9.6	6.6	--		1.4	11.0	17.6	--	

The VES curves in this profile also have been delineated to be a four layer model. VES curves 1, 4 and 6 are HA type curves with configuration $\rho1 > \rho_2 < \rho_3 = H$ and $\rho_1 < \rho_2 < \rho_3 = A$ which equal $\rho_1 > \rho_2 < \rho_3 < \rho_4 = HA$ curve, VES curves2,3 and 5 are AA type curves with configuration $\rho1 < \rho_2 < \rho_3 = A$ and $\rho_1 < \rho_2 < \rho_3 = A$ which equal $\rho_1 < \rho_2 < \rho_3 < \rho_4 = AA$ and VES curves 7 and 8 are KH type curves with configuration $\rho1 < \rho_2 > \rho_3 = K$ and $\rho_1 > \rho_2 < \rho_3 = H$ which equal $\rho_1 > \rho_2 < \rho_3 < \rho_4 = KH$. The resistivity values for the first layer range between 22.2 Ωm and 28.5Ωm, while the corresponding thickness range between 0.7m to 2.0 m and the corresponding depth also range between 0.7 m to 2.0 m. The lowest resistivity is at VES8 and the highest at VES2. The resistivity values for the second layer range between 14.8 Ωm and 240.2 Ωm, while the corresponding thickness range between 0.7 m to 9.7 m and the corresponding depth also range between 1.5 m to 11.1m. The lowest resistivity is at VES3 and the highest at VES7. The third layer resistivity values range between 154.0 Ωm and 379.9 Ωm. The corresponding thickness and depths for the third layer range between 2.5 m and 14.8 m and 5.6 m and 17.8 m respectively. The lowest resistivity is at VES1 and the highest at VES4 The resistivity values for the fourth layer range between 3968.9 Ωm and 13956.2 Ωm. All the VES have cumulative depth that range between 5.6m and 17.8m. The resistivity values for the first layer range between 22.2 Ωm and 28.5 Ωm correspond to leachate (Abdullahi *et al.,* 2010, Omolayo and

Fatoba, 2014) and the resistivity values for the second for some of the VES point show resistivity values that implies sandy soil (permeable), therefore the plume noticed on the surface will percolate in to the groundwater.

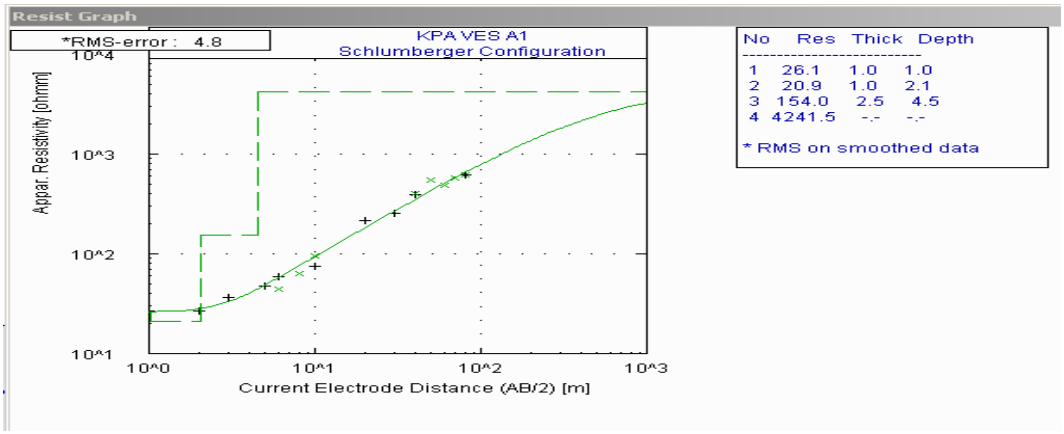


Figure 2: Typical VES curve along Profile A at Kpagungun Refuse dump

Table.2: General VES results from Profile B during dry season at the Kpagungun Refuse dump

	ρ1	ρ2	ρ3	ρ4	ρ5	t1	t2	t3	t4	t5	d1	d2	d3	d4	d5
1	26.7	22.9	2983.0			1.1	1.2	--			1.1	2.3	--		
2	32.6	35.8	3192.8			2.2	1.9	--			2.2	4.1	–		
3	26.9	15.1	13304.8			1.1	1.4	--			1.1	2.54	--		
4	26.5	16.7	12947.8			1.7	9.6	6.6	--		1.7	11.3	17.9	--	
5	22.8	29.8	379.1	5774.1		0.8	0.7	15.3	--		0.8	1.4	16.8	--	
6	25.3	19.8	1669.7			1.7	9.5	6.5	--		1.7	11.6	17.7	--	
7	25.3	20.5	881.3			0.9	0.9	--			0.9	1.8	--		
8	26.7	16.8	306.9	1262.3		0.6	0.7	5.7			0.6	1.4	7.0	--	

The VES curves in this profile are characterised to be a three and four layer model. VES curves 1, 3, 4, 6 and 7 for this profile are H type curves with configuration $\rho 1 > \rho_2 < \rho_3 = H$ and VES curve 2 is an A type with configuration $\rho_1 < \rho_2 < \rho_3 = A$, VES curve 5 is an AA with configuration $\rho 1 < \rho_2 < \rho_3 < \rho_{4=}$ AA and VES8 is HA with configuration $\rho 1 > \rho_2 < \rho_3 = H$ and $\rho_1 < \rho_2 < \rho_3 = A$ which equal $\rho_1 > \rho_2 < \rho_3 < \rho_4 = HA$. The resistivity values for the first layer range between 22.8 Ωm and 32.6 Ωm, while the corresponding thickness range between 0.6m to 2.2 m and the corresponding depth also range between 0.6 m to 2.2 m. The lowest resistivity is at VES3 and the highest at VES1. The resistivity values for the second layer range between 15.1 Ωm and 35.8 Ωm, while the corresponding thickness range between 0.7 m to 9.6 m and the corresponding depth also range between 1.3m to 11.6m. The lowest resistivity is at VES3 and the highest at VES2. The third layer resistivity values range between 306.9 Ωm and 3192.8 Ωm, while the corresponding thickness range between 0.7 m to 9.6 m and the corresponding depth also range between 7.0 m to 17.9 m. The lowest resistivity is at VES8 and the highest at VES3. All the VES have cumulative depth that range between 7.0 m to 17.9 m. The resistivity values for the first layer range between 22.8 Ωm and 32.6 Ωm correspond to leachate (Bayode *et al.,* 2011, Oladunjoye *et al.*, 2011, Jegede *et al.,* 2011).and the resistivity values for the second for some of the VES point show resistivity values that implies sandy soil (permeable), therefore the plume noticed on the surface will percolate in to the groundwater.

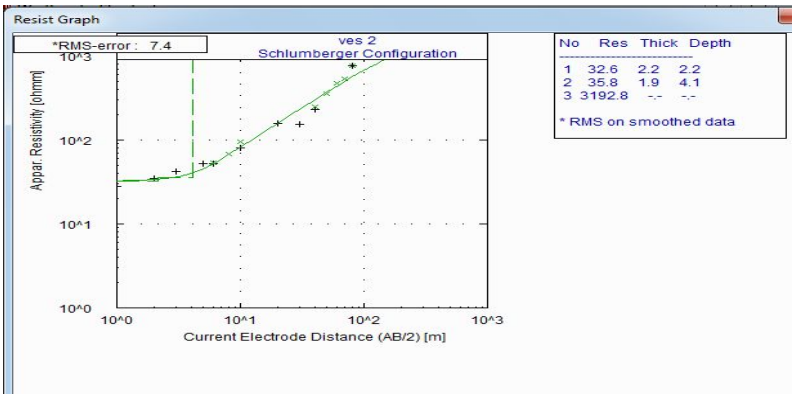


Figure 3: Typical VES curve along Profile B at Kpagungun Refuse dump

Table 3: General VES results from Control site during dry season at the Kpagungun Refuse dump

VES NO	**Number of ressitivities of layers(Ωm)**				**Thickness of layers(m)**				**Depth to** bottom layers(m)			
	ρ1	ρ2	ρ3	ρ4	t1	t2	t3	t4	d1	d2	d3	d4
1	133.1	77.6	632.4	36530.2	1.1	3.3	2.7	--	1.1	4.3	7.0	--
2	132.9	82.2	127.4	38453.4	1.1	2.3	1.8	--	1.1	3.4	5.2	--
3	132.0	114.8	117.1	34124.6	0.9	2.7	2.1	--	0.9	3.6	5.8	--
4	132.4	112.2	103.0	36724.9	0.9	3.1	5.3	--	0.9	3.1	5.3	--

The VES curves in this profile also have been delineated to be a four layer model. VES curves 1 to 3 for this profile are HA type curves with configuration $\rho1 > \rho_2 < \rho_3 = H$ and $\rho_1 < \rho_2 < \rho_3 = A$ which equal $\rho_1 > \rho_2 < \rho_3 < \rho_4 = HA$ curve and VES curve 4 is a QH curve with configuration $\rho1 > \rho_2 > \rho_3 = Q$ and $\rho1 > \rho_2 < \rho_3 = H$ which equal $\rho1 > \rho_2 > \rho_3 < \rho_4 = QH$. The resistivity values for the first layer range between 132.0 Ωm and 133.1 Ωm, while the corresponding thickness range between 0.9m to 1.1 m and the corresponding depth also range between 0.9 m to 1.1 m. The lowest resistivity is at VES5 and the highest at VES2. The resistivity values for the second layer range between 77.6 Ωm and 114.8 Ωm, while the corresponding thickness range between 2.3 m to 3.3 m and the corresponding depth also range between 3.1 m to 4.3 m. The lowest resistivity is at VES1 and the highest at VES3. The third layer resistivity values range between 103.0 Ωm and 632.4 Ωm. The corresponding thickness and depths for the third layer range between 2.3 m and 3.3m and 5.2 m and 7.0 m respectively. The lowest resistivity is at VES4 and the highest at VES1. The resistivity values for the fourth layer range between 34124.6Ωm and 38453.4 Ωm. The resistivity values for the first layer range between 132.0 Ωm and 133.1 Ωm implies sandy soil and resistivity values for the second layer range between 77.6Ω m and 114.8 Ωm implies clay soil (impermeable) (Egwebe *et al*., 2007), thus the groundwater at this site is free from contamination (Adabanija and Alabi, 2014). All the VES have cumulative depth that range between 5.2 m and 7.0 m. All the VES points in this profile are shallow as seen in the hand dug wells within the vicinity of the refuse dump.

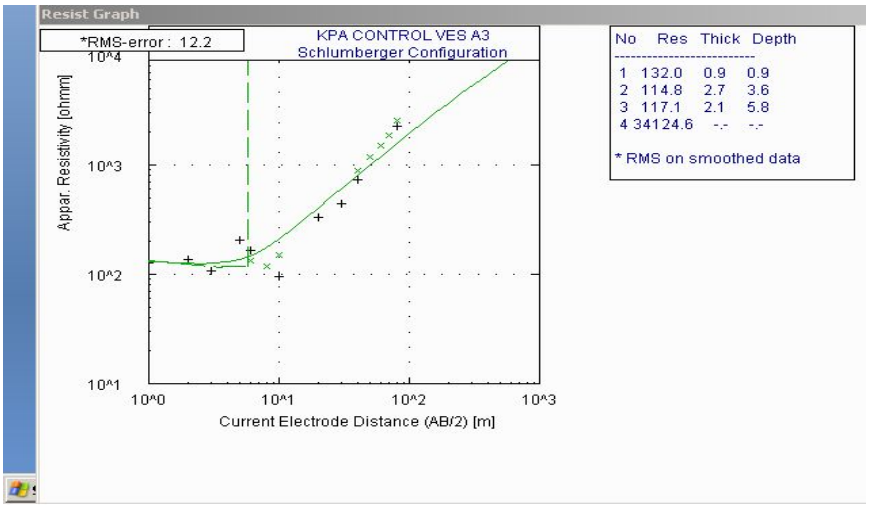


Figure 4: Typical VES curve along Profile C at Kpagungun Refuse dump

Table 4: Physio-Chemical Analysis of Hand Dug Wells in Kpagungun refuse dump

Parameter	Unit	Well A	Well B	Well C	Control Well	WHO
Temp	^{O}C	22.7	27.0	24.0	30.7	40
pH		7.02	7.57	7.14	7.64	6.5-9.2
Conductivity	µS/cm	793	787	793	87	100
Alkalinity	mg/l	1,150	1,440	1,180	169	200
Acidity	mg/l	33	88	83	37	
TDS	mg/l	800	1400	1300	220	500-550
Total Hardness	mg/l	66	66	63	50	500
Zinc	mg/l	0.05913	0.08483	0.07198	0.0005	3.0
Lead	mg/l	0.19231	0.00000	0.38462	0.0000	0.001
Manganese	mg/l	0.22857	0.15714	0.08571	0.0023	0.5
Iron	mg/l	0.06757	0.03378	0.03378	0.0125	0.3
Copper	mg/l	0.00000	0.25000	0.25000	0.0000	2.0
Chromium	mg/l	1.25000	0.41667	0.83333	0.0062	0.05
Nitrogen	mg/l	0.00000	0.00000	0.00000	0.0000	
Cobalt	mg/l	0.02857	0.00000	0.02857	0.0001	
Cadmium	mg/l	0.09697	0.00606	0.00606	0.0012	0.003

The temperature for the groundwater in the study area ranged between 22.7 ^{O}C and 27.0 ^{O}C which is below WHO limits and the control well has a temperature of 30.7 ^{O}C. The Groundwater pH value for Kpagungun well averaged 7.24, while pH value for control well is 7.64. The pH values for both wells as well as control well meet the WHO standard. The value of alkalinity for wells A and B are above WHO limits, while the value for Well C is within allowable limits. The Total Dissolve Solid and Total Hardness are lower than WHO allowable limit. Water in this area is found to be contaminated by Lead, Chromium and Cadmium with level of contamination exceeds WHO regulated guidelines, this is similar to work of Jegede e*t al.,* 2011 and Adabanija and Alabi 2014.

Table 5: Physio-Chemical Analysis of Soil Samples in Kpagungun refuse dump

Location	pH	Zn (mg/Kg)	Pb (mg/Kg)	Mn (mg/Kg)	Fe (mg/Kg)	Cu (mg/Kg)	Cr (mg/Kg)	Ni (mg/Kg)	Co (mg/Kg)	Cd (mg/Kg)
KG1	6.81	6.8123	9.61539	18.57140	6.7568	50.00000	125.0000	30.0000	8.5714	0.7369
KG2	6.62	4.8843	9.43271	15.00000	5.3649	37.50000	62.50000	25.0000	5.2857	0.5445
KG3	6.51	4.2417	9.15385	11.42860	4.9716	25.00000	57.30010	20.0000	4.8571	0.3683
KG4	6.41	3.5990	8.72539	7.85714	3.3784	20.00000	41.66670	15.0000	3.5322	0.2312
KG5	6.92	3.2561	8.02583	4.28571	2.8046	16.50000	36.62801	10.0000	2.4286	0.1674
KG6	6.42	2.9563	7.83517	3.21486	1.6892	12.50000	20.83330	6.00000	1.6246	0.0863
Min	6.41	2.9563	7.83517	3.21486	1.6892	12.5000	20.8333	6.0000	1.6246	0.0863
Max	6.92	6.8123	9.61539	18.57140	6.7568	50.00000	125.0000	30.0000	8.5714	0.7369
Mean	6.62	4.2916	8.7981	10.0596	4.1609	26.9166	57.3214	17.6667	4.3833	0.3558
S.D	0.21	1.4172	.7384	6.0625	1.8658	14.2317	36.3645	9.0921	2.4793	0.3334
KGC1	6.18	0.0017	0.0000	0.0072	0.0014	0.0000	1.0057	0.0000	0.0056	0.0004
KGC2	6.25	0.0128	0.0058	0.0156	1.0010	3.5000	2.0000	1.0000	0.0084	0.0003
KGC3	6.30	0.0010	0.0000	0.0018	0.0031	5.0000	4.6667	2.0000	0.0064	0.0011
Min	6.18	0.0010	0.0000	0.0018	0.0010	0.0000	1.0057	0.0000	0.0056	0.0003
Max	6.30	0.0128	0.0058	0.0156	1.0010	5.0000	4.6667	2.0000	0.0084	0.0011
Mean	6.24	0.0052	0. 0019	0.0082	0.3352	2.8333	2.5575	1.0000	0 .0068	.0008
S.D	0.06	0 .0067	0. 0033	0.0.070	0.5767	2.5658	1.8931	1.0000	.0015	0.0004

KG: Kpagungun, KGC: Kpagungun Control

In all the metals analysed, the concentrations are higher at distance 10 m from the centre of each dumpsite and decreases as distance increases to 60 m. The concentrations further decrease at control points of about 200 m away from three sides of the refuse dump. This trend is observed in Awokunmi *et al.,* (2010) and Riziki (2010). This trend showed that the concentration of heavy metals is due to the effect of waste disposal. The pH value for all points at all the sites is less than 7. 0 this implies slightly acidic. Bahaaeldin *et al.*, (2010) found that the average value for pH was 6.7 for municipal landfill leachate indicating the young leachate and waste degradation was at its late stage of acidic phase. The values for the present study also fall within this range. These values imply that the pH of the soil within the study area is acidic and are probably due to the leaching of organic acids from decaying vegetation (Alile *et al.,* 2010).

Conclusion

This study has revealed probable contamination zone beneath the subsurface where the waste dump site is located and this contamination zone is a region of very low resistivity (14.8- 35.8 Ωm) which could result from metals (heavy metals inclusive) entering the soil and ground water from the waste dump site while the heavy metal determination revealed some of the heavy metals that result in such very low resistivity values. The hydrogeologic features of the study areas indicated that contaminants derived from the waste disposal sites infiltrate through the vulnerable sandy aquifer and hence to the groundwater flow. This suggests that the soil and the groundwater system had been contaminated beyond the depth of 17.8 m in the study area. Combining the results of the resistivity survey and the heavy metal determination helped to reveal probable ground water contamination zones and the heavy metals that could result in the contamination.

References

Abdullahi, N. K., Osazuwa, I. B. & Onugba, A. (2010). Detecting municipal solid waste leachate plumes through electrical resistivity survey and physio-chemical analysis of Ground water samples. *Journal of Amereican Science,* 6(8).

Alabi, A. A. (2011). Geology and environmental impact assessment and benefit of granitic rock of Minna Area, Northwestern Nigeria. *Ethiopian Journal of Environmental Studies and Management,* 4(4).

Alile, O. M. & Emekeme, R. E. (2010). Subsurface probe and hydrochemical analysis for the purpose of sitting waste landfill. *African Journal of Environmental Science and Technology* (AJEST), 4(1).

Awokunmi, E. E., Asaolu, S. S. & Ipinmoroti, K. O. (2010). Effect of leaching on heavy metals concentration of soil in some dumpsites. *African Journal of Environmental Science and Technology (AJEST),* 4(8).

Badmus. B. S., Odenwande, A. A., & Oyedele, T. (2001). Leachate contamination effect on groundwater exploration. *African Journal of Environmental Studies,* 2(1), 38 - 41.

Bahaa-eidin, E. A. R., Yusoff, I., Samsudin, A. R., Yaacob, W. Z. W. & Rafek, A. G. M. (2010). Deterioration of groundwater quality in the vicinity of an active open-tipping site in West Malaysia. *Hydrogeology.*

Bayode, S., Omosuyi, G. O., Mogaji, K. A. & Adebayo, S. T. (2011). Geoelectrical delineation of strucuturally-controlled leachate plume around Otutubiosun dumpsite, Akure, Southwestern Nigeria. *Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS),* 2(6).

Carpenter, P. J., Kaufmanna, R. S. & Price, B. (1990). Use of resistivity soundings to determine landfill structure. *Groundwater*, 28,569-575.

Egwebe, O., Aigbun, C. O. & Ifedi, S. O. (2007). Geoelectrical evaluation of waste dump sites in Warri and its environs, Delta State, Nigeria. *Journal of Applied Sciences and Environment Management (JASEM),* 11(2).

Jegede, S. I., Osazuwa, I. B. & Abdullahi, N. K. (2011). Geoenvironmental study of groundwater contamination in a dual aquifer environment using earth resistivity imaging. *Journal of American Science,* 7(2).

Kayabali, K., Yueksel, F. A. & Yeken, T. (1998). Integrated use of hydrochemistry and resistivity methods in groundwater contamination caused by a recently closed solid waste site. *Environmental Geology*, 36(3 & 4), 227 - 234.

Matlas, M. S., Marques, B., DeSilva, M., Ferreira, P. & Ramalho, E. (1994). A geophysical and hydrochemical study of aquifer contamination by landfill. *Journal of Applied Geophysics,* 32, 155-162.

Oladunjoye, M. A., Olayinka, A. I. & Amidu, S. A. (2011). Geoelectrical Imaging at an abandoned waste dump site in Ibadan Southwestrn Nigeria. *Journal of Applied Sciences,* 11(22).

Olayinka, A. I. & Olayiwola, M. A. (2001). Integrated use of geoelectrical imaging and hydrochemical methods in delineating limits of polluted surface and groundwater at a landfill site in Ibadan area. Southwestern. *Nigeria Journal of Mining and Geology*, 37(1), 53-68.

Omolayo, D. & Fatoba, J. T. (2014). 2D electrical imaging surveys for leachate plume migration at an old dump site in Ibadan South Western Nigeria: A Case Study*. International Journal of Geophysics, Article ID 879530, 6.*

Riziki, S. S. (2010). Heavy metal concentrations in soils and leachates of mtoni dumpsite bordering the Indian Ocean in Dares Salaam, Tanzania. *Scientific Research and Essays,* 5(16).

Singh, S. B., Dhar, R. L. & Gupta, C. P. (1985). Application of deep resistivity soundings for groundwater exploration in Barmer district, Rajastan. Technical report, NGRI-91-Environment – 102 (17).

JOSTMED, VOLUME 11(3), DECEMBER, 2015

ARTICLES AND RESEARCH REPORTS ON TECHNOLOGY

MARKETING OF FUEL WOOD AS SOURCE OF LIVELIHOOD TO RURAL WOMEN IN SELECTED VILLAGES OF KWARA STATE, NIGERIA

OGUNLADE, I.; AJILORE, O. R. & ADEBAYO, S. A.
Department of Agricultural Extension and Rural Development,
University of Ilorin, Kwara state Nigeria
E-mail: sijuadeadebayo@yahoo.com; Phone No: +234-816-517-4309

Abstract

This study determined the contribution of marketing of fuelwood to rural women livelihood in selected villages in Kwara State with a view of assessing the effect on the environment. A snowball sampling method was used to sample 60 respondents who were interviewed for the primary data. Data were analysed using percentages, means and standard deviation while linear regression was used to test for the hypothesis.The finding showsthat the mean age is 43 years. Majority of the respondents were married (71.7 %) and had a male headed household (68.3%). The study also reveals that all the respondents (100%) cut down and pick dead woods, 78.3% used cutlass, 83.3% hired trunk for transporting the wood from forest to their various destinations and 66.7% covered a distance of above 2km. It was also found that 91.7% of the respondents were aware that cutting down trees from the forest could result to forest decimation and extinction of some wood species. It was also discovered that 53.3% of the respondents earned below ₦10000 per monthfrom fuelwood business while 28.3% earned above ₦18000 as their monthly total income.The linear regression result shows that income from fuel wood ($p<0.01$) contribute significantly to the rural women livelihood. Therefore, the study recommends that women should be encouraged to go into forest farming so as to increase their income. However, government should set policies that will discourage cutting down and burningof trees in the forest reserve areas.

Keywords: Fuelwood; Marketing; Livelihood; Rural women

Introduction

Fuel wood marketing has helped in the past towards poverty reduction and increase the livelihood of the rural people most especially the women. The rural population relies on fuel wood both for cooking and as a livelihood option. The findings of *Arnold (2003*) shows that forest products are consumed directly or exchanged both inside and outside formal market. In the Nigeria for instance, 80 % of the households rely on fuel wood for cooking *(Chirwa et al., 2008).*

However, harvesting fuelwood contributes to deforestation, soil erosion and loss of agriculture and grazing environments, with serious impacts on livelihood opportunities in agriculture and forestry. Over time, over-reliance on fuel wood has led to shortages of wood around those woodlands (Shackleton, 2004). Moreover, the report of FAO (2001) reveals that biodiversity and nutrient losses are major concern of fuel wood consumption because about 191 tree species are endangered while a number of animal species and small plants are threatened due to forest conversion. Nigerian rural women occupy an important position in improving livelihood, food security, nutrition, and health of families, communities and the nation. However, they engage in low-income activities; poor livelihood options that have serious implications on their livelihood status and overall well-being. The deteriorating livelihood security among the rural population would have profound implication for a nation as a whole. This study therefore seeks to

investigate the extent to which the sale and use of fuel wood can contribute to women's livelihood and to identify the effect of collection of fuel wood from the forest on the environment. The specific objectives of this study are to examine the methods the rural women use in collection of the fuel wood:

(i) determine the perceived effects ofcutting down trees to the environment by the rural women.
(ii) examine the fuel wood sellers' knowledge of wood fuel for effective pricing.
(iii) determine the constraints faced by the rural women selling fuel wood.
(iv) investigate the poverty profile of the rural women.

Hypothesis

Ho_1: There is no significant relationship between socio economics characteristics of the rural women selling fuel wood and their livelihood.

Methodology

Study area

The study was carried out in Kwara state Nigeria.Kwara state which is one of the 36 states in Nigeria came into existence on 27th May, 1967. It is located between latitudes 7°45 and 9°30 and longitude 2°30 and 6°25 east on the prime meridian. The name kwara was derived from the native appellation for River Niger, the longest river in Nigeria which is 1174.6km long (Adekunle, 2006). Kwara state is bounded in the north by Niger state, in the south by Oyo, Osun and Ekiti in the east and in the west by Benin Republic. It is located in the NorthWestern Nigeria and because of this unique geographical location; the state is referred to as the 'gateway' between the north and the south of the country. The topography is mainly plain to slightly gentle rolling lands. The annual rainfall ranges between1000mm and 1500mm and it has two distinct season, rainy and dry season. Average temperature ranges between 30°C and 35°C. Kwara state covers the area of 36825 squarekilometers and has a population of about 2591555. The state is divided into 3 senatorial district which are kwara south, kwara central and kwara north and it has 16 Local Government Areas. Agriculture is the main stay of the economy and 72% of the population is engaged in this sector. The state provides food crops such as maize, cassava, sweet potato, cassava, banana, cocoyam, onion, sweet potatoes, vegetables and livestock such as goat, sheep, cattle and poultry.The study was carried out in some selected villages surrounding Ilorin, kwara state. Ilorin metropolis consists of 3 Local Government Areas-Ilorin East, West and South. It is located on Latitude 8°30'N and Longitude 4°35'E. The city emerged as the Kwara State capital in 1967, during the creation of 12 states in Nigeria by the defunct military era. Both physical and structural expansion of the city started from this period and it is almost impossible to distinguish other three LGA'S that are parts of the mother town within the city center.

Population of the study

The population for this study was all the rural women selling fuelwood in villages around Ilorin, Kwara state.

Sampling procedure and sample size

The sampling technique involves purposive selection of women selling fuel wood in the villages around Ilorin. A total of 60 rural women selling fuel wood were selected. Interview schedule

was used to elicit information from the respondents. Data were analyzed using percentage, mean and standard deviation while linear regression was used in testing the hypothesis.

Results and Discussion

Socio- economic characteristics of the respondents

Table 1 shows the socio-economic characteristics of the respondents. The result reveals that 35% of the respondents were between 30-39 years and 50+ years. About 18.4% of the respondents were between 40-49 years. The mean age is 43. This implies that majority of the women were youth. Majority of the women were married (71.7%). Many of the respondents have non-formal education (33.3%) and 28.3 % of them had primary education. Majority of the respondents have small household size (66.7%), male headed household (68.3%) and 70% of the respondents had fuelwood marketing as their main occupation.The result implies that the respondents have very low educational level and can easily be engaged in merger activities to earn a livelihood. Moreover, the finding implies that fuel wood collection and marketing is really a source of livelihood to the respondent because majority of them were involved in the activities solely. The result is in line with findings of Sultana (2006) who reported that villagers living in and outside the park earn between 62% -100% of their total household income from fuel wood in Bangladesh.

Table 1: Personal characteristics of the respondents

Variables	Frequency	Percentages (%)
Age		
20-29	7	11.60
30-39	21	35.00
40-49	11	18.40
50 above	21	35.00
Total	60	100
Marital status		
Married	43	71.70
Separated	4	6.70
divorced	2	3.30
Widow	11	18.30
Total	60	100
Education		
Non formal	20	33.30
Quaranic	12	20
Adult	4	6.70
Primary	17	28.30
Secondary	7	11.70
Total	60	100
Family size		
1-5	40	66.70
6-10	20	33.30
Total	60	100
Household head		
Woman	19	31.70
Man	41	68.30

Total	60	100
Main occupation		
Fuel wood seller	42	70.0
Petty trader	11	18.30
Labourer	3	5.00
Artisans	1	1.70
Farmers	3	5.00
Total	60	100

Source: Field study 2013

Method used in fuel wood collection by the rural women

Table 2 shows the methods used by the women to collect fuel wood. The result reveals that all the respondents (100%) cut down and pick dead woods, 71.7% cut down life trees and allow to dry, 51.7% engaged in burning up life trees and cutting them down, 85% collected branches of trees that were cut down for other purposes. About 78.3% used cutlass to cut fuel wood, 75% used sawing machine and 73.3% used axe. This result implies that the women collect fuel wood both manually and mechanically. Collecting the fuel wood manually will limit the amount of fuel wood they can gather and the amount of sales they can make daily whereas where machine is available to cut down the trees will make enough fuel wood available for sale and thereby increase their income.

Table 2: Distribution of respondents according to the methods used in collecting fuel wood

Methods	Frequency	Percentages
Cut down and pick dead woods		
Used	60	100
Not used		
Total	60	100
Cut down life trees and allow to dry		
Used	43	71.70
Not used	17	28.30
Total	60	100
Burn up life trees and cut down		
Used	31	51.70
Not used	29	48.30
Total	60	100
The branches of trees cut down for other purposes		
Used	51	85
Not used	9	15
Total	60	100
Tools used for cutting down trees (Cutlass)		
Used	47	78.30
Not used	13	21.7
Total	60	100
Tools used for cutting down trees (saw machine)		
Used	45	75
Not used	15	25
Total	60	100

Tools used for cutting down trees (Axe)		
Used	44	73.30
Not used	16	26.70
Total	60	100

Source: Field study 2013

Methods of transporting fuel wood by the rural women

Majority of the respondents used hired truck (83.30 %) as means of transportation while 36.70% used head potage for wood transportation. The majority of the women (66.7 %) traveled above 2km before they could get fuel wood, 31.7% traveled between 1 and 2km while just 25% travel below 1km before getting fuel wood. The result implies that the rural women depend on hired tuck to convey the fuel wood to the market locations. This can be made possible when they gather their resources together to hire the truck and put their wares together to be transported to the location. Naibbi (2015) in the study conducted in northern part of Nigeria discovered that fuel wood collector usually hire a truck for the trip. The operation is called 'Dandi' whereby the workers that engaged in the procurement of fuelwood, hire a vehicle for a day trip.Moreover, the result further implies that fuel wood is more of forest activity because the women can only get sufficient fuel wood in the forest and not in the neighborhood.The result is in line with the report of Preston (2012) who found that women cover an average distance of 3.86 kilometers to collect fuel wood in Tanzania.

Table 3: Distribution of respondents according to the methods used in transporting fuel wood

Method of transportation of fuel wood	Frequency	Percentages
Head potage		
Used	22	36.70
Not used	38	63.30
Total	60	100
Hire truck		
Used	50	83.30
Not used	10	16.70
Total	60	100
My own truck		
Used	6	10
Not used	54	90
Total	60	100
Wheel barrow		
Used	5	8.30
Not used	55	91.70
Total	60	100
Distance covered to get fuelwood		
Less than 1 km	15	25
1km – 2km	19	31.70
2km and above	40	66.70

Source: Field study 2013

Perceived Effects of Cutting Down Trees on the Environment

Table 4 showed the level of awareness of perceived effects of cutting down trees to the environment. The findings show that 80% of the rural women selling fuelwood were aware that cutting trees leads to deforestation, soil erosion (53.3%), global warming and land degradation(55%), forest degradation (86.7%) and 91.7% each were aware of decimation of wood land and extinction of some wood species as effects of cutting trees to the environment. This result confirms the report of Sileshi et al., (2007) who discovered that biodiversity and nutrient losses have been cited as the major concern in African wood lands. Moreover, Ishaya et al, (2009) in the study conducted in Nigeria showed that women acknowledge the fact that collection of fuel wood in the environment has really affected the vegetation cover of its natural plants.

Table 4: Distribution of respondents by level of awareness of perceived effects of cutting trees on the environment

Level of awareness on effects of cutting trees	Frequency	Percentage
Deforestation: destruction of trees		
Aware	48	80
Not aware	12	20
Total	60	100
Soil erosion: washing away of the soil		
Aware	32	53.30
Not aware	28	46.70
Total	60	100
Global warming: keep the environment warm		
Aware	33	55
Not aware	27	45
Total	60	100
Land degradation: loss of land dignity		
Aware	33	55
Not aware	27	45
Total	60	100
Forest degradation: loss of forest dignity		
Aware	52	86.70
Not aware	8	13.30
Total	60	100
Decimation of wood land: decrease in wood land		
Aware	55	91.70
Not aware	5	8.30
Total	60	100
Extinction of some wood species: eradication of some wood species		
Aware	55	91.70
Not aware	5	8.30
Total	60	100

Fuel wood sellers' knowledge of woodfuel for effective pricing

Table 5reveals fuel wood sellers' knowledge on effective pricing of wood fuel. Majority of the respondents (95%) know the wood fuel that most produces heat in order of *igieemi, igiayin,*

igiidi and igiyanfa take the least in heat production. In terms of smoke production, 90% of the women identified that *igiyanfa* produces smoke most while *igiayin and igieemi* take the least in smoke production.Majority of the respondents (88.7%) identified *Igieemi*as the most easily split fuelwood, followed by igiara and igiidi which are 38.3% and 7% respectively.The result implies that the value or quality of the fuel wood will determine its price because fuel wood that produces heat easily and can be easily split will reduce drudgery and will attract buyers, therefore, the price will be reasonably better. However, fuel wood that produces a lot of smoke and cannot be easily split may not attract buyers on time and the price may be fairly low.

Table 5: Distribution of respondents by their knowledge of fuel wood for effective pricing

Wood type	Heat value		Smoke production		Easily split	
	Yes	No	Yes	No	Yes	No
Igiayin(*Anogeissusleiocarpus)Kane tree*	57 (95)	3 (5)	2 (3.3)	58 (96.70)	7 (11.70)	53 (88.3)
Igieemi (*Butyrospermumparadoxum*) Shea butter tree	57 (95)	3 (5)	2 (3.3)	58 (96.7)	53 (88.3)	7 (11.70)
Igiseedun	27 (45)	33 (55)	4 (6.7)	56 (93.3)	20 (33.3)	40 (66.7)
Igiara (*Pterocarpuserinaceus) African teak*	36 (60)	24 (40)	14 (23.3)	46 (76.7)	23 (38.3)	37 (61.7)
Igiidi*(Terminaliaschimperiana*	46 (76.7)	14 (23.3)	18 (30)	42 (70)	23 (38.3)	37 (61.7)
Igiyanfa	14 (23.3)	46 (76.7)	54 (90)	6 (10)	26 (43.3)	34 (56.7)

Note: Percentages are in parenthesis

Constraints faced by the rural women selling fuel wood

Table 6 shows constraints faced by the rural women selling fuel wood. The findings reveals that transportation problem, poor road condition, scarcity of labour and unavailability of market are not regarded as severe problem because they fall below cut off mean of 2.00 however long distance to forest is regarded as a severe problem because it is above the cut off mean of 2.00. The findings of Ishaya et al, (2009) confirms this result that in recent times women and children have to walk longer distance to get fuel wood.

Constraints	Very severe	Severe	Less severe	Mean	SD
Transportation problem	8 (13.3)	14 (23.3)	3 (63.3)	1.50	0.725
Poor road condition	14 (23.3)	16 (26.7)	30 (50)	1.73	0.821
Scarcity of labour	9 (15)	10 (16.7)	41(68.3)	1.47	0.747
Unavailability of market	6 (10)	22 (36.7)	32 (53.3)	1.57	0.673
Long distance to forest	20 (33.3)	21(35)	19 (31.7)	2.02	0.813

Note: Percentages are in parenthesis

Poverty Profile of The Rural Women Selling Fuelwood

Table 7 shows the poverty profile of the rural women selling fuel wood. The study revealed that about half of the respondents(53.3%) earned below ₦10000 per month, 26.6% earned between ₦10000 and ₦18000 per month on fuelwood marketing alone, while 20.1% earned above ₦18000. The findings further showed that 31.7% of the women earn below ₦10000 as monthly total income, 40% earn between ₦10000 and ₦18000 and 28.3% earn above ₦18000. Those that leave below ₦10000 per month can be regarded as being poor because they leave below 2 US dollars per day, those that earn between ₦10000 and ₦18000 per month can be regarded as being above poverty level because they are able to afford 2 US dollars per day and they take the largest percentage which signifies that majority of the fuelwood sellers are above poverty level. Those that earn above ₦18000 are relatively okay because they earn up to Nigeria minimum wage set by the Federal Government of Nigeria, 2010.

Table 7: Distribution of respondents by their income

Fuel wood	Frequency	Percentage
Income/Month (₦)		
Below 10000	32	53.3
10000 -18000	16	26.6
Above 18000	12	20.1
Total Income/Month (₦)		
Below 10000	19	31.7
10000 - 18000	24	40
Above 18000	17	28.3

Testing of hypothesis

Ho_1: There is no significant relationship between the social economics characteristics of the rural women selling fuel wood and their livelihood

The linear regression analysis as shown in table 8 reveals that all the socio economic characteristics under consideration except income from fuel wood did not contribute significantly to the rural women livelihood. It was only fuel wood income that is significant at 1%. This implies that as their income from fuel wood increases they are able to engage in more livelihood activities.

Table 8: Regression analysis of the socio economics characteristics of the rural women selling fuel wood and their livelihood

Livelihood	Coefficient	Std error	T	P>/t
Age	-8.99	7.05	-1.27	0.28
Education	0.04	3.15	0.01	0.99
Household size	5.10	3.51	1.45	0.15
Total income	-1.28	4.88	-0.26	0.79
constraints	0.79	6.98	0.11	0.91
Fuel wood income	14.09	4.24	3.33*	0.00
Constant	-19.96	42.86	-0.47	0.64

F (6, 53) = 7.44
R squared = 0.4573
Adjusted R-squared = 0.3958

Conclusion and recommendations

The results of the study revealed that fuel wood marketing has contributed to the livelihood of the rural women selling because their total household incomeis obtained from it. Besides, the women are aware of its effect on the environment. Therefore, the forest extension agents should enlighten the women to go into forest farming so as to increase their income. However, government should set policies that will discourage cutting down and burning of trees in the forest reserve areas.

References

Arnold, M., K. Köhlin, R. & Persson, G. S. (2003). Fuelwood revisited: What has changed in the last decade? *Occasional Paper 39,* CIFOR, Jakarta.

Chirwa, P. W., Akinnifesi, F. K., Sileshi, G., Syampungani, S., Kalaba, F. K. & Ajayi, O. C. (2008). Opportunity for conserving and utilizing agrobiodiversity through agroforestry in Southern Africa. *Biodiversity,* 9(1&2), 45 - 48.

FAO (2001). *State of the world's forests.* Rome, Italy: Food and Agriculture Organization of the United Nations.

Ishaya, S., Grace, J., Maisamari, A. & Mohammed, A. M. (2009). Fuelwood scarcity: Women's perception, experience and adaptation strategies in Gwagwalada Area Council, Nigeria. *Advances in Natural and Applied Sciences,* 3(1), 79 - 84.

Naibbi, A. I. (2015). Traditional energy discourse: Situation analysis of urban fuelwood sourcing in Northern Nigeria. *Resources and Environment,* 5(6), 192 - 199.

Preston, K. M. (2012). *Fuelwood collection and consumption: A Case Study in Lupeta, Tanzania.* A Thesis Submitted in partial fulfillment of the requirements for the degree of Master of Science in Forestry Michigan Technological University.

Shackleton, C. M. & Shackleton, S. E., (2004a). The use of woodland resources for direct household provisioning. In: M. J. Lawes, H. C. Eeley, C. M. Shackleton & B. S. Geach, (Eds.), *Indigenous forests and woodland in South Africa: Policy, people and practice*. Pietermaritzburg: *University of KwaZulu-Natal Press*. 195–226.

Sileshi, G., Akinnifesi, F. K., Ajayi, O. C., Chakeredza, S., Kaonga, M. & Matakala, P. W. (2007). Contributions of agroforestry to ecosystem services in the miomboecoregion of eastern and southern Africa. *African Journal of Environmental Science and Technology,* 1(4), 68-80.

Sultana, R. (2006). *Linking fuel wood collection and community livelihoods in Satchari National park.*

RELATIONSHIP BETWEEN BASIC MORPHOMETRIC MEASUREMENTS AND CROSS CARCASS VARIATION IN THE BODY PARTS OF TRUNK FISH (*MORMYRUS RUME)* FROM AGAIE- LAPAI DAM, NIGER STATE, NIGERIA

BAKE, G. G., KOLO, A. W., KPOTUN, A. & SADIKU, S. O. E.
Water Resources, Aquaculture and Fisheries Technology Department,
School of Agriculture & Agric Technology, Federal University of Technology, Minna, Nigeria
E-mail: gabbygana@yahoo.co.uk Phone No: +234-80-6285-0992

Abstract

A total of 91 Mormyrus rume specimen of various sizes were collected from Agaie – Lapai dam (Niger State) Nigeria, fourth nightly using gill nets, hook and line and cast nets, to evaluate the relationship between basic morphometric measurements, growth pattern, proximate composition of the whole body and cross carcass variation in its body parts using length weight relationship (LWR), condition factor (K) and laboratory analysis. The result of the basic biometric measurement of the specimens showed that Mormyrus rume from Agaie–Lapai dam had mean standard length of 34.08±3.28cm, total length of 37.71±3.57cm with a corresponding body weight ranges between 279.25-520g. The growth pattern analysis depicted that the fish was negative allometric with b value of 2.57 and condition factor "K" ranged from 0.73 – 1.21 with a mean value of 1.00±0.09. The results of the whole body proximate composition and cross carcass composition of its body parts showed that there was an inverse relationship between the body lipid and moisture in the whole body composition and that moisture was highest in the fish body in October and lowest in July while lipid was highest in June and lowest in October. Cross carcass variation of various parts of the fish showed that moisture ranged between 56.67-70.49 and was significantly higher in the fillet than other regions examined, the crude protein value ranged between 17.83-25.26% and the skin had the highest significant value, the lipid and ash ranged from 7.29-10.32% ;and the ash ranged from 2.02-6.40%, while the head region having the highest significant value in both the lipid and the ash values. It could be concluded that the M. rume of Agaie-Lapai depicted a strong significant correlation between the length and weight and the growth exponent "b" indicated a negative allometric growth pattern with a (K) value index above 1. Proximate analysis showed that the lipid and moisture were inversely proportional in the body of the fish while other nutrients in the body of the fish did not fluctuate significantly over time and nutrients were not evenly distributed among the body parts.

Key words: growth pattern, length- weight relationship, K value, cross carcass variation

Introduction

Length and weight data are useful standard results of fish sampling programs (Morato *et al.,* 2001). In fish, size is generally more biologically relevant than age, mainly because several ecological and physiological factors are more size-dependent than age-dependent. Consequently, variability in size has important implications for diverse aspects of fisheries science and population dynamics (Erzini, 1994). Length-weight regressions have been used frequently to estimate weight from length because direct weight measurements can be time-consuming in the field (Sinovcic *et al.,* 2004). One of the most commonly used analyses of fisheries data is length-weight relationship (Mendes *et al.,* 2004). The morphometric relationships between length and weight can be used to assess the well being of individuals and to determine possible differences between separate unit stocks of the same species (King,

2007). In addition, length-weight relationships are also important in fisheries management for comparative growth studies (Moutopoulos and Stergiou, 2002). Pauly (1993) stated that length-weight relationship (LWR) provides valuable information on the habitat where the fish lives while Kulbicki *et al.* (2005) stressed the importance of LWR in modelling aquatic ecosystems.

The importance of fish and fisheries product in developing countries is on the increase. Foran *et al.* (2005) reported that fish is a highly proteinous food. Therefore, considering the nutritional benefits associated with fish consumption, it has become important that fish's mineral and proximate composition be assessed in order to establish the safety level of the table sized species before consumption. Furthermore, research has shown that fish is much more than just alternative source of animal protein. Fish oil is the richest source of fat that are essential for the normal brain development in unborn babies and infants. Health benefits of fish meat has been studied extensively and there are reports which confirm its preventive effects against cardiovascular diseases and some types of cancer, including colon, breast and prostate cancer (Rose and Connoll, 1993; Marchioli, 2001; Sidhu, 2003). These effects are largely attributable to the polyunsaturated fatty acids (PUFA) found in fish oils especially the n-3 family including the eicosapentaenoic acid (EPA or 20:5 n-3), the docosapentaenoic acid (DPA or 22:5 n-3) and the docosahexaenoic acid (DHA or 22:6 n-3) which are not synthesised in the human body but their inclusion in human diets is essential (Alasalvar *et al.*, 2002). Most of these freshwater fish species are valuable sources of macro and micronutrients and play important roles in providing proteins and vitamins that are not commonly available in other foods. They are usually caught by a large number of subsistence fishermen and provide a major source of biochemical constituents to poor households. The variation in the chemical composition of fish is closely related to feed intake, migratory swimming and sexual changes in connection with spawning. Different types of food make proximate composition a bit different and also different part of the body makes the composition different as well. So it is essential to know the proximate composition of the fish to report their nutrient composition from the public health point of view.

Mormyrids or elephant snout fishes are curious looking fish, highly variable in shapes of their head and the extent of their unpaired fins. *Mormyrus rume* belong to the family Mormyridae and are found in freshwaters of tropical Africa (Meek, 1916; Greenwood *et al.,*1966). *Mormyrus rume* Valenciennes, 1846 are found in fresh waters of tropical Africa (Fawole, 2002). They occur in fast moving waters with demersal habits. Members of the family have rudimentary electric organs situated on each side of the terminal portion of the tail and they possess large brains (Olaoshebikan and Raji, 2004).

Dams are usually constructed in order to prevent floods, to supply drinking and domestic water, to generate energy and for irrigation purposes since the ancient times. The earliest dams were probably built for the purpose of irrigation, flood control and water supply. Most modern reservoirs are designed for two or more of these purposes. Usually the role of water storage reservoir is to impound water in periods of higher flows so that it may be released gradually during periods of lower flows, but sometimes the sole purpose of impoundment is to provide a new body of standing water for use. Example of such uses are for fishing or boating or for water-heat dissipation from a thermoelectric generating plant (Baxter, 2005).

Hence, sustainable management of the water, taking into account the economic, social and cultural development and the environmental impacts which came out as a result of the mentioned studies, has gained an increasing importance (Sait *et al,* 2006).

Human activities have fragmented and simplified the tropical wetland habitat. Resources enjoyed by the wetland communities are systematically being destroyed. Sustainable management and conservation of the wetland resources are urgently required. It has been established that information on the chemical composition of fish in respect to the nutritive value is very essential to compare with other sources of animal protein, meat and poultry products.

Fish is a highly proteinous food consumed by the populace; a larger percentage of consumers eat fish because of its availability, distingused flavours and palatability, while fewer percentages do so because of its nutritional value. Therefore, studies on the proximate composition and mineral composition of the freshwater fishes need to be continously studied by fisheries researchers. However the consumer and fishery workers are left with limited or little of information on the importance of particular fish species in their daily diets (Adewoye *et al.,* 2003). Few reports on the nutritive values of *Mormyrus rume* exist, and there is lack of information about basic morphometric measurement and proximate composition of different body parts of *Mormyrus rume* found in man-made dams in the North Central Zone of Nigeria. So it is in this view that this study was carried out, to evaluate the relationship between some basic morphometric measurements and cross carcass variation in the body parts of *Mormyrus rume* from Agaie-Lapai dam.

Materials and Method

Sampling area

Agaie – Lapai dam is located at the boundary between Lapai and Agaie Local Government Areas of Niger state, hence the name Agaie-lapai dam. It is a man-made earth fill dam across river Jatau at Bakajeba with a reservoir capacity of $147x10^6$ cubic meters. The dam is of rolled heterogeneous embankment type with a crest length of 1193.87 m, maximum height of about 16 m and about 38 mm^3 capacities. It also has part of its components about 750 m Spill channel with 3 m free board. Accessibility is through a 2.5 km-untarred road, which Tees off on the right of Paiko-Lapai tarred road. The dam is about 23 km away from Paiko. It lies to the North-East of Lapai town and East of Bakajeba town. The dam is geographically located at latitude $9^0$14 North of the Equator and longitude $6^0$30 East of Greenwich. The major source of the dam is River Jatau, which is a tributary of River Kaduna. The main purpose of establishing the dam was to get water for Abuja metropolis and also to supply water for irrigation in Agaie, Lapai and its environs. The dam site as a typical tropical climate characteristic seasonal changes: rainy and dry seasons. The rainy season is usually from April to October, having its peak within the month of August and September while the dry season covers the remaining months of November to March. Maximum and minimum mean temperature is between 28.33^0C and 38.89^0C and 19.44^0C and 26.67^0C, respectively. Before the construction of the dam, the major occupation of the people was farming and fishing around the dam site.

Fish sampling and Measurement

Specimens of *Mormyrus rume* were collected from the fishermen at two sampling sites twice a month for seven months from April, 2012 to October, 2012. Gill nets of mesh sizes 50-55 mm were used by the fishermen. A total of 91 fishes were collected at the sampling site. Specimens collected were kept chilled in an ice chest to avoid post mortem damage. The fishes were washed, kept in the ice chest and quickly taken to the laboratory. At the laboratory, total length (TL) was measured from the tip of the snout (mouth closed) to the extended tip of the caudal fin. Standard length (SL) was measured from the tip of the snout to the caudal peduncle. Other

basic morphometric features; snout length, head length, fork length and eye diameter were measured using a metre rule and a mathematical set divider. The lengths were taken with metre rule to the nearest 0.1cm. Body weight of individual fish was measured to the nearest 0.1g using the sensitive weighing balance after removing the water and other particles from the body surface. Linear regression was employed to evaluate the relationship between the measurements.

Growth Pattern and Condition Factor

Linear regression was employed to determine the type of relationship between any given pairs of variables and their linear equation. Correlation analysis was used to ascertain the significance of this relationship; a derivative of length weight study is the ponderal index denoted as:

The length-weight relationship (LWR) was expressed by the equation:

$$\text{Log weight} = \text{Log } a + b \text{ Log length}$$

Where W =weight (g) L= standard length (cm)
Where a and b are regression constants.
The condition factor was calculated using the Formular:

$$K = [100\ W] / L^3$$

Where K = condition factor, L = standard length (cm) and W =weight (g).

Proximate Composition Analyses

After preparation of edible parts of fish as described, proximate composition analyses were performed according to Association of Official Analytical Chemists (AOAC) procedures (AOAC, 2000). Water content was determined by drying samples at 105±2°C until a constant weight was obtained. Dried samples were used for determination of crude fat, protein and Ash contents. Crude fat was measured by solvent extraction method in a soxhlet system where n-hexane was used as solvent. Crude protein content was calculated by using nitrogen content obtained by Kjeldahl method. A conversion factor of 6.25 was used for calculation of protein content (AOAC, 2000).

Statistical Analyses

Data collected were analyzed using one – way analysis of variance (ANOVA) using Statistica 6.0 (Stat-Soft, Inc., USA). Differences between treatments were compared by Tukey's test. Level of significance was tested at $P<0.05$.

Results

The result of biometrics of *Mormyrus rume* specimens are presented in Table 1. Standard length of the specimens ranged from 28.5-39 cm with a corresponding body weight ranging from 279.25-520g and a total length ranging from 31.3-43.75cm. Snout length ranged from 0.6-0.8cm with a mean standard deviation of 0.67±0.05, while the head length ranged between 5.6-8.4cm with a mean standard deviation of 7.27±0.77.

Relationship between the Morphometric Measurements

Standard length – head length relationship: When the head length was regressed against the standard length in figure 1, it was observed that there was a strong positive relationship between the head length and the standard length, as correlation co-efficient (r) was 0.81 and was significant ($P<0.05$). This indicates that a proportional increase in the standard length can be associated with an increase in the head length.

Body weight – head length relationship: Figure 2 shows the regression of the head length against the body weight; it was observed that there was a strong positive relationship between the head length and the body weight as correlation co-efficient (r) was 0.77 and was significant (P<0.05). This indicates that a proportional increase in the body weight can be associated with an increase in the head length.

Standard length – snout length relationship: Figure 3 shows the regression of the snout length against the standard length. It was observed that there was a significant relationship between the snout length and the standard length as correlation co-efficient (r) was 0.82 and significant (P<0.05). This means that a proportional increase in the standard length was associated with an increase in snout length.

Body weight- snout length relationship: Snout length was regressed against the body weight as shown in figure 4 it was observed that there was a significant relationship between the snout length and the standard length as correlation co-efficient r was 0.88 and significant (P<0.05). This means that a proportional increase in the standard length was associated with an increase in snout length.

Standard Length – body weight relationship, condition factor and growth pattern: Figure 5 shows the regression of standard length against the body weight. It was observed that there was a strong positive relationship between the standard length and the body weight, as correlation coefficient (r) was 0.95 and was significant (P<0.05). This means that an increase in standard length was associated with an increase in body weight. It was also observed that the growth pattern indices of *Mormyrus rume* from Agaie - Lapai dam was negatively allometric with b value of 2.56. The condition factor of *Mormyrus rume* from Agaie - Lapai dam is shown in Table 2 and it ranged from 0.73 – 1.21 with a mean value of 1.00±0.09.

Proximate Composition and Carcass Variation of the Body Parts

Whole body composition: The result of the seasonal proximate composition of whole *Mormyrus rume* specimens from Agaie- Lapai dam examined is shown in Table 3. There was a significant seasonal variation in the lipid and moisture values of the specimens. Lipid from the samples collected ranged from 7.14±0.34 to 9.86±0.42% and was significantly highest in July and lowest in April (P<0.05), while the moisture content of the samples ranged between 66.47±2.35 and 69.66±3.21 and was significantly highest in October and lowest in July (P<0.05). The crude protein did not vary considerably over time, the samples value ranged between 16.37±1.48 and16.47±1.25 hence, there was no significant differece in the crude protein of the fish between April to October in all the samples analysed (P>0.05) and the ash content ranged between 3.44±0.37 and 3.75±0.22 but there was no significant difference in the ash content of the samples throughout the period of the study (P>0.05).

The results of the proximate composition of some of the body parts of *Mormyrus rume* samples is shown in Table 4.The skin had the highest value in both moisture and crude protein and was significantly (P<0.05) higher than the other body parts examined (73.13±0.55 and 25.26±0.39) while the head region had the lowest moisture content and crude protein (56.67±0.14 and 17.83±0.20) and was significantly (P<0.05) lower than other body parts measured. The head region had the highest lipid content (10.32±0.45) however it was not significantly different from

that of the fillet but was significantly different from that of the skin. The head region also had the highest significant value in the ash content (6.40±0.24) while the fillet had the lowest significant ash content (2.02±0.05).

Discussion

From the result of the basic morphometric measurement of the 91 *Mormyrus rume* specimens examined, it was observed that the fish have the ability to grow averagely big, hence can be regarded as a fast growing fish. Biometric analysis of the body parts shows the following; when the snout length was regressed against the standard length, there was a positive correlation and the correlation was significant. Hence it was observed that an increase in the length of the fish also leads to a proportionate increase in the snout length. The head length also showed a strong positive correlation when regressed against the standard length; hence an increase in the length was associated with an increase with head length. From the above analysis, it could be said that any increase in size could be associated to all parts of the fish body. There was a strong positive linear relationship between the head length and the body weight. This implies that for any increase in weight, there is also a proportional increase in the head length. This agrees with the theory of proportionality of growth of organism as stated by Mosby (2009) and Bake and Sadiku (2012).

Data analysis of the length-weight relationship gave useful information concerning the growth pattern and well being of the fish. Zafar *et al.* (2003) reported that fish weight is considered to be a function of length. Growth was described as the change in the absolute weight (energy content) or length of fish over time (Wooten, 1998), while Sadiku (1994), Bake and Sadiku (2012) summarized growth as a function of size. Wooten reported that fish grow in length as well as in bulk. Linear regression of log standard length and log weight gave useful co-efficient. Regression "b"= 3 is isometric; below this is negative allometric and above it is positive allometric (Tesch, 1978). Fagbenro *et al.* (1991) stated that obedience to the cube law (isometric growth, b = 3) is rare in a majority of fishes especially freshwater fishes. This was found to be the case with *M. rume* in this study; which showed a deviation from the cube law. The growth of *Mormyrus rume* from Agaie – Lapai dam was negatively allometric with "b" value of 2.56. This implies that the length growth rate is faster than the body weight growth rate. This result is similar to the findings of Odedeyi *et.al* (2007) from Ose River.

Samat *et al.,* (2008) and Abowei (2009) reported that the suitability of an aquatic habitat for fish growth is determined by the value of the condition factor. This study showed that the condition factor of *Mormyrus rume* from Agaie - Lapai dam ranges from 0.73 – 1.21 with a mean value of 1.00±0.09. This result is similar to the findings of Oben *et al.* (1999) on *M. rume* in Lekki Lagoon and Odedeyi *et al*. from Ose River, hence in this study the condition factor of *Mormyrus rume* from Agaie – Lapai dam indicated that the fishes were is a good condition and well being.

The proximate composition of *Mormyrus rume* (protein, lipid, moisture and ash) were considered in evaluating the nutritional value of the specie studied. The proximate composition of *Mormyrus rume* varies considerably between April - October. Stansby (1985); Azim *et.al* (2012) reported that variation in proximate composition of fresh fish may vary with species variation, season, age and feeding habit of the fish. The result of the present study shows that there was fluctuation in moisture and lipid value of whole *Mormyrus rume* from April-October, this variation in moisture and lipid content of the samples showed that with a gradual decline in

moisture content, fat content gradually increased, this result agrees with the previous works reported on freshwater fisheries by Sadiku and Oladimeji (1991); Bake and Sadiku (2012); Bake *et al* (2014). Huss 1995; Love, 1997; Saoud, *et al*., (2007), also reported that fat content has shown inverse proportionality to water content in some semi fatty fish species muscle, this may be attributed to the seasonal differences in availability of food and changes in the reproductive cycle having considerable effect on the tissue biochemistry of the fish particularly changes in the lipid and water content of there body system.

The nutritional elements showed variable values in the various body regions measured. From this study the skin had the highest significant value in the crude protein, this may likely be as a result of some digestable and undigestable properties of protein attributed to the skin of fishes Choi and Regenstein (2000). Gudmunsson and Hafsteinsson (1997) and Choi and Regenstein (2000) reported that the fish skin is a potential source of phosporus, gelatin, melanin and keratin. the high concentration ash content in the head region can be attributed to the concentration of inorganic materials present in the head region, this agrees with the report of Steffens (2006) who stated that the head region of a fish is mostly bones whis are very rich in inorganic materials.

In conclusion, this study shows that there is a proportionate growth and a positive relationship between the basic morphometrics parts of the fish measured, the high condition factor of the fish also reflect a good physiological state and the well beign of the fish. The growth pattern of *Mormyrus rume* from Agaie-Lapai dam is negatively allometric, which is the normal growth pattern of the fish. The proximate composition of the fish shows that the fish is rich in protein hence can be a very source of protein to the rural populace and the is a fatty fish because of its high lipid content. Further studies need be carried out on the other properties and compositions of the fish.

References

Abowei,J. F. N. & Hart, A. I. (2009). Some morphormetric parameters of ten finfish species from the lower Nun River, Niger Delta, Nigeria.Res. *J. Biol. Sci.,* 4(3), 282 - 288.

Adewoye, S. O., Fawole, O. O. & Omotosho, J. S. (2003). Concentrations of selected elements in some freshwater fishes in Nigeria. *Sci. Focus,* 4, 106 - 108.

Alasalvar, C., Taylor, K. D. A., Zubcov, E., Shahidi, F. & Alexis, M. (2002). Differentiation of cultured and wild sea bass (Dicentrarchus labrax): total lipid content, fatty acid and trace mineral composition. *Food Chem,* 79, 145 - 150.

AOAC. (Association of Official Analytical Chemists) (2000). *Official methods of analysis 13th Edition*. Washington D. C.

Azim, M. A., Islam, M. R., Hossain, M. B. & Minar, M. H. (2012). *Seasonal Variations in the Proximate Composition of Gangetic Sillago, Sillaginopsis panijus* (Perciformes: Sillaginidae), Middle-East Journal of Scientific Research.

Bake, G. G. & Sadiku, S. O. E. (2012). Basic morphometric measurements and growth pattern of Heterotis niloticus from River Kaduna flood plains, Nigeria. *Journal of Science,Technology and Mathematics Education*, 8(1), 113 - 118.

Bake, G. G., Yisa, P. Z. & Sadiku, S. O. E. (2012). Proximate composition, food and feeding habit of Heterotis niloticus from River Kaduna flood plains, Nigeria. *Journal of Science, Technology and Mathematics Education*, 9(1), 34 - 39.

Bake, G. G., Kpotun, A., Egwin, E. C. & Sadiku, S. O. E. (2014). Growth pattern, condition factor and proximate composition of *Synodontis membernaceus* from River Kaduna flooded plains in Niger state of Nigeria. *International Journal of Applied Biological Research,* 6(1), 31 - 44.

Baxter, R. M. (2005). Environmental effects of dams and impoundment. *Journal of Annual Review Ecological Systems*.

Choi, S. S. & Regenstein, J. M. (2000). Physico-chemical and sensory characteristics of fish gelatin. *Journal of Food Science,* 65, 194 - 199.

Erzini, K. (1994). An empirical study of variability in length at age of marine fishes. *Journal of Applied Ichthyology,* 10, 17 - 41.

Fafioye, O. O. & Oluajo, O. A. (2005). Length-weight relationships of five fish species in Epe Lagoon, Nigeria. *Afr. J. Biotechnol*, 4.

Fagbenro, O. A., Olaniran, T. S. & Esan, A. O. (1991). Some aspects of the biology of the catfish, *Heterobranchus bidorsalis* Geoffrey Saint-Hillarie, 1809 (Clariidae) in River Ogbese, Nigeria. *Journal of A rican Zoology,* 105, 363 – 372.

Fawole, O. O. (2002). Morphormetric of diet of M.rume in the Lekki Lagoon Nigeria. *Rev. Biol Trop.* 50(2), 68 - 694.

Foran, J. A., Carpenter, D. O., Hamilton, M. C., Knuth, B. A. & Schwager, S. J. (2005). Risk-based consumption advice for farmed Atlantic and wild pacific salmon contaminated with dioxins and dioxin-like compounds. *Environ. HealthPerspect,* 33,552 - 556.

Greenwood, P. H., Myers, G. S., Rosen, D. E. & Weitzman, S. H. (1966). Phyletic studies of Teleostan fishes with a provisional classification for living fishes. *Ms.Bull. Am. Museum of Natural History,*131,339 - 456.

Gudmundsson, M. & Hafsteinsson, H. (1997). Gelatin from cod skin as affected by chemical treatments. *Journal of Food Science,* 62(1), 37 – 39.

Hetzel, B. S. (1994). *S.O.S for a billion: The nature and magnitude of iodine deficiency disorders. In: S.C.S. the conquest of iodine deficiency disorder*. Delhi-Inland: Oxford University Press, 1 - 26p.

Holden, M. & Reed, W. (1972). *West African freshwater fishes.* London: Longman Publishers. P.68.

Huss, H. H. (1995). *Quality and quality changes in fresh fish.* FAO Fisheries Technical Paper No. 348. FAO, Rome, Italy, pp. 20-92.

King, M. (2007). *Fisheries biology, assessment and management. 2nd edition.* Oxford: Blackwell Scientific Publications. Pp. 189 - 192.

Kulbicki, M., Guillemot, N. & Amand, M. (2005). A general approach to length weight relationships for New Caledonian Lagoon fishes. *Cybium,* 29, 235 - 252.

Le Cren, E. D. (1951). The length-weight relationship and seasonal cycle in gonad weight and conditions in the perch Perca fluviatilis. *Journal of Animal Ecology,* 20(2), 201 - 219.

Marchioli, R. (2001).Efficacyon-polyunsaturated fatty acids after my ocardialin farction: Resultsofgissi-prevenzione. *Trial.Lipids,* 36,119 - 126.

Meek, A. (1916). *The migrations of fish.* London: Edward Arnold. p427.

Mendes, B., Fonseca, P. & Campos, A. (2004). Weight length relationships for 46 fish species of the Portuguese west coast. *J. of Applied Icht.,* 20,355 - 361.

Morato, T., Afonso, P., Loirinho, P., Barreiros, J. P., Sanstos, R. S. & Nash, R. D. M. (2001). Length-weight relationships for 21 costal fish species of the Azores, North-eastern Atlantic. *Fisheries Research,* 50, 297 - 302.

Mosby's Medical Dictionary, 8th edition (2009). Elsevier Publication.

Moutopoulos, D. K. & Stergious, K. I. (2002). Weight-length and length-length relationships for 40 fish species of the Aegean sea (Hellas). *J. Appl. Ichthyol.,*18, 200 - 203.

Mumba, P. P. & Jose, M. (2005). Nutrient composition of selected fresh and processed fish species from Lake Malawi: A nutritional possibility for people living with HIV/AIDS. *International Journal of Consumer Studies,* 29(1), 72 - 77.

Oben, P. M., Ugwumba, O. A. & Fagade, S. O. (1999). Using lunar rings on the opercular bones of Mormyrus rume (Cuvier and Valenciennes) for age and growth determinations. *Nigerian Journal of Science,* 33, 77 – 83.

Odedeyi, D. O., Fagbenro, O., Bello, O. & Adebayo, O. (2007). Length-weight relationship and condition factor of the elephant fish, Mormyrus rume(Valenciennes, 1846) in River Ose, SouthWestern Nigeria. *Animal Research International,* 4(1), 617 – 620.

Olaosebikan,B. A. & Raji, A. (2004). *Field guide to Nigerian freshwater.* Fishes Federal Fisheries Technology New Bussa. Second edition, p.111.

Onasanya, S. (2002). Nigeria makes Vit A fortification mandatory. Excerpt from the Revised Nigerian Industrial Standards. *Nutriview*, 2(6), 8 - 15.

Pauly, D. (1993). Fishbyte section editorial. *Naga ICLARM Q*, 16, 26.

Petrakis, G. & Stergiou, K. I. (1995). Weight-length relationships for 33 fish species in Greek waters. *Fisheries Research,* 21, 465 - 469.

Rose, D. P. & Connolly, J. M. (1993). Effects of dietary omega-3 fattyacids on human breast cancer growth and metastases in nude mice. *J.Natl.Cancer Inst*, 85, 1743 - 1747.

Sadiku, S. O. E. & Oladimeji, A. A. (1991). Relationship of proximate of composition of *lates niloticus* (L) *Synodontis shall* (Broch &Schneider) and *Sarotherodon galilaeus* (trewaues) from Zaria Dam Nigeria. *Bioscience Research Communications*, 3 (1) 29 -40.

Sait, M. T., Nermin, A., Fatih, E. & Nurcan, D. (2006). Positive and negative impacts of dams on the environment. *International Congress on River Basin Management*.

Samat, A., Shukor, M. N., Mazlan, A. G., Arshad, A. & Fatimah, M.Y. (2008). Length weight relationship and condition factor of Pterygoplichthys pardalis(Pisces: Loricariidae) in Malaysia Peninsula. *Research Journal of Fisheries and Hydrobiology,* 3(2), 48 – 53.

Saoud, P. I., Malek, B., Ghanawi, J. & Nada, L. (2007). Seasonal variation in highly unsaturated fatty acid composition of muscle tissue of two fishes endemic to the eastern Mediterranean. *Ecology of Food and Nutrition*, 46(2), 77 – 89.

Sidhu, K. S. (2003). Health benefits and potential risks related to consumption of fish or fish oil. *Regulatory Toxicology and Pharmacology*, 38, 336 - 344.

Sinovcic, G., Franicevic, M., Zorica, B. & Ciles-Kec, V. (2004). Length-weight and length-length relationships for 10 pelagic fish species from the Adriatic Sea(Crotia). *J. of Applied Ichthyology,* 20, 156 - 158.

Stansby, M. (1985). Fish or Fish oil in the diet and heart attack. *Mar. Fish. Review,* 46(2), 60 - 63.

Steffens, W. (2006). Freshwater fish-wholesome foodstuffs. *Bulg. J. Agric. Sci.,* 12, 320 – 328.

Tesch, F. W. (1978). Age and growth. Pages 98 –130. In: W. E. Ricker, (Ed.). *Methods for assessment of fish reproduction in freshwaters*. IBP Handbook No. 3. Oxford: Blackwell Scientific Publications.

Wootton, R. J. (1998). *Ecology of teleost fishes.* 2nd Edition. Dordrecht Kulwer.

Zafar, M., Mussaddeq, Y., Akhter, S. & Sultan, A. (2003). Weight-length and condition factor relationship of Thaila, Catla catla from Rawal Dam Islamabad, Pakistan. *Pakistan Journal of Biological Sciences,* 6(17), 1532 – 1534.

Table 1: Summary of biometric measurements of *M.rume* sample from Agaie-Lapai dam, Niger State

Measurement	Range(cm)	Mean value
k value	0.73-1.21	1.00±0.09

Table 2: Summary of condition factor 'K' value of *M.rume* sample from Agaie-Lapai dam, Niger State

Measurements	Range (cm)	mean value
Total length (cm)	31.55-43.75	37.71±3.57
Standard length(cm)	28.5-39	34.08±3.28
Body weight (g)	279.25-520	386.41±79.83
Snout length (cm)	0.6-0.8	0.67±0.05
Head length (cm)	5.6-8.4	7.27±0.77
Eye diameter (cm)	0.7-1.3	1.16±0.15
Fork length(cm)	2.6-4.75	3.63±0.73

Table 3: Summary of the whole body of proximate composition of *M. rume* sample from Agaie-Lapai dam, Niger State

Months	Moisture (%)	Lipid (%)	Protein (%)	Ash (%)	Crude fiber (%)
April	68.17±2.13^{b}	7.14±0.34^{b}	16.41±1.32	4.36±0.08	1.18±0.14
May	67.36±2.16^{c}	7.56±0.22^{b}	16.44±1.03	4.31±0.12	1.21±0.12
Jun	67.44±1.13^{c}	9.57±0.31^{a}	16.45±0.45	4.35±0.24	1.22±0.24
Jul	66.47±2.35^{d}	9.86±0.42^{a}	16.47±1.25	4.30±0.05	1.19±0.05
Aug	66.55±2.46^{d}	9.75±1.02^{a}	16.43±2.05	4.32±0.56	1.20±0.56
Sept	68.74±1.32^{b}	8.98±1.21^{c}	16.38±1.45	4.31±0.62	1.23±0.62
Oct	69.66±3.21^{a}	8.23±1.32^{c}	16.37±1.48	4.32±0.31	1.19±0.31

Table 4: Summary of Proximate composition of various body parts of *M. rume* sample from Agaie-Lapai dam, Niger State

Body component	Head region	Fillet	Skin
Moisture	56.67±0.41^{c}	70.49±0.49^{b}	73.14±0.55^{a}
Crude protein	17.83±0.20^{c}	20.95±0.69^{b}	25.26±0.39^{a}
Lipid	10.32±0.45^{a}	9.15±0.34^{ab}	7.29±1.29^{c}
Ash	6.40±0.01^{a}	2.02±0.05^{c}	3.06±0.02^{b}

*1 Values in the same row with different superscript letters are significantly different ($p<0.05$) from each other ($n=3$).

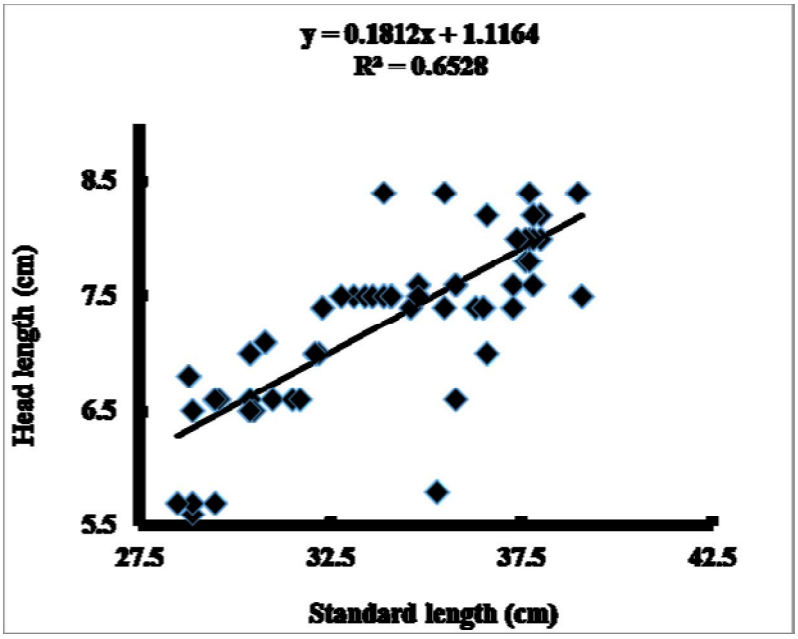


Figure 1: Standard length-head length relationship

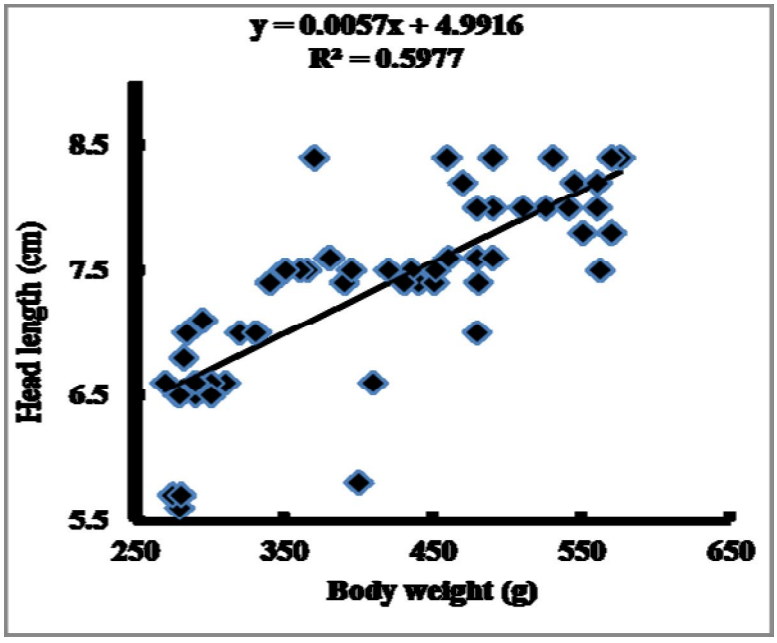


Figure 2: Body weight-head length relationship

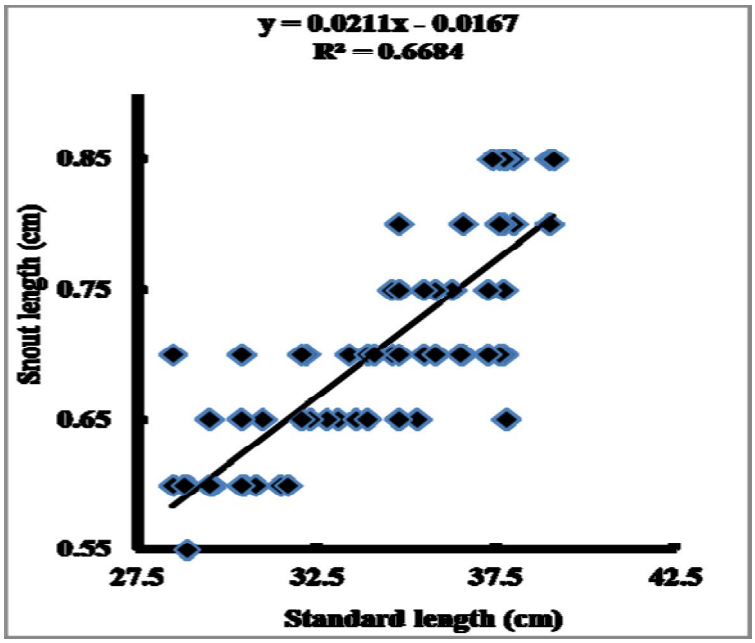


Figure 3: Standard length -snout length relationship

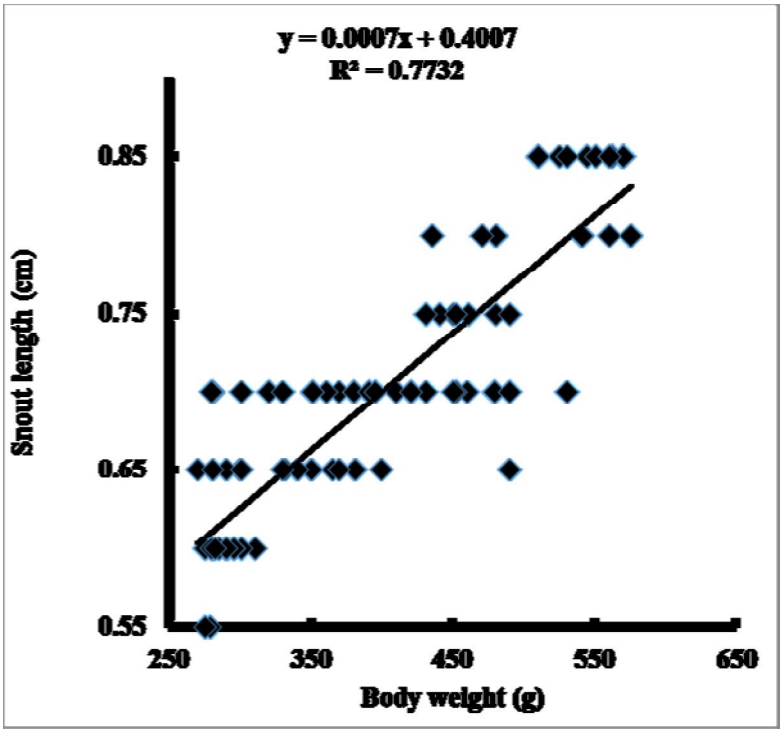


Figure 4: Body weight-snout length relationship

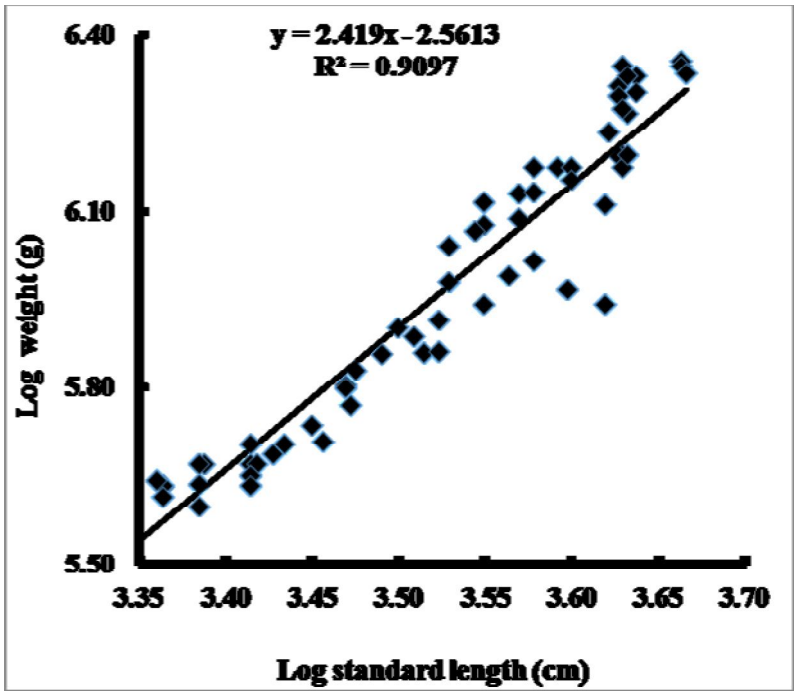


Figure 5: Standard length – Body weight relationship

REVIEW OF MAIZE STREAK VIRUS DISEASE AND MANAGEMENT STRATEGIES IN SUB-SAHARAN AFRICA

SALAUDEEN, M. T[1*], UZOMA, A. O[2] & BASHIR, M[3]
[1]Department of Crop Production,
Federal University of Technology, Minna, Niger State Nigeria
[2]Department of Soil Science and Land Management,
Federal University of Technology, Minna, Niger State Nigeria
[3]National Biotechnology Development Agency, Lugbe, Abuja, Nigeria
E-mail: mtsalaudeen@futminna.edu.ng Phone No: +234-806-333-0183

Abstract
Maize streak disease (MSD) induced by Maize streak virus (MSV) is an economically important viral disease of maize in sub-Saharan Africa. Following its first report in South Africa in 1901, the virus has been confirmed in virtually all African countries. Maize streak virus is a member of the Geminiviruses with characteristic monopartite genome, measuring18 × 30 nm in size. Each virion of the MSV contains a single, covalently bound, circular ssDNA molecule of about 2.7 kb. Replication occurs through double stranded DNA (dsDNA) intermediates, using a rolling circle replication mechanism. The virus induces various forms of foliar symptoms such as white, yellow or red streaks in susceptible varieties. Maize streak virus has a wide host range within the grass family (Poaceae) and is transmitted by several leafhoppers (Cicadulina spp.) in a persistent manner. Eleven strains of MSV have been identified, with various degree of pathogenicity, causing maize losses of about US$480 million annually. Management of MSV could be by application of insecticide, early planting, crop rotation and cultivation of resistant genotypes. Among these control options, adoption of resistant varieties is by far the most effective and sustainable. There is need for multidisciplinary approach and continuous collaboration from maize breeders, entomologists and plant virologists in order to eradicate MSD menace in the region.

Keywords: Maize productivity; *Maize streak virus*; management; strains and host resistance; transmission and epidemiology.

Introduction
Maize (*Zea mays* L.) is and important cereal crop in sub-Saharan Africa (SSA) where it is cultivated on 25 million hectares (Gianessi, 2015). It is a major food source in many developing countries of Latin America, Africa and Asia. At global level it accounts for 15 % of proteins and 20 % of calorie intake (Sofi *et al.*, 2009). Maize, which may be eaten as a vegetable or processed into various dishes, is regarded as a hunger breaker after a long dry period (Menkir & Kling, 1999). Additionally, maize is extensively traded as feed crop in livestock industries, and about 460 million (65 %) of total world maize production is used for this purpose (Babatunde *et al.*, 2008). Besides food and feed, maize has a wide range of industrial applications including manufacturing of ethanol and pharmaceuticals (Tijani & Osotimehin, 2007). Furthermore, maize may be planted in intercropping or mixed cropping, indicating its compatibility with the common practice among tropical subsistence farmers (Alabi & Esobhawan, 2006). In West and Central Africa (WCA) production potential is greatest in the moist savanna where annual rainfall and solar radiation are favourable, and incidence of pests and diseases are minimal (Badu-Apraku *et al.*, 2008).

Maize productivity is seriously constrained by low soil fertility, lack of improved technology, and subsistence farming (IITA, 2009). The influence of several insect pests, diseases and parasitic weeds pose serious biotic stresses on maize yield (Badu-Apraku *et al*., 2008). In addition, recurrent drought has been identified as a principal climatic threat to its productivity in sub-Saharan Africa (SSA) (Centro Internacional de Mejoramiento de Maíz y Trigo [CIMMYT], 2010). Several pathogens such as bacteria, fungi, nematodes and viruses have also been implicated in low yield. However, Maize streak disease (MSD) induced by *Maize streak virus* (MSV; genus *Mastrevirus*, Family *Geminiviridae*) is the most important viral disease of maize in SSA (Shepherd *et al*., 2010). Symptoms of the disease are influenced by host – pathogen interactions, virus strain, maize genotype, plant age at infection, and climatic conditions. They generally include chlorotic streaks along the veins of the leaf laminae, stunting, and plant death (Bosque-Pérez *et al*., 1998). Disease incidence and yield losses can be as high as 100 %. Annual losses attributed to streak infection about US$480 million (Karavina, 2014). Complete yield loss and field abandonment is rampant when both drought and streak infection occur simultaneously. *Maize streak virus* is vectored by eight leafhopper species namely, *Cicadulina arachidis* China, *C. bipunctata* Melichar, *C. ghaurii* Dabrowski, *C. latens* Fennah, *C. mbila* Naudé, *C. parazeae* Ghauri, *C. similis* China, and *C. storeyi* China (= *C. triangula* Ruppel) (Oluwafemi *et al*., 2007; Fajinmi *et al*., 2012), in a persistent manner (Nawaz-ul-Rehman & Fauquet, 2009).

Control strategies include crop rotation, timely planting, chemical seed treatment, roguing, insecticidal control of insect vectors and host plant resistance. However, the use of resistant maize genotypes is the most viable option; being cost-effective, safe, sustainable and compatible with integrated pest management (IPM) (Danson *et al*., 2006). In West Africa, the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria initiated a breeding programme for MSV in 1975. This was aimed at developing maize varieties that combine resistance to MSV with desirable agronomic characters (Efron *et al*., 1989). This paper reviews MSV with emphasis on its origin and distribution, properties, symptoms induced, strains and diversity, transmission, epidemiology, host range, and management strategies.

Origin and Distribution of *Maize Streak Virus*

Maize streak virus was first reported in South Africa by Fuller (1901) as 'mealie variegation'. The virus was later renamed *Maize streak virus* by Storey (1925). MSV is now widely distributed in sub-Saharan Africa (European Plant Protection Organization [EPPO], 2006). In Africa, it is present in Angola, Benin, Botswana, Burkina-Faso, Burundi, Cameroon, Central African Republic, Congo Democratic Republic, Cote d'Ivoire, Egypt, Ethiopia, Gabon, Ghana, Guinea, Kenya, Madagascar, Malawi, Mali, Mauritius, Mozambique, Niger, Nigeria, Rwanda, Réunion, Sao Tome and Principe, Senegal, Sierra Leone, South Africa Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia and Zimbabwe (EPPO, 2006). In Asia, it has been confirmed in India, Indonesia and Yemen (EPPO, 2006). Efron *et al*. (1989) documented that the virus does not occur in the New World; it is found both in the forest and savanna and from sea level up to elevations of 200 m.

Properties of *Maize Streak Virus*

Maize streak virus is a member of the genus *Mastrevirus* (family: *Geminiviridae*) (Willment *et al*., 2001). *Geminiviruses* are plant viruses with monopartite or bipartite circular single stranded DNA (ssDNA) genomes. They are 2.5 to 3.0 kb particles of 20 × 30 nm wide (Frischmuth & Stanley, 1993). The *Geminiviridae* comprises four genera (*Mastrevirus, Curtovirus, Topocuvirus* and *Begomovirus*), based on their genome organizations and biological properties (Fauquet *et*

al., 2003). MSV is a member of the *Geminivirus* group that consists of viruses having monopartite genomes (Hull *et al*., 1991). The particle measures 18 × 30 nm in size (Bosque – Pérez, 2000). Each virion of the MSV contains a single, covalently bound, circular, ssDNA molecule of about 2.7 kb which codes for four potential products (Shepherd *et al*., 2014). Replication occurs through double stranded DNA (dsDNA) intermediates, using a rolling circle replication mechanism (Laufs *et al*., 1995a, b). Recently, studies have proved that 'recombination – dependent replication' mechanisms are also involved in *Geminivirus* replication (Jovel *et al.,* 2007). *Geminiviruses* do not encode their own DNA polymerases but rely on the nuclear DNA replication machinery of the host (Munoz-Martin *et al*., 2003).

In replicative double stranded DNA (dsDNA) molecules, genetic expression arises from both strands, and diverges from an intergenic region containing the virion – sense origin of replication (Morris – Krsinich *et al*., 1985). Rolling circle replication begins by binding of the virus replication – associated protein (*Rep*) to the virion – strand origin of replication, where the protein begins and terminates virion strand DNA synthesis (Willment *et al*., 2007). Additionally, MSV *Rep* consists of two complementary sense open reading frames (ORFs), C1 and C2. *Rep* (Spliced transcript) or *Rep* A (unspliced transcript) is produced from the C1:C2 containing an intron. Although MSV replication is facilitated by *Rep* alone (Liu *et al*., 1998), *Rep* A plays a variety of important additional functions during its life cycle. Such activities include the modulation of host cell cycle regulation, and probably other development pathways (Shepherd *et al*., 2005).

Also present in the MSV genome are the movement protein (MP) and the coat protein (CP). The former enhances the movement of the virus from the site of replication (nucleus) to adjacent cells. Conversely, CP is responsible for the encapsidation of the viral nucleic acid, and determines virus – vector interactions (Briddon *et al*., 1994). Additionally, MSV CP binds non-specifically to both ssDNA and dsDNA (Liu *et al*., 1999). It is also required for cell – to – cell and systemic spread of the virus in plants (Liu *et al*., 2001a), and interacts specifically with MP to move virus DNA out of the nucleus (Liu *et al*., 2001b).

Symptoms of Maize Streak Virus Disease

Maize streak virus disease symptoms are influenced by several factors including the level of resistance of the maize genotype, age at infection, virulence of the strain and environmental factors (Bosque – Pérez *et al*., 1998). In susceptible maize plants, streak disease normally manifests as minute, pale, circular spots on the lowest exposed portion of the youngest leaves. As leaves expand, conspicuous chlorotic streaks ranging from broken to almost continuous streaks are evident along the veins on the most of the leaf laminae and, since the virus is systemic, symptoms manifest on the inoculated and subsequent leaves (Thottappilly *et al*., 1993). As infection advances, less streaks are found on secondary and tertiary veins, compared to the primary veins. Lesion colour is either white or yellow, but some MSV strains induce red pigmentation on maize leaves, abnormal shoot and flower bunching in grasses (Shepherd *et al*., 2010).

The streak pattern arises from the failure of chloroplasts to develop in tissues surrounding the vascular bundles (Bosque – Pérez, 2000), thereby reducing the photosynthetic ability of the plant (Mesfin *et al*., 1995). Immunohistochemical studies have demonstrated that the virus is restricted only to vascular tissues and does not invade the apical meristems within the shoot apex. In mature leaf tissues which exhibit streak symptoms, MSV is not limited to vascular

tissue (Lucy *et al*., 1996). Infection is more severe in younger than older plants and early infection can result in stunting, small sized, misshapen ears or complete yield loss. Infection of young plants can lead to plant death (Shepherd *et al*., 2010).

Maize streak virus strains, evolution and diversity

Serological and molecular studies have been conducted to investigate the relationship among MSV isolates. Peterschmitt *et al*. (1991) characterized MSV isolates from 11 African countries and concluded that they were of the same serotypes. At molecular level, restricted fragment length polymorphisms (RFLPs) and polymerase chain reaction (PCR) have been used to study MSV diversity. For instance, Isnard *et al*. (1998) used RFLP analysis and sequencing to confirm the occurrence of the mutant spectrum (Quasi-species) nature of three isolates. Additionally, Martin *et al*. (2001) reported that typing of MSV isolates resulted in classification into strains and subtypes. Willment *et al*. (2001) applied RFLP analysis involving a set of seven enzymes to type closely related MSV isolates. Also, MSV isolate from Nigeria (Mullineaux *et al*., 1984), Kenya (Howell, 1985) and South Africa (Lazarowitz, 1988) have been sequenced.

Currently, 11 strains of MSV have been confirmed. These include MSV – A, MSV-B, MSV-C, MSV-D, MSV-E, MSV-F, MSV-G, MSV-H, MSV-I, MSV-J, MSV-K (Varsani *et al*., 2008). The MSV-A_1, strain arose from isolates MSV – Gat (Kenya), MSV- Mat B (Zimbabwe), MSV-Sag (Kenya), MSV-Mat A (Zimbabwe), and MSV- Ama (Kenya). Presently, there is a high degree of MSV diversity in Nigeria (Oluwafemi *et al*., 2014). The MSV-A_2 strain originated in Nigeria and was found in the MSV-N isolate. The MSV – A_3 strain was first reported in Kenya and consists of two isolates namely MSV-Ken, and MSV-MtKA. The MSV-Kom, MSV-SA, and MSV-VM, which gave rise to MSV-A_4 strain originated in South Africa (Varsani *et al*., 2008). Additionally, the MSV-A_5 consists of the MSV-MaKD and MSV-Mat C isolates which originated from South Africa and Zimbabwe, respectively (Willment *et al*., 2001). The MSV-R_2 and MSV-Rev originating from Réunion gave rise to the MSV-A_6. Conversely, the MSV-Jam (Kenya), MSV-Mom (Kenya), MSV-Tas (South Africa), and MSV-VW (South Africa) were isolates of MSV-B. The MSV-C, MSV-D, and MSV-E were of South Africa origin and were detected in MSV-Set, MSV-Raw, and MSV-Pat, respectively (Varsani *et al*., 2008).

Out of these strains, only MSV-A strain causes economic damage in maize fields (Martin *et al*., 2001). Differences also occur within the same strain of the virus. Briddon *et al*. (1994), Martin *et al*. (2001) and Willment *et al*. (2001) reported fairly obvious differences in the genetic make up of MSV-A population in Eastern, Western and Southern Africa. The MSV-A_1 and MSV-A_4 are apparently responsible for over 95 % of MSD cases that have been investigated over the last 20 years. Consequently, these lineages could be implicated for MSD epidemics throughout Southern and East Africa (Martin *et al*., 2001; Willment *et al*., 2001; Varsani *et al*., 2008). Although the negative impact of MSV-A_4 is most felt in Southern Africa, MSV-A_1 is a serious threat to maize productivity in the whole of sub-Saharan Africa (Varsani *et al*., 2008). The low spread of MSV-A_4 is because it is less severe in maize than MSV-A_1 (Martin *et al*., 1999). The MSV-B, MSV-C, MSV-D and MSV-E which normally infect wild grasses are also known to produce mild infections in MSV – susceptible maize cultivars (Martin *et al*., 1999, 2001). These strains probably contributed to the evolution of the economically significant MSV-A strain. For example, the MSV-A_4 is different from other MSV-A lineages because it is the product of a recombination event between MSV-A and MSV-B viruses occurring in southern Africa (Martin *et al*., 2001).

Recombination is an important phenomenon among the *Geminiviruses* and this has played a significant role in the evolution of MSV. However, intra-strain or intra-species recombination is probably more prevalent during recent MSV-A evolution than inter-strain or inter-species recombination (Varsani *et al*., 2008). Additionally, recent investigations indicated that less than 200 nucleotides were exchanged in natural inter-strain recombination events involving MSV-A viruses (Shepherd *et al*., 2010). Earlier, van der Walt *et al*. (2009) documented that co-infection of maize plants with reciprocal MSV-A – MSV-B chimaeras resulted in rapid recombination that gave rise to MSV-A like recombinants. Therefore, this is an indication that fitness of contemporary MSV-A genotypes cannot be easily improved through inter-strain recombination (Shepherd *et al*., 2010). Accumulating evidences have also demonstrated that large inter-strain recombination events and smaller intra-species recombination events have played a significant role in the evolution of various MSV strains other than MSV-A. For instance, MSV-F, MSV-H, MSV-J and MSV-K probably arose via the exchange of large genomic regions of over 1000 nucleotides, amongst two or more different MSV strains (Varsani *et al*., 2008).

Transmission of *Maize Streak Virus* by Insect Vectors

Maize streak virus is exclusively transmitted by leafhoppers (*Cicadulina* spp.) (Magenya *et al*., 2009). Twenty two species of *Cicadulina* are known world wide. Among the eighteen species present in Africa only nine of them are vectors of MSV (Lett *et al*., 2002). However, only eight species of *Cicadulina* are efficient transmitters of the virus: *Cicadulina arachidis* China, *C. bipunctata* Melichar, *C. ghaurii* Dabrowski, *C. latens* Fennah, *C. mbila* Naudé, *C. parazeae* Ghauri, *C. similis* China, and *C. storeyi* China (= *C. triangula* Ruppel) (Oluwafemi *et al*., 2007; Fajinmi *et al*., 2012). Additionally, these species vary in their ability to transmit the virus. According to IITA (1986), *C. mbila* and *C. storeyi* were more active transmitters than a population of *S. ghauri* and *C. arachidis*. Asanzi *et al*. (1995b) also compared the transmission efficiencies of these insects and found that *C. ghauri* and *C. arachidis* required longer aquisition access time than *C. mbila* and *C. storeyi*.

The virus is vectored in a persistent manner and the latent period in *C. mbila* is 6 – 12 hours. (Storey, 1928). Conversely, a minimum of 14 – 18 hours is required by *C. storeyi* (Okoth *et al*., 1988). Additionally, Storey (1928) reported that *C. mbila* can acquire the virus from diseased plants within 15 seconds and inoculate it only after 5 minutes. On the other hand, *C. storeyi* can do so in 30 seconds and transmit after a 2-hour inoculation access period (IAP) (Zagre, 1983). Asanzi (1991) reported a minimum acquisition access period of 15 minutes and 1 hour for *C. arachidis* and *C. ghauri*, respectively and a maximum of 1 hour for both species. However, it is generally believed that transmission efficiency increases with increasing duration of acquisition and inoculation access periods. Asanzi *et al*. (1995b) observed that the differences in the minimum acquisition and inoculation access periods among *C.* species was probably due to several factors, including *Cicadulina* feeding behaviour and the titre of virus within the geographic origin of the leafhopper population. Bock (1974) was of the opinion that it depends on the differences in the permeability of the insect's gut. This report was later confirmed using polymerase chain reaction (PCR) assay in individual insect organs (Lett *et al*., 2002). The virus was found in the gut, haemolymph and head of a vector species (*C. mbila*), but restricted to the gut of a non-vector species (*C. chinai*) (Lett *et al*., 2002).

Although MSV accumulated in the alimentary canal (Lett *et al*., 2002; Ammar *et al*., 2009), and virus titre decreased considerably over time in both the gut and haemolymph. In contrast, MSV DNA copies remained stable over time in the head (probably in the salivary glands, from which

the virus was released into the phloem when the leafhopper feeds on a host plant). Although studies have shown that *C. mbila* is the species most often implicated in MSD epidemics (Magenya *et al.*, 2008). Oluwafemi *et al.* (2007) found that *C. storeyi* was more efficient transmitter of MSV. Within the same leafhopper species difference exist in the ability to transmit MSV. For example, Alegbejo *et al.* (2002) reported that females were more efficient in transmitting MSV than the male leafhoppers. Additionally, all five nymphal instars of *C. mbila* are able to acquire and transmit MSV, and this ability is retained during moulting, but transovarial transmission is not feasible (Bock, 1974).

Several studies have been conducted using *C. mbila* in order to understand MSV epidemiology (Liu *et al.*, 2001a). The probing of *C. mbila* into plant tissue facilitates the production of a salivary secretion around the stylets which hardens into a salivary sheath that is required for ingesting plant fluids (Mesfin *et al.*, 1995). The virus ingested into the gut is translocated to the midgut epithelial cells. It is then released into the haemocoel, and later the salivary gland and finally into the salivary ducts. The virus undergoes a latent period between 6 and 12 hours, after which it persists in the insect throughout its entire life (Bosque-Pérez, 2000; Alegbejo *et al.*, 2002). Mesfin *et al.* (1995) observed that *Cicadulina* spends more time acquiring MSV from tissues other than phloem, possibly the mesophyll, resulting in more virus acquisition. However, virus concentration does not increase in the insect following acquisition (Lett *et al.*, 2001). Mesfin and Bosque-Pérez (1998) documented that *C. storeyi* spend significantly shorter time while feeding on the mesophyll of MSV- infected plants than on healthy ones.

Epidemiology and Host Range of *Maize Streak Virus*

Maize streak virus is spread by *Cicadulina* species and its incidence is closely associated with vector population dynamics, which in turn, depends on rainfall, temperature and availability of alternative hosts (Atiri *et al.*, 2000). Increased epidemic of MSD is attributable to several factors including staggered planting which encourages higher incidence of MSV – A in early planted maize and devastation of seedlings that emerge in successive plantings (Dabrowski *et al.*, 1991); the population density of wild grasses which harbour both MSV-A and *Cicadulina* vectors (Autrey & Ricaud, 1983); the availability within leafhopper populations of a high percentage of MSV transmitters; and environmental factors that favour long distance movement of leafhopper (Rose, 1978). Continuous cultivation of maize all the year round also favours leafhoppers population build up and increased MSD epidemiology (Bosque-Pérez, 2000). Additionally, MSV is more severe where ultra-short season hybrids are cultivated. The shorter growing time of hybrids enables farmers to cultivate a second crop which provides continuous hosts for leafhoppers. Thus, temporal overlap of these two crops results in green bridge (Kloppers, 2005). Cultivation of maize in a monoculture aggravates MSV incidence via its leafhopper vectors. Other cases of MSV epidemic include the shift in natural parasites, introduction of new susceptible cultivars and the increased area under maize cultivation (Bosque-Pérez, 2000).

Although maize is a favoured host for *Cicadulina* feeding, several weed species have been implicated in leafhopper abundance and consequently MSD incidence. The leafhoppers preferentially breed on these grasses. Unfortunately, about 70 % of the over 138 grass species on which leafhoppers feed are potential MSV hosts (Konaté & Traoré, 1992). Varsani *et al.* (2008) observed that the maize adapted MSV-A strain and the closely related grass-adapted MSV-B strain seem to be more pathogenic on the genus *Digitaria*. Earlier, Mesfin *et al.* (1992) documented that virus isolates are not readily transmissible to susceptible maize field. Therefore, an adequate understanding of the survival of the grasses that harbour vectors and

MSV isolates infecting maize during the dry season (November to March), particularly in low – lying hydromorphic soils (Fadamas), provides detailed information on MSV ecology and epidemiology (Bosque-Pérez, 2000). The impact of temperature and wind on the movement and feeding of leafhoppers also affects leafhopper population (Asanzi *et al*., 1995b), and the spread of MSV. Moreover, studies in West Africa revealed that differences in species distribution and population dynamics of *C. mbila* were related to variation in soil types, altitude and seasons. Also, increase in nutritive status of host plants encourages leafhopper population build up and spread of the virus (Asanzi *et al*., 1995a).

The virus has a wide host range, attacking cultivated and wild plants. The maize adapted MSV - A strain infects more than 80 plants species in the family *Poaceae* (Damsteegt, 1983) but it is probable that ancestral MSV – A viruses that first infected maize specifically adapted to infecting species in the genus *Digitaria* (Varsani *et al*., 2008). *Maize streak virus* also infects wheat (*Tritium aestivum* L.) barley (*Hordeum vulgare* L.), rye (*Secale cereale* L.), oats (*Avena sativa* L.), sugarcane (*Saccharum officinarum* L.), finger millet (*Eleusine coracana* [L.] Gaertn.), pearl millet (*Pennisetum americanum* [L.] R. Br.), and sorghum (*Sorghum bicolor* [L.] Moench) (Varsani *et al*., 2008). It has been observed that MSD is not economically important on these crops with the exception of sugarcane streak disease (Van Antwerpen *et al*., 2008).

Management of Maize Streak Disease

Cultural control

Agronomic practices can be used to check the occurrence and spread of MSV (Bosque-Pérez *et al*., 1998). These include the use of 'barrier' of bare ground between early and late planted maize fields to reduce leafhopper movement and subsequent spread (Bosque-Pérez, 2000). Control can also be achieved through avoidance of maize plantings downwind from older cereal plants, and the use of crop rotation to reduce invasion by viruliferous leafhoppers (Barrow, 1992). Others include early planting before the outbreak of leafhoppers. Planting date could be adjusted to avoid migrating leafhoppers landing on young plants. However, in areas with erratic and unreliable rainfall, it is not feasible to commence planting of maize, before the onset of rains, or even late planting (Magenya *et al*., 2008).

Effective soil nutrient management is also recommended to curtail the negative impacts of MSV. Additionally, inhibition of plant viral agents strongly correlates to plants deficiency in nutrients necessary for viral growth and reproduction. This trend seems to apply particularly for both nitrogen and phosphorus elements (Byerlee & Heisey, 1996). The form of fertilizer applied also influences viral agents. Contrast to nitrate fertilizers, alkaline phosphate fertilizers have a beneficial effect against viral diseases, such that, by promoting maturity, they hasten the stage of resistance in the plant (Byerlee & Heisey, 1996). The mechanism is such that while P simultaneously encourages plants growth and virus concentration, K increases enhances plant growth and reduces viral concentration (Byerlee & Heisey, 1996). The level of nitrogen in plant tissues is the phytophagous insects principal attracting components. Thus, a positive correlation has been observed between migrations and reproduction of leafhoppers with the levels of soluble nitrogen content of host plants (Alegbejo & Banwo, 2005).

Biological control

The potential of utilizing natural enemies (predators and parasitoids) and entomopathogenic microbes for leafhoppers control has been accomplished in Asian countries (Mitsuhashi *et al*.,

2002). Thus, a number of parasitoids, predators and entomopathogens of important Cicadelid pests including *Cicadulina* spp that occur in India have been identified (Singh *et al*., 1993). However, there are no detailed attempts to identify and utilize biological control agents of leafhoppers in Africa (Magenya *et al*., 2008).

Chemical control

Maize streak virus vectors can be controlled by the application of systemic insecticides to the planting furrows during maize planting or even more effectively, as seed treatments (Shepherd *et al*., 2010). Additionally, Dahal (1997) documented that leafhopper populations seemed to be controlled by the carbamate class of insecticides. However, control is only partial since the recurring influx of migrant hopper populations re-infects the crop after each application (Magenya *et al*., 2008). Moreover, the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) have reported various cases of ill-health associated with those applying pesticides in the maize-based systems in Africa (WHO, 1986; FAO, 1998). It has been documented that a million people applying pesticide are poisoned in Africa annually, with 20,000 cases resulting in death (WHO, 1986). Pesticide poisoning is a serious problem among the small – scale farmers, who lack adequate knowledge on pesticides and who fail to wear appropriate protective clothing (Matthews *et al*., 2003). Additionally, most of the resource-poor farmers cannot afford the pesticide costs (Mathews *et al*., 2003). Although appropriate insecticide use will continue to play a vital role in maize viral disease / vector control; non – chemical alternatives remain the most cost effective, safest and environmentally suitable approaches for tropical resource- poor farmers (Matthews *et al*., 2003).

Host Plant Resistance

Adoption of resistant cultivars is the most appropriate and cost – effective approach for controlling the virus (Muiru *et al*., 2015). Resistance in maize was discovered thirty years after its first report, in the variety 'Peruvian yellow' (Fielding, 1933) in South Africa. Subsequently, tolerance was found in other materials and utilized to develop a hybrid population, P × H (Soto *et al*., 1982). Resistance to MSV was also found in East Africa (Storey and Howland, 1967). Similarly, the International Institute of Tropical Agriculture (IITA), Nigeria discovered resistance within IITA's maize population Tropical Zea – Yellow (TZ-Y) and the local variety Revolution collected by the Institute Recherche Agronomique Tropicale (IRAT) in Réunion (Soto *et al*., 1982). Over the years, maize varieties have been developed at IITA that combine high levels of MSV resistance with desirable agronomic characteristics including high yield potential, preferred grain type and early maturity (Kim, 1982; Efron, 1984). These streak- resistant populations are suitable for cultivation in different ecological zones and have good consumer acceptability characteristics (Shoyinka, 1988). The severe outbreak of MSD in northern Nigeria in 1984 allowed IITA to select in farmers' fields some extremely rare maize populations that stood up to infection with the virus.

Recently, genetic engineering which involves the use of transgenic plants has been demonstrated (Shepherd *et al*., 2014). Shepherd *et al*. (2007a, b) developed MSV resistant maize using dominant negative mutants of the virus' replication-associated protein gene (*Rep*). The MSV resistance inherited by transgenic plants was effective up to the T_3 generation. It was observed that the transgenic plants were able to delay streak symptom development, decrease severity and enhance survival rate following infection by the virus. The investigation was based on the understanding that multifunctional *Rep* is essential for MSV replication but mostly expressed in low levels. Since *Rep* acts as an oligomer, it becomes very valuable for pathogen-

derived resistance. Therefore, where target plants naturally express mutant forms of the *Rep* gene, the invading virus will be rendered ineffective.

Conclusion and Recommendations

Maize is one of the cereals that contribute substantially to food security in sub-Saharan Africa but productivity is seriously constrained by maize streak disease. The impacts of the virus are more felt by smallholders maize cultivators who have little or no access to agronomic inputs that could limit infections. Adoption of MSV-resistant/tolerant maize cultivars which is the best management option is recommended for maize growers in the region. Further, there is need for multidisciplinary approach and continuous collaboration from maize breeders, entomologists and plant virologists in order to eradicate MSD menace in the region.

References

Alabi, R. A. & Esobhawan, A. O. (2006). Relative economic value of maize – okra intercrops in rainforest zone, Nigeria. *Journal of Central European Journal,* 7, 433-438.

Alegbejo, M. D. & Banwo, O. O. (2005). Relationship between some weather factors, *Maize streak virus* genus *Mastrevirus* incidence and vector populations in northern Nigeria. *Journal of Plant Protection Research,* 45, 99 – 105.

Alegbejo, M. D., Olojede, S. O., Kashina, B. D. & Abo, M. E. (2002). *Maize streak Mastrevirus* in Africa: Distribution, transmission, epidemiology, economic significance and management strategies*. Journal of Sustainable Agriculture,* 19, 35-45.

Ammar, E. D., Gargani, D., Lett, J. M. & Peterschmitt, M. (2009). Large accumulations of *Maize streak virus* in the filter chamber and midgut cells of the leafhopper vector *Cicadulina mbila*. *Archives of Virology,* 154, 255 - 262.

Asanzi, M. C. (1991). *Studies of epidemiology of Maize streak virus and its Cicadulina leafhopper vectors in Nigeria.* The Ohio State University. Ph.D Thesis, 167pp.

Asanzi, C. M., Bosque-Pérez, N. A. & Nault, L. R. (1995a). Movement of *Cicadulina storeyi* (Homoptera: Cicadellidae) in maize fields and its behaviour in relation to maize growth stage. *Insect Science and its Application,* 16, 39 - 44.

Asanzi, M. C., Bosque-Pérez, N. A, Nault, L. R, Gordon, D. T. & Thottappilly, G. (1995b). Biology of *Cicadulina* species (Homoptera: Cicadellidae) and transmission of *Maize streak virus*. *African Entomology,* 3, 173 - 179.

Atiri, G. I., Njukeng, A. P. & Ekpo, E. J. A. (2000). Climate in relation to plant virus epidemiology and sustainable disease management. *Journal of Sustainable Agriculture,* 16, 17-29.

Autrey, L. J. C. & Ricaud, C. (1983). The comparative epidemiology of two diseases of maize caused by leafhopper-borne viruses in Mauritius. In: R. T. Plumb & J. M. Thresh (eds.) *Plant virus epidemiology.* Oxford: Blackwell. Pp. 277-285.

Babatunde, R. O., Fakayode, S. B. & Obafemi, A. A. (2008). Fadama maize production in Nigeria: case study from Kwara State. *Research Journal of Agriculture and Biological Sciences,* 4, 340 - 345.

Badu-Apraku, B., Lum, A. F., Fakorede, M. A. B., Menkir, A., Chabi, Y., The, C., Abdulai, M., Jacob, S. & Abgaje, S. (2008). Performance of early maize cultivars derived from recurrent selection for grain yield and *Striga* resistance. *Crop Science,* 48, 99-112.

Barrow, M. R. (1992). Development of maize hybrids resistant to *Maize streak virus*. *Crop Protection,* 11, 267-271.

Bock, K. R. (1974). *Maize streak virus*. CMI/AAB Description of plant viruses. No. 133.

Bosque-Pérez, N. A. (2000). Eight decades of *Maize streak virus* research. *Virus Research,* 71, 107 - 121.

Bosque-Pérez, N. A., Olojede S. O. & Buddenhagen I. W. (1998). Effect of *Maize streak virus* disease on the growth and yield of maize as influenced by varietal resistance levels and plant stage at time of challenge. *Euphytica,* 101, 307-317.

Briddon, R. W., Lunness, P., Chamberlin, L. C. & Markham, P. G. (1994). Analysis of the genetic variability of *Maize streak virus*. *Virus Genes,* 9, 93 - 100.

Byerlee, D. & Heisey, P. W. (1996). Past and potential impacts of maize research in sub-Saharan Africa: a critical assessment. Food Policy, 21(3), 255-277.

CIMMYT (Centro Internacional de Mejoramiento de Maíz y Trigo). (2010). E-News. 7(2). Available http://www.google.com.ng/#hl=en&source=hp&biw=771&bih=372&q=CIMMYT+ENews%2C+vol+7+no.+2%2C+April+2010&btnG=Google+Search&oq=&aq=&aqi=&aql=&gs_upl=&fp=99ab148d9e515263. Accessed 09 September, 2015.

Dabrowski, Z. T, Nwilene, F. & Kumar, R. (1991). First regular observations on leafhoppers, *Cicadulina* spp., vectors of *Maize streak virus* (MSV) in South-Eastern Nigeria. *Insect Science and its Application,* 12, 249 - 261.

Dahal, G., Shrestha, R. B. & Thapa, R. B. (1997). Species composition and relative abundance of rice green leafhoppers (*Nephotettix* spp.) in different altitudinal regions of Nepal. *International Journal of Pest Management,* 43, 49 - 58.

Damsteegt, V. D. (1983). *Maize streak virus* 1: Host range and vulnerability of maize germplasm. *Plant Disease,* 67, 734-737.

Danson, J., Lagat, M., Ininda, J. & Kimani, M. (2006). Application of simple sequence repeats (SSRs) markers to study the resistance of locally adapted maize hybrids to damaging maize streak virus disease. *African Journal of Biotechnology,* 5, 1430 - 1434.

Efron, Y. (1984). A summary of maize resistance breeding. *Annual Plant Resistance Insect Newsletter,* 10, 68 - 69.

Efron, Y., Kim, S. K., Fajemisin, J. M., Mareck, J. H., Tang, C. Y., Dabrowski, Z. T., Rossel, H. W., Thottappilly, G. & Buddenhagen, I. W. (1989). Breeding for resistance to *Maize streak virus*: A multidisciplinary team approach. *Plant Breeding,* 103, 1 - 36.

EPPO (European Plant Protection Organization) (2006). PQR database (version 4.5). Paris, France: European and Mediterranean Plant Protection Organization. www.eppo.org. Accessed 08 September, 2015.

Fajinmi, A. A., Dokunmu, A. O., Akheituamen, D. O. & Onanugu, K. A. (2012). Incidence and infection rate of *Maize streak virus* by Cicadulina triangular on maize plants and its distribution from lowest diseased leaf under tropical conditions. *Archives of Phytopathology and Plant Protection,* 45,1591-1598.

FAO (Food and Agriculture Organization). (1998). *Pesticide application.* Available httpJ/www.fao.org/ag/AGS/agse/activity. Accessed 08 September, 2015.

Fauquet, C. M., Bisaro, D. M., Briddon, R. W., Brown, J., Harrison, B. D., Rybicki, E. P., Stenger, D. C. & Stanley, J. (2003). Revision of taxonomic criteria for species demarcation in the *Geminiviridae* family, and a new updated list of *Begomovirus* species. *Archives of Virology,* 148, 405-421.

Fielding, W. L. (1933). Field experimental work on rotation crops. In: Empire Cotton Growing. *Association Progress Report*, 1931 - 1932. Pp. 10-14.

Frischmuth, T. & Stanley, J. (1993). Strategies for the control of *Geminivirus* disease. *Seminars in Virology,* 4, 329 - 333.

Fuller, C. (1901). *Mealie variegation first report of Government entomologist, South Africa.* 1899 - 1900. Pp 17 - 19.

Gianessi, L. (2015). *International pesticide benefits.* Available https://croplife.org/case-study/importance-of-pesticides-for-growing-maize-in-sub-saharan-africa/ Accessed 13 September, 2015.

Howell, S. H. (1985). Physical structure and genetic organisation of the genome of *Maize streak virus* (Kenyan isolate). *Nucleic Acids Research,* 13, 3018-3019.

Hull, R., Stanley, J. & Briddon, R. W. (1991). *Geminivirus*. Francki, R. I. B., Fauquet, C. M., Kundson, D. L. and Prow, F. (eds.). In: Classification and nomenclature of viruses. *Archives of Virology,* Suppl. 2, Springer Verlag, Wien (AT). Pp. 173-177.

IITA (International Institute of Tropical Agriculture) (1986). Solving the problem of *Maize streak virus*: A research breakthrough to increase maize production in sub-Saharan Africa. An award-winning project paper submitted to TAC-CGIAR, Italy.

IITA (International Institute of Tropical Agriculture) (2009). *Maize. Overview.* Available http://www.iita.org/cms/details/maize project details.aspx?zoneid=63&articleid=273. Accessed 09 September, 2015.

Isnard, M., Granier, M., Frutos, R., Reynaud, B. & Petterschmitt, M. (1998). Quasispecies nature of three *Maize streak virus* isolates obtained through different modes of selection from a population used to assess response to infection of maize cultivars. *Journal of General Virology,* 79, 3091-3099.

Jovel, J., Preiss, W. & Jeske, H. (2007). Characterization of DNA intermediates of an arising *Geminivirus*. *Virus Research,* 130, 63 - 70.

Karavina, C. (2014). *Maize streak virus*: A review of pathogen occurrence, biology and management options for smallholder farmers. *African Journal of Agricultural Research,* 9, 2736 – 2742.

Kim, S. K. (1982). Development of two early maturing streak resistant maize populations for Africa. *IITA Research Briefs,* 3(2), 5 - 6.

Kloppers, F. (2005). *Maize diseases: Reflection on the 2004/2005 season.* Available http://saspp.org/index2.php?option=com_content&do_pdf=1&id=2. Accessed 08 September, 2015.

Konate, G. & Traore, O. (1992). Reservoir hosts of *Maize streak virus* (MSV) in the Sudan-Sahel zone: Identification and spatio-temporal distribution. *Phytoprotection,* 73, 111 - 117.

Laufs, J., Schumacher, S., Geisler, N., Jupin, I. & Gronenborn, B. (1995a). Identification of the nicking tyrosine of *Geminivirus Rep* protein. *Federation of European Biochemical Societies Letters,* 377, 258 - 262.

Laufs, J., Traut, W., Heyraud, F., Matzeit, V., Rogers, S. G., Schell, J. & Gronenborn, B. (1995b). *In vitro* cleavage and joining at the viral origin of replication by the replication initiator protein of tomato yellow leaf curl virus. *Proceedings of National Academy of Sciences,* 92, 3879 - 3883.

Lazarowitz, S. G. (1988). Infectivity and complete nucleotide sequence of the genome of a South African isolate of *Maize streak virus*. *Nucleic Acids Research,* 16, 229 - 249.

Lett, J. M., Granier, M., Grondin, M., Turpin, P., Molinaro, F., Chiroleu, F., Peterschmitt, M. & Reynaud, B. (2001). Electrical penetration graphs from *Cicadulina mbila* on maize, the fine structure of its stylet pathways and consequences for virus transmission efficiency. *Entomologia Experimentalis et Applicata,* 101, 93 - 109.

Lett, J. M., Granier, M., Hippolyte, I., Grondin, M., Royer, M., Blanc, S., Reynaud, B. & Peterschmitt, M. (2002). Spatial and temporal distribution of *Geminiviruses* in leafhoppers of the genus *Cicadulina* monitored by conventional and quantitative polymerase chain reaction. *Phytopathology,* 92, 65 - 74.

Liu, H., Lucy, A. P., Davies, J. W. & Boulton, M. I. (2001a). A single amino acid change in the coat protein of *Maize streak virus* abolishes systemic infection, but not interaction with viral DNA or movement protein. *Molecular Plant Pathology,* 2, 223 - 228.

Liu, H., Boulton, M. I., Oparka, K. J. & Davies, J. W. (2001b). Interaction of the movement and coat proteins of *Maize streak virus*: implications for the transport of viral DNA. *Journal of General Virology,* 82, 35 - 44.

Liu, H., Boulton, M. I., Thomas, C. L., Prior, D. A., Oparka, K. J. & Davies, J. W. (1999). *Maize streak virus* coat protein is karyophyllic and facilitates nuclear transport of viral DNA. *Molecular Plant-Microbe Interactions,* 12, 894 - 900.

Liu, L., Davies, J. W. & Stanley, J. (1998). Mutational analysis of *Bean yellow dwarf virus*, a *Geminivirus* of the genus *Mastrevirus* that is adapted to dicotyledonous plants. *Journal of General Virology,* 79, 2265 - 2274.

Lucy, A. P., Boulton, M. I., Davies, J. W. & Maule, A. J. (1996). Tissue specificity of *Zea mays* infection by *Maize streak virus*. *Molecular Plant-Microbe Interactions,* 9, 22 - 31.

Magenya, O. E. V., Mueke, J. & Omwega, C. (2008). Significance and transmission of *Maize streak virus* disease in Africa and options for management: A review. *African Journal of Biotechnology,* 7, 4897 - 4910.

Magenya, O. E. V., Mueke, J. & Omwega, C. (2009). Association of maize streak virus disease and its vectors (Homoptera: Cicadelidae) with soil macronutrients and altitude in Kenya. *African Journal of Agricultural Research,* 4, 1284 - 1290.

Martin, D. P., Willment, J. A., Billharz, R., Velders, R., Odhiambo, B., Njuguna, J., James, D. & Rybicki, E. P. (2001). Sequence diversity and virulence in *Zea mays* of *Maize streak virus* isolates. *Virology,* 288, 247 - 255.

Martin, D. P., Willment, J. A. & Rybicki, E. P. (1999). Evaluation of *Maize streak virus* pathogenicity in differentially resistant *Zea mays* genotypes. *Phytopathology,* 89, 695 - 700.

Matthews, G., Wiles, T. & Baleguel, P. (2003). A survey of pesticide application in Cameroon. *Crop Protection,* 22, 707 - 714.

Menkir, A. & Kling, J. G. (1999). Effect of reciprocal recurrent selection on grain yield and other traits in two early – maturing maize populations. *Maydica,* 44, 159 - 165.

Mesfin, T. & Bosque-Pérez, N. A. (1998). Feeding behaviour of *Cicadulina storeyi* China (Homoptera: Cicadellidae) on maize varieties susceptible or resistant to *Maize streak virus*. *African Entomology*, 6, 185 - 191.

Mesfin, T., Bosque-Pérez, N. A., Buddenhagen, I. W., ThottappiIly, G. & OIojede, S. O. (1992). Studies of *Maize streak virus* isolates from grass and cereal hosts in Nigeria. *Plant Disease,* 76, 789 - 795.

Mesfin, T., Den Hollander, J. & Markham, P. G. (1995). Feeding activities of *Cicadulina mbila* (Hemiptera: Cicadellidae) on different host-plants. *Bulletin of Entomological Research,* 85, 387 - 396.

Mitsuhashi, W., Saiki, T., Wei, W., Kawakita, H. & Sato, M. (2002). Two novel strains of Wolbachia coexisting in both species of mulberry leafhoppers. *Insect Molecular Biology,* 11, 577 - 584.

Morris-Krsinich, B. A., Mullineaux, P. M., Donson, J., Boulton, M. I., Markham, P. G., Short, M. N. & Davies, J. W. (1985). Bidirectional transcription of *Maize streak virus* DNA and identification of the coat protein gene. *Nucleic Acids Research,* 13, 387 - 396.

Muiru, W. M., Charles, A. K., Kimenju, J. W., Njoroge, K. & Miano, D. W. (2015). Evaluation of resistance reaction of maize germplasm to common foliar diseases in Kenya. *Journal of Natural Sciences Research,* 5, 140 – 146.

Mullineaux, P. M., Donson, J., Morris-Krsinich, B. A., Boulton, M. I. & Davies, J. W. (1984). The nucleotide sequence of *Maize streak virus* DNA. *EMBO Journal,* 3, 3063-3068.

Munoz-Martin, A., Collin, S., Herreros, E., Mullineaux, P. M., Fernandez, L. M. & Fenoll, C. (2003). Regulation of MSV and WDV virion-sense promoters by WDV non-structural proteins: a role for their retinoblastoma protein-binding motifs. *Virology*, 306, 313 - 323.

Nawaz-ul-Rehman, M. S. & Fauquet, C. M. (2009). Evolution of *Geminiviruses* and their satellites. *Federation of European Biochemical Societies Letters,* 583, 1825-1832.

Okoth, V. A. O., Dabrowski, Z. T. & Van Emden, H. F. (1988). Comparative analysis of some parameters affecting *Maize streak virus* (MSV) transmission by various *Cicadulina* populations. *Insect Science and its Application,* 8, 295 - 300.

Oluwafemi, S., Kraberger, S., Shepherd, D. N., Martin, D. P. & Varsani, A. (2014). A high degree of African streak virus diversity within Nigerian maize fields includes a new *Mastrevirus* from *Axonopus compressus*. *Archives of Virology,* 159, 2765 - 2770.

Oluwafemi, S., Jackai, L. E. N. & Alegbejo, M. D. (2007). Comparison of transmission abilities of four *Cicadulina* species vectors of *Maize streak virus* from Nigeria. *Entomologia Experimentalis et Applicata,* 124, 235 - 239.

Peterschmitt, M., Reynaud, B., Sommermeyer, G. & Baudin, P. (1991). Characterization of *Maize streak virus* isolates using monoclonal and polyclonal antibodies and by transmission to a few hosts. *Plant Disease,* 75, 27 - 32.

Rose, D. J. W. (1978). Epidemiology of maize streak disease. *Annual Review of Entomology,* 23, 250 - 282.

Shepherd, D. N., Dugdale, B., Martin, D. P., Varsani, A., Lakay, F. M., Bezuidenhout, M. E., Monjane, A. L., Thomson, J. A., Dale, J. & Rybick, E. P. (2014). Inducible resistance to *maize streak virus.* PLoS ONE 9(8): e105932. doi:10.1371/ journal.pone.0105932.

Shepherd, D. N., Mangwende, T. Martin, D. P., Bezuidenhout, M. Thomson, J. A. & Rybicki, E. P. (2007a). Inhibition of *Maize streak virus* (MSV) replication by transient and transgenic expression of MSV replication-associated protein mutants. *Journal of General Virology,* 88, 325 - 336.

Shepherd, D. N., Martin, D. P., McGivern, D. R., Boulton, M. I., Thomson, J. A. & Rybicki, E. P. (2005). A three-nucleotide mutation altering the *Maize streak virus* Rep pRBR-interaction motif reduces symptom severity in maize and partially reverts at high frequency without restoring pRBR-Rep binding. *Journal of General Virology,* 86, 803 - 813.

Shepherd, D. N., Martin, D. P., Van de Walt, E., Varsani, K. D. A. & Rybicki, E. P. (2010). *Maize streak virus*: an old and complex 'emerging' pathogen. *Molecular Plant Pathology,* 11, 1 - 12.

Shepherd, D. N., Rybicki, E. P. & Thompson, J. A. (2007b). *Maize streak virus transgenic maize: A first for Africa.* Available http://www.isb.vt.edu/news/2007/artspdf/oct0701.pdf. Accessed 10 September, 2015.

Shoyinka, S. A. (1988). Cereal viruses in Africa. In: A. O. Williams *et al*. (eds.). *Virus diseases of plants in Africa.* OAU/STRC publication, Lagos, Nigeria. 225 pp.

Singh, S. P., Rao, N. S. & Henneberry, T. J. (1993). Leafhoppers and their natural enemies. Technical Bulletin Project. *Directorate of Biological Control, ICAR,* (6), 65.

Sofi, P. A., Wani, S. A. Rather, A. G. & Wani, S. H. (2009). Quality protein maize (QPM): Genetic manipulation for the nutritional fortification of maize. *Journal of Plant Breeding Crop Science,* 1, 244 - 253.

Soto, P. E., Buddenhagen, I. W. & Asnani, V. L. (1982). Development of streak virus-resistant maize populations through improved and selection methods. *Annals of Applied Biology,* 100, 539-546.

Storey, H. H. (1925). The transmission of streak disease of maize by the leafhopper *Balclutha mbila* Naudé. *Annals of Applied Biology,* 12, 422-439.

Storey, H. H. (1928). Transmission studies of maize streak disease. *Annals of Applied Biology,* 15, 1 - 25.

Storey, H. H. & Howland, A. K. (1967). Inheritance of resistance in maize to the virus of streak disease in East Africa. *Annals of Applied Biology,* 59, 429 - 436.

Thottappilly, G., Bosque – Pérez, N. A. & Rossel, H. W. 1993. Viruses and virus diseases of maize in Tropical Africa. *Plant Pathology*, 42, 494 - 509.

Tijani, A. A. & Osotimehin, K. O. (2007). Economics of pesticide use among maize farmers in Edo State, Nigeria. *Research Journal of Biological Sciences,* 3(3), 129 - 132.

Van Antwerpen, T., McFarlane, S. S., Buchanan, G. F., Shepherd, D. N., Martin, D. P., Rybicki, E. P. & Varsani, A. 2008. First report of *Maize streak virus* infection of sugarcane in South Africa. *Plant Disease,* 92, 982.

van der Walt, E., Rybicki, E. P., Varsani, A., Polston, J. E., Billharz, R., Donaldson, L., Monjane, A. L. & Martin, D. P. (2009). Rapid host adaptation by extensive recombination. *Journal of General Virology,* 90, 734 - 746.

Varsani, A., Shepherd, D. N., Monjane, A. L., Owor, B. E., Erdmann, J.B., Rybicki, E. P., Peterschmitt, M., Briddon, R. W., Markham, P. G., Oluwafemi, S., Windram, O. P., Lefeuvre, P., Lett, J. M. & Martin, D. P. (2008). Recombination decreased host specificity and increased mobility may have driven the emergence of *Maize streak virus* as an agricultural pathogen*. Journal of General Virology,* 89, 2063 - 2074.

WHO (World Health Organization) (1986). Informal consultation on planning strategy for the prevention of pesticide poisoning WHO Geneva. *WHO/VBC/* , 86, 926.

Willment, J. A., Martin, D. P., Palmer, K. E., Schnippenkoetter, W. H., Shepherd, D. N. & Rybicki, E. P. (2007). Identification of long intergenic region sequences involved in *Maize streak virus* replication. *Journal of General Virology,* 88, 1831-1841.

Willment, J. A., Martin, D. P. & Rybicki, E. P. (2001). Analysis of the diversity of African streak *Mastreviruses* using PCR-generated RFLPs and partial sequence data. *Journal of Virological Methods,* 93, 75 - 87.

Zagre, M. B. (1983). *Studies on Maize streak virus and its transmission characteristics by the leafhopper vector Cicadulina triangula.* Diploma Ingenieur Agronome Thesis. University National Du Benin.

MEAT YIELD AND CARCASS QUALITY OF CASTRATES AND NON-CASTRATE SAVANNA BROWN GOATS FED *leucaena leucocephala* SUPPLEMENTED WITH FREE GRAZING

ISAH GBODO MOHAMMED
Department of Agricultural Science, School of Vocational Education,
Niger State College of Education, Minna, Nigeria
E-mail: isagbodo@gmail.com Phone No: +234-703-336-6199

Abstract

Twelve weeks trial was conducted, with twenty four 5 month-old Savanna Brown Goats (castrates and non castrates) with an average weight of 7.5±1.5 kg. The goats were used to evaluate the effect of leucaena leucocephala on meat yield and carcass quality. The animals were randomly assigned to four treatments T1 comprises of with 0.00 % LL, T2 20 % LL, T3 30 % LL and T4 40 % in a randomized block design that contained two replicate. Other ingredients used included groundnut cake, rice bran, maize bran and salt which was varied to give crude protein value of 13.29, 12.24 and 11.15 for treatment I, ii, iii and iv respectively. The result obtained showed significant difference (P<0.05) of major primal cuts between non-castrate males and castrates. Similar trend was observed in meat to bone ratio from forelimb, hind limb, thoracic, neck and lumba regions across the treatments and type. It was therefore concluded that castrates fed 30 % Leucaena leucocephala meal diets had better meat yield while the non-castrate were better at 40 % Leucaena leucocephala. However, more studies are required to compare castrate of other ruminants with non-castrates as well as comparison between castrates and non-castrates of all the ruminants.

Keyword: Meat Yield; Carcass; Castrate; Non-Castrate; Savanna brown Goats; Free Grazing

Introduction

The share of animal protein in total protein intake of average Nigerians has remained far short of official recommended minimum requirement of about 75g of total protein and 35g of animal protein per person per day (Aderinola *et al.,* 2008). It is obvious that both aggregate and animal protein consumption levels have been markedly inadequate (Aderinola *et al*., 2008). The situation, therefore, called for increased production of indigenous livestock in both number and quality to increase protein intake. Adu (1990) however, observed that the major limiting factor of indigenous livestock production in the tropics is the feed. Tropical grasses are known to have a high rate of growth under favourable conditions (rainy-season) resulting in higher dry matter production but low forage quality in addition to crop residues, which cannot meet the optimum nutritional status of ruminants. To worsen the situation the recurring dry season inhibit the growth of shallow rooted grasses and legumes rendering them feed less during the season. Supplemental feeds are therefore necessary to meet animal requirements of maintenance, growth, production, reproduction in both rainy and dry seasons (Dennar, 1991). However, the cheaper the feed source (without sacrificing its quality) the better the returns to the farmers and the consumers too. Majority of goats are found in the semi-arid regions, which experience long dry seasons (Ngongoni *et al*., 2006), leading to shortages in animal feed, both in quality and quantity (Gusha *et al*., 2013), thus resulting to the low animal productivity (Atti *et al*., 2009). It is thus important to evaluate other alternative feed sources that are adapted to these regions such as leucena. In addition, ruminants can make efficient use of other non-conventional feed resources (Ngongoni *et al*., 2007) such as browse legume trees, for example Acaciaangustissima, Gliricidia sepium and Leucaena leucocephala (Archimède *et al*., 2010). It is

adaptable to all tropical soils, highly palatable to animals, drought resistant, thus able to retain its green colour better than pasture species (Archimède *et al*., 2010). Goats search for feed is laden with curiosity. It has more of tendency to vary its diets with changing seasons than sheep and cattle (Ngongoni *et al*., 2007). They are inquisitive in the selection of feed and extremely flexible in their dietary composition, being able to consume not only grasses and forbs but also leave and twigs from shrubs not normally eaten by sheep and cattle (Ngongoni *et al*., 2007). Therefore the aim of this research was to evaluate meat yield and meat quality characteristics of castrates and non castrate goats fed *Leucaena leucocephala* supplemented with free grazing.

Materials and Methods

Site of study: The research was conducted at the Teaching and Research Farm, Department of Animal Production, School of Agriculture and Agricultural Technology, Federal University of Technology Minna, Niger state. Minna lies between the Latitude 9° 31 and 9^{o} 45 North, and Longitude 6°31 and 6^{o} 45, East of the equator.

Experimental Animals and their Management: Twelve weeks trial was conducted, with twenty four (24) 5 month-old Savanna Brown goats (castrates and non castrates) with an average weight of 7.5±1.5 kg. The goats were used to evaluate the effect of *leucaena leucocephala* meat yield and carcass quality. The animals were purchased from Minna goat market. The goats were randomly allotted to four treatments with two replicates each. Each treatment had six goats with three per replicates. Before the commencement of the experiment, the animals were weighed, dewormed with Albedazole suspension and washed with Acaricidi solution of 100mls to 120 litres of water against internal and external parasites. They were also vaccinated against pest depetite of ruminant (PPR) using tissue culture rinderpest vaccine. Subsequent signs of disease were treated.

Experimental Diets: *Leucaene lecocephala* leaves were harvested from the research farm, maize bran, and rice bran and groundnut cake were bought from minna central market.. Harvested leucaena was sun cured for 24 hours and air dried for another 24 hours to approximately 85 % dry matter. Leucena was used to compound the diets (Table 1). Leucena meal was included in the diets at 0, 20, 30 and 40 % respectively. The design of the experiment was complete randomized design (CRD). Feed was weighed and fed to animals from 7am to 8pm every day *ad-libitum*, after which they were released to graze freely. Weekly weighing was recorded using averyl scale.

Table 1: Experimental diets fed to castrates and non castrates Savanna Brown goats

	Leucena leaves			
Ingredients	0.00	20.00	30.00	40.00
Leucena	00	20	30	40
Rice bran	54.00	8.00	5.00	3.00
Maize bran	37.50	64	60	55
Ground nut cake	8.50	8.00	5.00	2.00
Total	100	100	100	100
Determined				
Dry matter	93.69	94.03	97.27	94.03
Ash	5.31	5.97	5.73	5.97
Lipid	15.83	14,53	13.91	12.93
Crude protein	13.29	12.34	13.24	11.15
Crude fibre	12.50	15.25	8.70	5.17

Data Collection

Slaughtering Procedure: After twelve weeks feeding trial, 16 goats (Two from each treatment) were used for the slaughtered experiment. The goats were starved over night. Live weights were taken before taking them out of their pens without exciting them. Sharp knife was used to slaughter them by cutting the jurgular veins and the animals were hunged head down on a pole for 30 minutes for proper bleeding.

Meat to Bone Ratio: One forelimb, hindlimb, neck cervico-thoracic region, lumbasacra from each animal was de-boned hot manually using a kitchen knife. Both meat and the bones were also measured.

Dry Matter and Proximate Analysis of Feed and Meat Samples: Duplicate samples of about 200 g of feed and lean meat taken. The 200 g of compounded feed for each treatment and primal cut of goat from the four treatments were obtained and oven dried at 60^0C to constant weight while proximate analysis was carried out using the standard technique (AOAC, 1990) for crude protein (CP), crude fibre (CF) Ether extract (EE) and nitrogen free extract (NFE).

Statistical Analysis: Data collected during the trial were analyzed using analysis of variance (ANOVA) according to SAS Institute (2010).

Results and Discussion

Proximate composition (primal cut meat) of castrates and non castrates savanna brown goats fed Leucena leaf meal are presented in Table 2. Values for DM vary from 26.32 to 31.47% and from 26.9 to 28.47 for castrates and non castrates respectively. The moisture values were higher in castrates which ranged from 68.58 to 74.23 while those of non-castrates varied from 71.53 to 73.75. Ash values varied from 0.80 to 1.31 for castrates and 0.89 to o1.33 for non-castrates. Lipid values being higher in castrate varied from 12.52 to 24.18 and 7.17 to 14.33. Crude protein (CP) values were higher for castrates varying from 15.86 to 30.17% and those of non-castrate were between 19.07 to 23.70% while crude fibre varied from 1.08 to 1.83% for castrates and 1.95 to 2.88% in non-castrates. Non-castrates had higher nitrogen free extract varying from 34.38 to 38.33% and castrates were 0.89 to 34.22 %.

Table 2: Proximate composition (primal cut meat) of Savanna brown goat fed Leucena leaf meal diets

Parameters %	0.00		20.00		30.00		40.00		SEM
	C	M	C	M	C	M	C	M	1.97
Moisture	73.33	71.88	72.77	73.77	65.63	71.53	74.71	73.75	1.97NS
Crude protein	24.54	20.13	15.89	13.70	30.17	21.50	25.40	19.07	1.97NS
Lipid	34.24	14.33	15.07	9.97	32.69	7.71	12.05	13.65	1.97NS
Ash	1.69	0.92	1.29	1.33	1.11	1.11	0.70	0.89	1.97NS

C – Castrate
M – Non-castrate (male)

Percent Meat Yield from Castrate Goats

Percent meat yield from forelimb, hindlimb, thoracic, neck and lumba regions of castrated savanna brown goats fed leucaenae *lecocephala* supplemented with free grazing presented in Table 3 showed significant difference (P<0.05) across all the treatments.

The percent meat yield from forelimb, hindlimb, thoracic, neck and lumba regions of non-castrated savanna brown goats fed *leucaena lecocephala* supplemented with free grazing are presented in Table 4. The result indicated significant difference (P<0.05) in all the meat cuts as well as meat/bone ratio.

Table 3: Percent meat yield from Forelimb, Hindlimb, Thoracic region, neck and lumba regions of castrates and non castrates Savanna brown goats

Parameters (%)	0.00	20.00	30.00	40.00	SE +
Fore limb					
Meat	645.24 ± 28.89^{b}	732.95 ± 0.22^{a}	894.81 ± 53.37^{a}	671.32± 5.98^{b}	+ 0.015
Bone	121.62± 0.035^{b}	142.75 ± 0.025^{a}	136.02 ± 0.022^{c}	139.72±0.028^{a}	+ 0.079
Meat/bone ratio	5.30 ± 0.24^{b}	5.13 ± 0.035^{b}	6.57 ± 0.39^{a}	4.27 ± 0.31^{c}	+ 15.190
Hind Limb					
Meat	821.28±38143^{b}	812.91 ± 1.21^{b}	1071.98±31.43^{a}	745.57±40.69^{c}	± 3.27
Bone	140.07±22.16^{b}	183.56 ± 0.12^{a}	181.64 ± 0.022^{a}	170,09 ± 4.67^{a}	± 0.184
Meat/bone ratio	5.94 ± 1.22^{a}	4.61 ± 0.31^{b}	5.92 ± 0.19^{a}	4.51 ± 0.13^{b}	± 9.241
Thoracic region					
Meat	1070.55± 0.30^{d}	1117.68 ± 3.27^{b}	1207.08 ± 0.09^{a}	1098.88±1.59^{c}	± 0.302
Bone	435.79 ± 0.98^{d}	458.48 ±1.63^{b}	503.54 ± 0.45^{a}	449.28 ± 0.75^{c}	± 0.013
Meat/bone ratio	2.46 ± 0.00^{a}	2.44 ± 0.035^{a}	2.34 ± 0.029^{b}	2.44 ± 0.035^{a}	± 0.542
Neck					
Meat	432.90 ± 0.23^{b}	578.53 ± 17.33^{a}	578.52 ± 0.37^{a}	429.24±0.024^{b}	± 0.011
Bone	178.37± 0.022^{c}	192.01 ± 0.022^{a}	189.75 ± 0.025^{b}	156.99±0.023^{d}	± 0.013
Meat/bone ratio	2.43 ± 0.00^{c}	3.01 ± 0.028^{a}	3.05 ± 0.00^{a}	2.73 ± 0.00^{b}	± 2.50
Lumba region					
Meat	422.19 ± 12.64^{b}	246.16 ± 0.021^{d}	533.92 ± 0.88^{a}	331.98 ± 1.46^{c}	± 1.841
Bone	140.75 ± 4.23^{b}	82.05 ± 0.035^{d}	174.64 ± 5.48^{a}	110.66 ± 0.49^{c}	± 1.002
Meat/bone ratio	3.65 ± 0.10^{c}	3.05 ± 0.022^{d}	3.80 ± 0.00^{b}	4.19 ± 0.035^{a}	± 0.015

^{abcd} Means in the same row with different superscripts are significantly different (P,0.05)
0.00 %= Non Leucena meal; 20.00, 30.00 and 40.00 % levels of Leucena meal inclusions; SE + = Standard error.

Table 4: Percent meat yield from Forelimb, Hindlimb, Thoracic region, neck and lumba regions of non-castrate Savanna Brown goats

Parameter (%)	0.00	20.00	30.00	40.00	SE +
Forelimb					
Meat	493.99 ± 9.76^{c}	330.78±0.026^{d}	494.08 ± 0.16^{b}	808.00 ± 0.63^{a}	± 1.411
Bone	120.73 ± 0.66^{c}	108.51 ± 1.07^{d}	130.13 ± 0.024^{b}	192.88± 0.024^{a}	± 0.182
Meat/bone ratio	3.65 ± 0.10^{c}	3.05 ± 0.022^{d}	3.80 ± 0.00^{b}	4.19 ± 0.035^{a}	± 0.015
Hind Limb					
Meat	562.68 ± 8.27^{c}	343.05±0.027^{d}	618.48 ± 0.36^{d}	951.75± 0.39^{a}	± 1.916
Bone	120.70 ± 0.69^{d}	150.67±0.026^{c}	181.87 ± 0.024^{b}	267.47±0.0023^{a}	± 0.100
Meat/bone ratio	4.66 ± 0.029^{a}	2.28 ± 0.00^{d}	3.40 ± 0.00^{c}	3.56 ± 0.00^{b}	± 0.014
Thoracic region					
Meat	487.22 ± 10.75^{c}	465.57 ± 0.45^{d}	611.94 ± 108^{b}	751.66 ± 1.31^{a}	± 1.572
Bone	206.85 ± 2.89^{c}	206.21 ± 0.93^{c}	231.68 ± 1.48^{b}	287.56 ± 2.02^{a}	± 0.004

Meat/bone ratio	2.35 ± 0.028[b]	2.25 ± 0.021[c]	2.64 ± 0.021[a]	2.61 ± 0.022[a]	± 0.013
Neck					
Meat	356.03 ± 0.024[c]	298.13±0.022[d]	405.49 ± 0.029[b]	519.20 ± 4.27[a]	± 0.616
Bone	143.97 ± 0.024[c]	35.40 ± 0.021[d]	163.86 ± 0.026[b]	208.94 ± 0.027[a]	± 0.015
Meat/bone ratio	2.47 ± 0.00[b]	8.42 ± 0.00[a]	2.47 ± 0.00[b]	2.49 ± 0.012[b]	± .0568
Lumba Region					
Meat	201.45 ± 0.10[c]	234.19±0.026[a]	212.76 ± 0.023[b]	212.76 ± 0.033[c]	± 0.144
Bone	97.65 ± -.40[a]	88.45 ± 0.48[c]	89.57 ± 0.49[b]	71.79 ± 0.60[d]	±0.144
Meat/bone ratio	2.06 ± 0.035[d]	2.65 ± 0.021[b]	2.37 ± 0.021[c]	2.97 ± 0.022[a]	± 0.005

[abcd] Means in the same row with different superscripts are significantly different (P,0.05)
0.00 %= Non Leucena meal; 20.00, 30.00 and 40.00 % levels of Leucena meal inclusions; SE + = Standard error.

Discussion

The proximate analysis of the diet showed high percentage of crude protein (CP) which is in line with those reported by Jones (1979). The results of primal cut (meat) analysis on the other hand showed that castrates were higher in lipid and crude protein but lower in crude fibre and nitrogen free extract (NFE). This is in conformity with Nuru (1985) who reported lower crude fibre and nitrogen free extract in castrated goats than non-castrated.

The results of meat yield showed that castrates recorded more favourable meat to bone ratio. It could be observed that despite the inferior dressing percentage values recorded by the castrates, they still had higher meat yield as seen in the proportion of meat to bones. Hill (1988) remarked that the lower the percent of bone, the better the carcass. Composition of meat is of interest to the producer and the consumer. This result compared favoruably well with that of Nuru (1985) who reported a value of 4:1:1 for Savanna Brown goats slaughtered after direct purchase from the market and 4:8:1 for those fattened for 3 months.

Conclusion

It was therefore concluded that castrates fed 30 % had better meat yield while the non-castrate were better at 40 %.

References

Archimède, H., González-García, E., Despois, P., Etienne, T. & Alexandre, G. (2010). Substitution of corn and soybean with green banana fruits and Gliricidia sepium forage in sheep fed hay-based diets: effects on intake, digestion and growth, *Journal on Animal Physiology and Animal nutrition*, 94(1), 118–128.

Aderinola, O. A., Akingbade, A. A., Akinwumi, A. O., Ewetola, O. & Adegorite, M. O. (2008). Effect of Gliricidia sepium supplementation on intake, digestibility and nitrogen balance of wad sheep and goats fed vetiver grass. *Bowen Journal of Agriculture,* 5, 80 – 86.

Adu, I. F. (1990). *Nutrient requirement of sheep and goats.* A valedictory lecture at National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Samaru, Zaria.

Atti, N., Mahouachi, M., Zouaghi, F. & Rouissi, R. (2009). Incorporation of cactus (Opuntia ficus-indica f. inermis) in young goats diets: 1. Effects on intake, digestion, growth and carcass composition Livestock Research for Rural Development 21 Article.

AOAC, (1990). *Official methods of analysis association of official analytical chemist.* 15th Edition Arlington.

Dennar, F. O. (1991). *Management of large scale sheep project.* Project funded by the Directorate of Food, Roads and Rural Infrastructure (DFRRI) Shika.

Jones, R. J. (1978). The value of *Leucaena Leucocephala* as a feed for ruminants in the tropics. *World Animal Review,* 31,13-23.

Ngongoni, N. T., Mapiye, C., Mwale, M. & Mupeta, B. (2006). Factors affecting milk production in the smallholder dairy sector of Zimbabwe. *Livestock Research for Rural Development,* 18(89).

Ngongoni, N. T., Mapiye, C., Mwale, M. & Mupeta, B. (2007). Effects of supplementing high protein ram pres sunflower cake concentrate on smallholder milk production in Zimbabwe. *Tropical Animal Health and Production,* 39, 297 – 307.

SAS Institute (2010). *SAS/STAT user's guide.* 9 ed. (SAS Institute, Cary).

RESPONSE OF MAIZE TO INTERCROPPING OF SOYABEAN ON *STRIGA HERMONTHICA* CONTROL IN MINNA, NIGER STATE, NIGERIA

MAMUDU, A. Y. & ABBAS, M. A.
Crop Production Department, School of Agricultural and Agric Technology,
Federal University of Technology, Minna, Nigeria
Email: mamuduay@gmail.com Phone No: +234-805-705-5760

Abstract
Field trial was conducted in 2013 cropping season on a naturally heavily Striga infested field at the research farm of Gidan Kwano campus of Federal University of Technology, Minna (Lat 09^{0}31'15"N and Long 6^{0}26'15"E) to determine the effect of spacing and intercropping soyabean on Strigahermonthica control in two varieties of maize (Striga resistant TZL-Compl-syn-STR-W1 and susceptible SAMMAZ 16). The intercropped with soyabean variety Tam 59 and spacing at0 cm, 40cm, 60 cm and 80cm. The experiment was layout in a randomized complete block design (RCBD) with three replications. The results indicate that there was significant difference ($p \leq 0.05$) in the maize varieties in developing Striga shoot emergence, reducing Striga shoot density per stand and per plot, Striga shoot flowering, and maize syndrome action score. The resistant maize variety was significantly taller (104.18cm at 8WAS) and produced greater 100 grain weight (523.0g), although there were no significant difference in the maize cob weight (876.9 and 854.5g), and maize varieties. There was no significant effect of spacingand intercropping (57.64 and 58.38) on number of days from planting of maize to Striga emergence. At 40cm spacing and intercropping there were significant difference on maize shoot density per stand and per plot (0.67 and 2.17 at 6WAS), Striga shoot flowering and severity score by 58 to 60% compared with 0cm (control) and other (60cm and 80cm), the Striga were significantly reduced, hence less damages. There were no significant difference in spacing and intercropping on maize cob weight, maize grain yield and 100 grain weight.

Keywords: Spacing, Soyabean intercropping, *Striga hermonthica* management.

Introduction
Striga hermonthica is a parasite flowering plant that is most serious in sub-Saharan Africa. It is a major constraint to cereal (Maize, sorghum, upland rice and millet) production. The potential production improvements resulting from the use of improved varieties and production techniques were often not realized due to the losses caused by this witch weed (*Strigahermonthica* (Del) Benth).Yield losses caused by the weed are often times significant and complete crop failure could occur. Kanampiu, *et al.,* (2003) reported that the *Striga* problem has continues to increase as a result; farmers are forced to abandon *Striga* infested fields. For now, no control measure has so far been developed that is effective in *Strigahermonthica* control. Several methods of controlling the weed are recommended, but are either incompatible with the cropping system, expensive or unstable and have to be practiced over several cropping seasons. Cost effective alternative control methods that are acceptable to small-scale farmers are needed.

Roda *et al.,* (2002) reported that intercropping has in many instances shown promise as a low-cost method of controlling *Striga.*Aliyu, *et al.,* (2004) also indicated that intercropping can be a useful alternative to optimize yield and maintaining soil fertility. Kureh, (2006) reported that intercropping of maize with soyabean is a means of suppressing *Striga* in the cereals crops.

Kolo and Mammudu (2008) reported that dressing of maize seed with P. biglobosa pulp gave better maize development both vegetative and in grain yield especially with the resistant varieties. Mamudu (2013) reported that intercrops with trap crops, nitrogen fertilization consistently delayed and reduce *Striga* emergence, caused low *Striga* damage to the crop and increased grain yield.

Gworgwor *et al.,* (2002) reported that soaking millet (*Pennisetum glaucum* (L.) R. Br. Seeds in low urine for about 6-7 hours supported less emergence of *Strigahermonthica* shoots. The objective of this study was to evaluate difference spacing of cover crop (soya bean) for *Striga hermonthica* control under field conditions.

Materials and Methods

A field trial was conducted on fields naturally infested by S. *hermonthica* during the 2013 cropping season in Minna (Lat $09^0$31'15''N and Long $6^0$26'15''E) in the southern Guinea savanna agro-ecological zone of Nigeria. The ridges were manually constructed 75 cm apart with hand hoe. The main plot size was 11m × 31m and subplot size is 3m × 3m with 1.5 m long ridges. Two maize varieties (TZL, Compl-syn-STR-WI) (*Striga* resistant) and (SAMMAZ 16) (susceptible) were intercropped with soyabean (TGM 59) at four levels of spacing, 0, 40, 60 and 80cm. the treatment were randomly laid out in randomized complete block design (RCBD) with three replications.

The maize varieties (TZL-Compl-syn-STR-WI and SAMMAZ-16) were sown at a depth of about 3 to 4cm on the ridges at different spacing (0, 40, 60 and 80cm). Soyabeans were intercropped with maize at recommended spacing 75 cm intra-row spacing. Manual weeding was carried out at 4 and 6 weeks after sowing.Handpulling of weeds other than *Strigahermonthica* was adopted in order to avoid damage to *Striga* shoots. Compound fertilizer (NPK 15-15-15) was applied at three weeks (WAS) at low rate of 14-6-11 kg/ha as side placement 5 cm away from the maize stand to avoid damage to *Striga* shoots.

Data were taken on days to *Striga* shoot emergence, *Striga* shoot density per m^2 and per stand of maize at 6, 8 and 10 WAS, number of *Striga* shoots flowering at 8 WAS. Severity score (on a scale of 1, where 1 indicated no plant damage by *Striga* and 9 indicated almost complete maize plant damage), maize plant height at 6 and 8 WAS, maize cob weight, maize grain yield and 100 grain weight were also recorded. The data collected were subjected to analysis of variance and treatment means separated by Duncan's Multiple Range Test (DNMRT) at $P \leq 0.05$.

Results

The result in Table 1shows that there was no significant difference ($p \leq 0.05$) in*Striga* shoot emergence when soyabeans was intercropped at different spacing with maize. However there was a significant difference ($p \leq 0.05$)in the number of *Striga* shoot emergence between two maize varieties (TZL- Compl-syn-WI (57.64) and SAMMAZ 16 (58.38) when intercropped with maize. The interaction effect of maize variety and intercropping soyabean and different spacing were not significant (Table 1).

The effect of spacing and intercropping on *Striga* shoot density varied significantly throughout the sampling periods (Table 2). At 6WAS,*Striga hermonthica* shoot density per maize stand was lowest at 40cm spacing of maize (0.67) compared to other spacing 60, 80 and control (1.67, 2.67 and 3.00 respectively). The highest *Striga* (2,67 and 3.00 respectively). The same trend

was observed at 8 and 10 WAS (Table 2). There were significant differences between the two maize varieties throughout the sampling periods. The resistant variety (TZL-Compl-syn-STRWI) significantly lower in number of *Striga* shoot per stand (1.17) than the susceptible SAMMAZ 16 (2.83). the same trend was observed at 8 and 10 WAS. The interaction effect of maize variety and intercropping soyabean at different spacing were not significant (Table 2). The effect of spacing and intercropping on *Strigahermonthica* shoot density per plot showed the same trend with that observed per stand. Also the *Striga*shoot per plot was significant between the two maize varieties throughout the sampling period with the resistant maize variety (TZL-Compl-syn-STR-WI) supported fewer *Striga* shoot than (SAMMAZ 16) susceptible variety (Table 3). The table also shows that the interaction effect of maize variety and intercropping soyabean at different spacing were not significantly different (Table 3).

Table 1: Effect of spacing and intercropping soya bean on days to *Striga* shoot emergence on *Striga hermonthica* control in maize

Treatment	First *Striga* shoot emergence
Maize variety (MV)	
TZL-Compl-syn-STR-WI	57.64[b]
SAMMAZ 16	58.38[a]
± SEM	0.20
Spacing (cm)	
0 (control)	58.50[a]
40	58.00[a]
60	58.00[a]
80	57.67[a]
± SEM	0.30
Interaction	
MV × S	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability. SEM (±) = Standard error of mean. NS = Not significant. MV = Maize variety. S = Soyabean

Table 2: Effect of spacing and intercropping soyabean on *Striga* shoot per stand on *Striga hermonthica* control in maize

Treatment	*Striga* shoot count per stand		
	6 WAS	8 WAS	10 WAS
Maize variety (MV)			
TZL-Compl-syn-STR-WI	1.17[b]	2.08[b]	3.50[b]
SAMMAZ 16	2.83[a]	3.67[a]	6.00[a]
± SEM	0.16	0.18	0.19
Spacing (cm)			
0 (control)	3.00[a]	4.33[a]	6.67[a]
40	0.67[c]	1.50[d]	2.67[d]
60	1.67[b]	2.33[c]	4.17[c]
80	2.67[a]	3.33[b]	5.50[b]
± SEM	0.22	0.25	0.30
Interaction			
MV × S	NS	NS	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability. SEM (±) = Standard error of mean. NS = Not significant. MV = Maize variety. S = Soyabean

Table 3: Effect of spacing and intercropping soyabean on *Striga* shoot per plot on *Striga hermonthica* control in maize

Treatment	*Striga* shoot count per stand		
	6 WAS	8 WAS	10 WAS
Maize variety (MV)			
TZL-Compl-syn-STR-WI	3.82[b]	4.55[b]	6.55[b]
SAMMAZ 16	5.38[a]	7.46[a]	9.38[a]
± SEM	0.20	0.40	0.36
Spacing (cm)			
0 (control)	6.67[a]	8.50[a]	11.33[a]
40	2.17[d]	3.00[c]	4.33[d]
60	4.17[c]	5.33[b]	7.00[c]
80	5.67[a]	7.67[a]	9.67[b]
± SEM	0.30	0.59	0.53
Interaction			
MV × S	NS	NS	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability. SEM (±) = Standard error of mean. NS = Not significant. MV = Maize variety. S = Soyabean

The effect of spacing and inter cropping with soyabean significantly produced the lowest number of *Striga* shoots with flowers at 40cm spacing that other treatments, while spacing at 80cm and control produced the least number with flowers (Table 4). This was due to due to close canopy which reduces the light intensity, increases the soil moisture and lowers the soil temperature thereby creating unfavourable condition for *Striga* seed germination. However, the reverse was the case with spacing at 80cm and control. (Table 4)

The effect of maize varieties on the number of flowering *Striga* shoot were significantly different with the resistant maize variety (TZL-Compl-syn-STR-WI) which significantly reduced number of flowering *Striga* shoot than susceptible SAMMAZ 16 by 50% (Table 4).

The interaction effect of intercropping soyabean and different spacing was not significant (Table 4). The effect of *Strigahermonthica* on maize damage severity score was more in 80cm spacing and control (that is normal spacing) than those with 40cm and 60cm spacing intercropped with soyabean (Table 5).

It was observed that the closer the spacing with intercropped the better the ground cover and lesser that *Striga* attack. Table 5 show that the effect of *Striga* damage on maize increased as the spacing increased. The maize varieties significantly influence maize damage severity score with the resistant maize variety (TZL-Compl-syn-STR-WI) showed least maize damage than susceptible (SAMMAZ 16) variety. (Table 5). The interaction effect of soyabean intercropping and different spacing was not significant. (Table 5).

Table 4: Effect of spacing and intercropping soyabean on *Striga* shoot flowering on *Strigahermonthica*control in maize

Treatment	*Striga* shoot flowering
Maize variety (MV)	
TZL-Compl-syn-STR-WI	2.45[b]
SAMMAZ 16	4.54[a]
± SEM	0.32
Spacing (cm)	
0 (control)	5.17[a]
40	1.50[c]
60	3.17[a]
80	4.50[a]
± SEM	0.46
Interaction	
MV × S	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability. SEM (±) = Standard error of mean. NS = Not significant. MV = Maize variety. S = Soyabean

Table 5: Effect of spacing and intercropping soya bean on maize plant height on *Strigahermonthica* control in maize at 6 WAS and 8 WAS

Treatment	Severity score
Maize variety (MV)	
TZL-Compl-syn-STR-WI	3.00[b]
SAMMAZ 16	5.92[a]
± SEM	0.30
Spacing (cm)	
0 (control)	6.33[a]
40	3.00[b]
60	3.83[b]
80	5.17[a]
± SEM	0.44
Interaction	
MV × S	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability. SEM (±) = Standard error of mean. NS = Not significant. MV = Maize variety. S = Soyabean

The 40cm spacing of maize with soya bean intercropping significantly resulted in taller plants than all other treatment at 6 and 8 WAS (Table 6). However, maize plant height was significantly reduced by effect of *Striga* as the spacing increased to 80cm with soyabean intercropping and the control (Table 6). The taller plant height observed at 40cm spacing with soyabean intercropped treatment was as a result of good protection produced by the treatment compared to other treatment. The *Striga* resistant maize variety (TZL-Compl-syn-STR-WI) significantly produced taller plants than SAMMAZ 16 (susceptible variety) (Table 6). The interaction effect of maize variety and intercropping soyabean and different spacing were not significant (Table 6). The maize cob weight was heavier at 40cm spacing compared to other treatment (Table 7). The resistant variety (TZL-Compl-syn-STR-WI) produced the heaviest maize cob weight than the susceptible SAMMAZ 16 (Table 7). The interaction effect of maize variety, intercropping soya bean and spacing was not significant (Table 7).

Table 6: Effect of spacing and intercropping soyabean on maize plant height on *Strigahermonthica* control in maize at 6 WAS and 8 WAS.

Treatment	Plant height (cm)	
	6 WAS	8 WAS
Maize variety (MV)		
TZL-Compl-syn-STR-WI	87.09[a]	104.18[a]
SAMMAZ 16	56.46[b]	85.23[b]
± SEM	1.74	2.27
Spacing (cm)		
0 (control)	57.50[c]	80.33[b]
40	81.83[a]	104.00[a]
60	76.33[a]	96.17[a]
80	66.33[b]	95.17[a]
± SEM	2.56	3.35
Interaction		
MV × S	NS	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability. SEM (±) = Standard error of mean. NS = Not significant

Table 7: Effect of spacing and intercropping soya bean on maize Maize cob weight on *Striga hermonthica* control in maize

Treatment	Maize cob weight (g)
Maize variety (MV)	
TZL-Compl-syn-STR-WI	876.9[a]
SAMMAZ 16	854.5[a]
± SEM	147. 40
Spacing (cm)	
0 (control)	700.0[a]
40	1133.3[a]
60	916.7[a]
80	716.7[a]
± SEM	216.97
Interaction	
MV × S	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability. SEM (±) = Standard error of mean. NS = Not significant. MV = Maize variety. S = Soyabean

There were no significant difference in maize grain yield throughout the spacing, also the interaction effect of maize variety, intercropping soya bean with maize and spacing was not significantly different. (Table 8).

The maize grain weight was not significantly difference between the two maize varieties (Table 8), although the result indicates that the resistance maize (TZL-Compl-syn-STR-WI) was recorded highest grain weight than the susceptible variety (SAMMAZ 16) (Table 8).

The maize grain weight obtained from both the resistance and susceptible variety were not significantly different (Table 8). The resistance maize variety (TZL-Compl-syn-STR-WI) significantly gave higher 100 grain weight than the susceptible (SAMMAZ 16) (Table 8).

The interaction effect of maize variety, intercropping soyabean, and different spacing level was not significant. (Table 8)

Table 8: Effect of spacing and intercropping soyabean on maize grain yield on *Striga hermonthica* control in maize

Treatment	Maize grain weight (g)
Maize variety (MV)	
TZL-Compl-syn-STR-WI	523.0[a]
SAMMAZ 16	502.2[a]
± SEM	79.67
Spacing (cm)	
0 (control)	395.6[a]
40	660.4[a]
60	561.0[a]
80	436.9[a]
± SEM	117.30
Interaction	
MV × S	NS

Means having the same letter (s) within a column are not significantly different (DMRT) at 5% level of probability. SEM (±) = Standard error of mean. NS = Not significant. MV = Maize variety. S = Soyabean

Discussion

The results presented indicate that the 40cm spacing with soya bean intercropping offered significant control of *Strigahermonthica* in all the parameters measured in this study which was achieved by reducing *Striga* shoot density which in agreement with the findings of Ghadiri and Bayat (2004). *Striga* shoot density was reduced by 56-60% compared with spacing of 80cm and control. The intercropping with soyabean also helps in suppressing *Striga* in the maize which is also in agreement with the finding of Kureh (2006). The lower the *Striga* shoot density, the lower the number of flowering, hence the lower the soil seed bank for future infestation. The increase in *Striga* shoot density in 60 cm and 80cm could be due to competitive ability of weeds which is more at wider cropping spacing, because of less crop canopy closure which allows for red light to be received by the weed which could give the weed better growth opportunity. The little shading in wider spacing also gave the weed opportunity to sufficient resources required for their germination, emergence and growth.

The effect of *Striga hermonthica* attack on maize with 40cm spacing with soyabean intercropping because the *Striga* shoot density was fewer (Table 5) in this treatment, this could be due to inability of the *Striga* seeds to properly germinate and/or attach to the host maize root. Consequently maize plant spacing at 40cm and intercropped with soyabean developed taller and maize grain yield was higher. Ghadiri and Bayat 2004; reported that manipulating agronomic factors such as row and plant spacing may provide a non-chemical approach to reducing the impact of weed interference on crop yields. Row spacing and plant population influence the ability of the crop to compete with weeds for resources (Ghadiri and Bayat 2004).

Conclusion

Resistant varieties are strongly recommended for sowing in *Striga* infested field. *Striga hermonthica* can be controlled by 40cm spacing and intercropping with soya bean as a component of integrated *Striga* management package.

References

Aliyu, L., Lagoke, S. T. O., Carsky, R. I., Kling, J., Omotayo, O. & Shebayan, J. Y. (2004). *Technical and economic evaluation of some Striga control packages in maize in the Northern Guinea Savanna protection.* Elsevier LTD. p. 66.

Ghadiri, H. & Bayat, M. L. (2004). Effect of Row and plant spacing on weed competition with pinto Beans (Phaseolus vulgaris L.). *Journal of Agricultural Science and Technology,* 6,1 - 9.

Gworgwor, N. A., Shall, S. D. & Abba, A. (2002). Preliminary evaluation of effectiveness of cow urine in controlling *Striga hermonthica* (Del.) Benth. In the semi-arid zone of Nigeria. *Journal of Sustainable Tropical Agricultural Research,* 4,50 - 55.

Kanampiu, F. K., Kabambe, V., Massawe, C., Jasi, L., Friensen, D., Ransom, J. K. & Gressel, J. (2003). Multisite, multi-season field tests demonstrate that herbicide seed coating herbicide-resistance maize control *Striga* spp. and increases yields in several African countries. *Crop Protection,* 22, 697 - 706.

Kolo, M. G. M. & Mamudu, A. Y. (2008). Water treatment of parkia biglobosa pulp dressed maize (Zea mays L.) Seeds for *Striga hermonthica* control at Minna, Nigeria. *Agricultural Tropica et Subtropica,* 41(3).

Kureh, A. A. (2006). Promoting Integral *Striga* Management Practice in Northern Nigeria. *Nigerian Journal of Weed Science,* 8(10), 33 - 34.

Mamudu, A. Y. (2013). Intercrops with trap crops, Nitrogen Fertilization for *Striga hermonthica* (Del.) Benth control at Niger State. *International Journal of Humanities and Social Science Invention,* 2, 64 - 69.

Reda, F., Woldewahi, G., Zemichael, B. & Bayou, W. (2002). Integrated cropping system approach for the control of *Striga hermonthica* in sorghum. In: S. T. O. Lagoke & M'boob, S. S. (Eds). *Integrated Striga management tech from research to farmers.* Proceedings of the fourth general workshop of the Pan Africa control network (PASCON), 28 October- 1st November 1996, Bamako, Mali. FAO/PASCON; Pp 190-194

COMPARATIVE EFFECTS OF HEAT-TREATMENT ON TENSILE STRENGTH AND ELECTRICAL CONDUCTIVITY OF FORMULATED AL- Ni AND AL- Zn ALLOYS

MURIANA, R. A.[1]; ABUBAKRE, O. K.[1], & TAJIRI, S. B.[2]
[1]Mechanical Engineering Department,
Federal University of Technology, Minna, Nigeria
[2]The Polytechnic of Sokoto State, Sokoto, Nigeria
E-mail: mraremu@yahoo.com Phone No: +234-703-784-9369

Abstract
This paper investigates the effects of annealing and age hardening on the ultimate tensile strength (UTS) and electrical conductivity of aluminium-Zinc/nickel casts using sand mould. Pure aluminium melt was alloyed with zinc and nickel, which were added in 2% to 10% step of 2. Annealing and age hardening were carried out and the obtained results show that in the annealed series of the alloys, Al-10%Zn alloy has the highest Brinell Hardness number (HBN) of 411, far above 245 for pure aluminium. Annealed Al-6%Ni alloy has the highest value of conductivity (6.15 x10^{7}S/m), very much above that of pure aluminium while Al-2%Ni alloy has the highest UTS of 604.44MPa. The Al-4%Ni alloy combined both high strength and conductivity, having UTS of 603.28MPa and electrical conductivity of 5.69 × 10^7 S/m.

Keywords*: Tensile Strength, conductivity, annealing and hardening.*

Introduction
Aluminium has varied fields of application including aerospace, vehicular, electrical, building and packaging purposes. Pure aluminium has weak and disadvantageous strength which can only be improved by alloying while its other mechanical properties are not tampered with. (Aniyi & Bello-Ochende, 1996; Abifarin & Adeyemi, 2003). Aluminium is remarkable for the low density and for its ability to resist corrosion due to the phenomenon of passivation. Structural components made from aluminium and its alloys are vital to the aerospace industry and are important in other areas of transportation and structural materials. Pure aluminium has a low tensile strength, but when combined with thermo-mechanical processing, aluminium alloys display a marked improvement in mechanical properties, especially when tempered. Aluminium alloys form vital components of aircraft and rockets as a result of their high strength-to-weight ratio. Aluminium readily forms alloys with many elements such as copper, zinc, magnesium, manganese, and silicon (e.g., duralumin). Today, almost all bulk metal materials that are referred to loosely as "aluminium", are actually alloys. For example, the common aluminium foils and beverage cans are alloys of 92% to 99% aluminium (Pio, Sulaimin and Mamouda, 2005).

Materials and Methods
The materials used for the experiments are: (i) Aluminium metal (ii) Nickel metal (iii) sand mould (iv) etching reagent (Hydrofluoric acid, Hydrochloric acid, Nitric acid and water) (v) file (vi) ladle (vii) emery cloth (viii) abrasive paper and (ix) hacksaw

The machines used for the experiment are: (i) melting furnace (ii) lathe machine (iii) shaping machine (iv) polishing machine (v) metallurgical microscope (vi) tensile testing machine and (vii) Whetstone bridge apparatus.

Methods

The developed alloys were used in carrying out electrical conductivity test, tensile test, hardness test and microscopic examination. Annealing and age hardening/precipitation hardening were carried out on the alloys. A universal tensile testing machine was used for the test during which each specimen was held against the two jaws of the machine and forces were applied gradually until the specimen fractured. Data were obtained from the process and tabulated for analyses. Electrical conductivity test was carried out using Wheatstone bridge (meter-bridge) method, where the specimen was the unknown resistance and was connected one side and a resistor of 2 ohms resistance on the other side. A galvanometer was used to get the balance point in metre along a constantan wire connected along a metre rule. The resistance of the test piece was determined from equation 1 below:

$$\frac{R_x}{R_n} = \frac{L_x}{Ln} \qquad 1$$

Where R_x is the resistance of the specimen, R_n is the known resistance (2 ohms in this case), L_x is the distance from of the balance point from the side of the unknown resistance and L_n is the distance of the balance point from side of the known resistance. Thickness of the specimen ranged from 89 mm to 0.095m, diameter was between 1.2 mm and 1.5 mm. The samples were prepared in cuboids form, some heat treated (Annealing and Hardening) and others left as cast. They were ground to mirror like surface and then polished using aluminium oxide as the polishing reagent. The specimens for microscopic examination were etched after being polished by dipping in a freshly prepared solution of 2cc hydrofluoric acid, 5cc nitric acid and 100cc water solution as etching reagent for 15 to 60 seconds. After etching, the specimens were mounted on the stage of the metallurgical microscope and adjusted to give a proper view of the structure and then it was captured as it appeared on the monitor of the attached system.

Results and Discussions

The results of the tensile and electrical conductivity tests carried out on the specimens were hereby presented. The tensile test results are presented in Table 1. The annealed, aged hardened and controlled (as-cast) samples were labeled as ANT, HNT and CNT respectively. Highest Modulus of Elasticity was recorded with age-hardened sample.

Table 1: Selected Tensile Properties of the Specimens

Specimen	U.T.S (MPa)	Strain, ε	Young Modulus, E (GPa)
ANT	571.56	0.06	158.77
HNT	594.54	0.07	170.67
CNT	603.28	0.08	143.64

The stress-strain graphs from the tensile tests are shown in Figures 1 - 5:

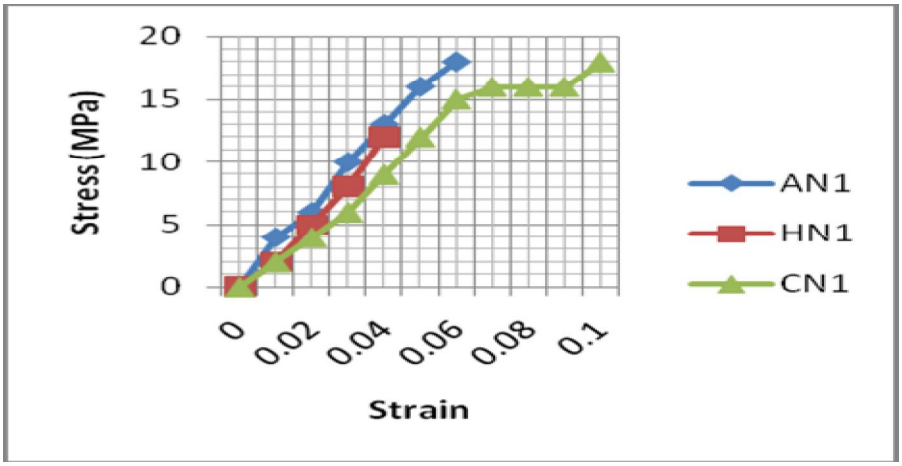


Fig 1: Stress-Strain Curve for Al-2 % Ni Alloys

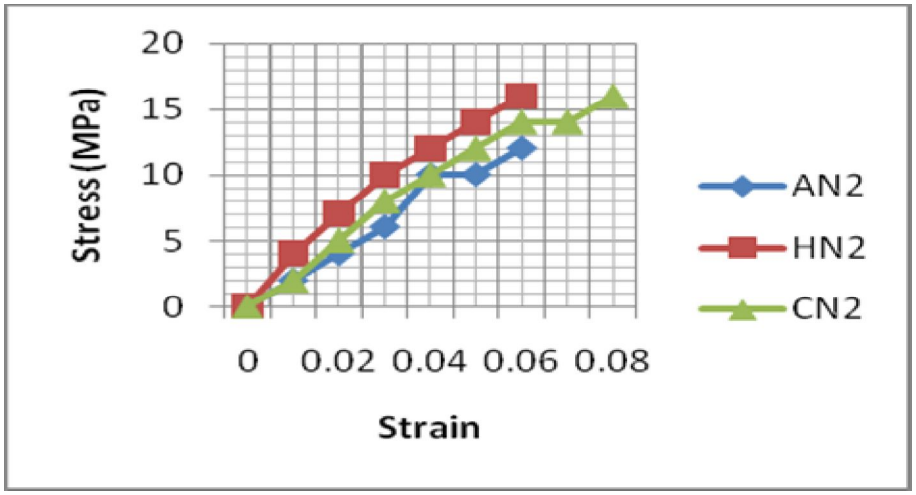


Fig 2: Stress-Strain Curve for Al-4 % Ni Alloys

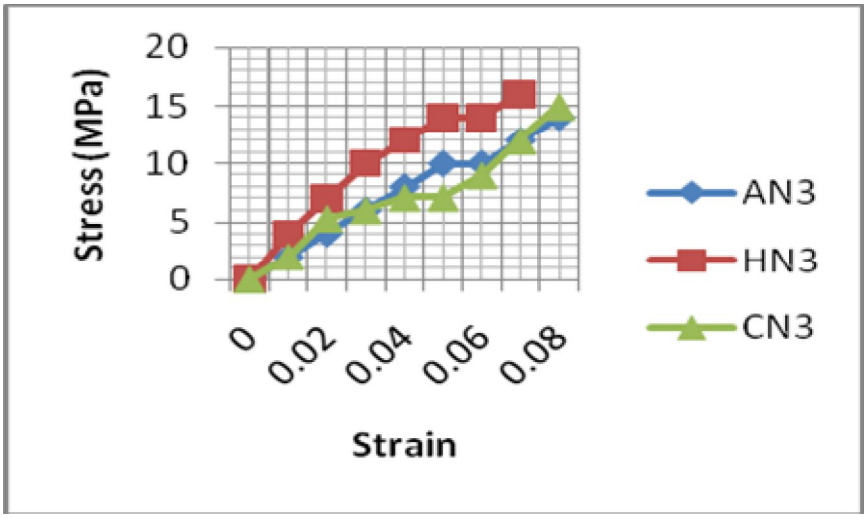


Fig 3: Stress-Strain Curve for Al-6 % Ni Alloys

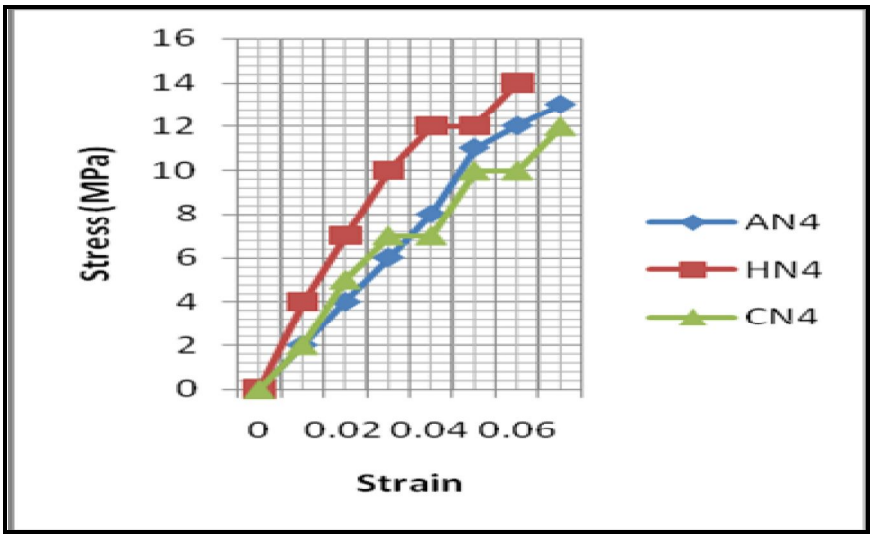


Fig 4: Stress-Strain Curve for Al-8%Ni

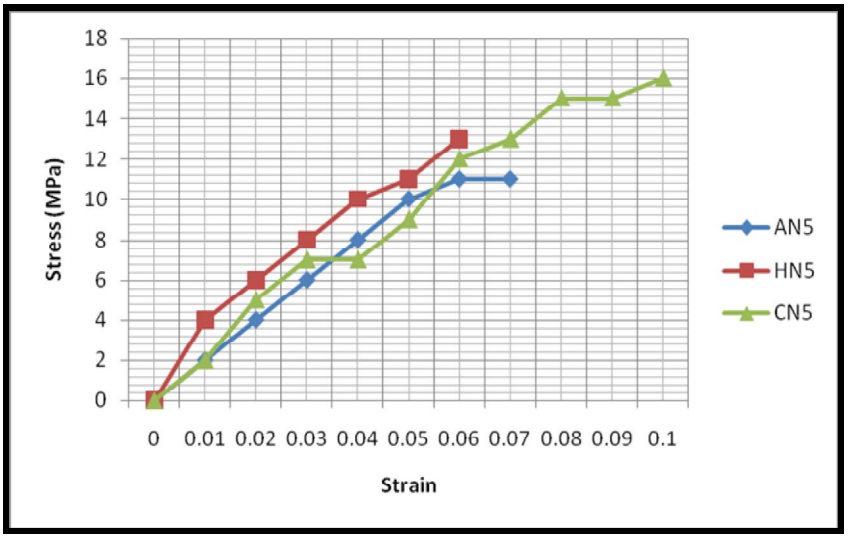


Fig 5: Stress-Strain Curve for Al-10%Ni Alloys

Figure 1, indicates that as-cast 2% Ni alloy was the toughest in the group, and in all the figures, annealing proved its worth as it reduced the hardness of the age-hardened alloys and rendered them more ductile.

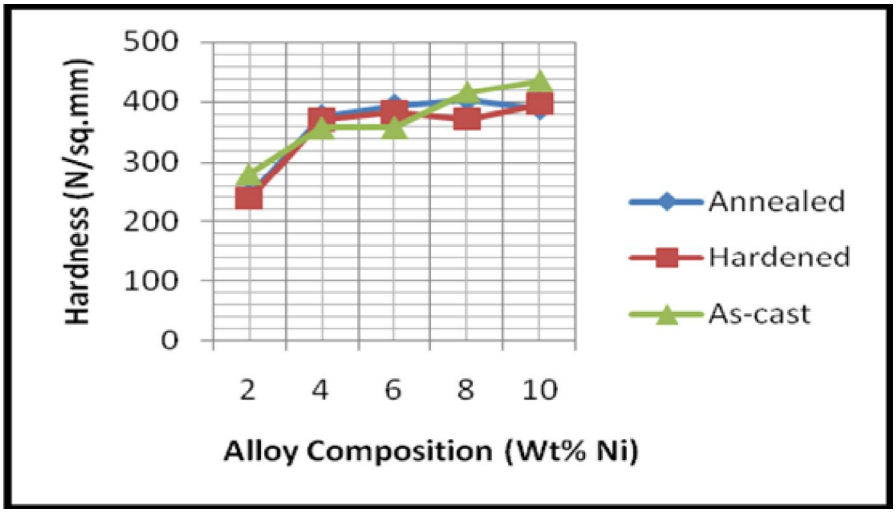


Fig 6: Hardness Values of Heat treated Al-Ni Alloys Specimens

Figure 6 shows the Brinell Hardness Number of the Al-Ni alloys, ranging from 2% to 10% Ni contents. It can be observed from the graph that Al-10%Ni as cast specimen has the highest HBN of 435, followed by 8%Ni hardened alloy with HBN of 416 and then 8%Ni annealed HBN of 403. The lowest value of the HBN is 238, for 2%Ni hardened specimen. The trend of the HBN shows that, as cast alloy set have higher HBN over the annealed and Hardened alloy, with the exception of as cast 4%Ni, and 6%Ni.

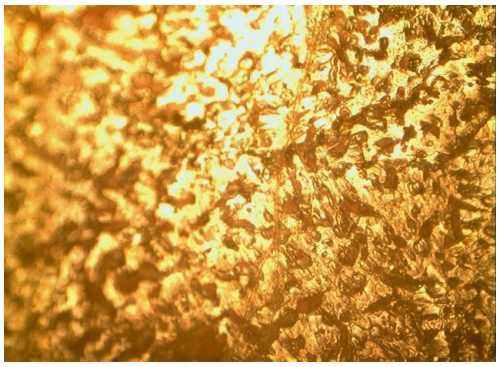


Plate 1: Annealed Al-2%Ni Alloy

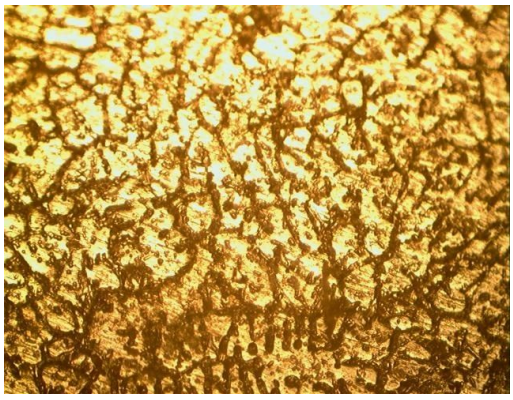


Plate 2: Annealed Al-4%Ni Alloy

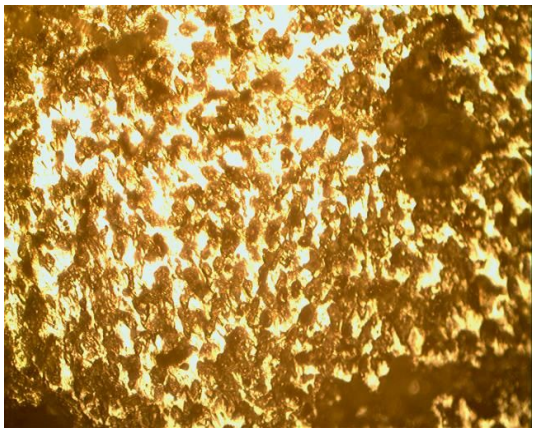


Plate 3: Annealed Al-6%Ni Alloy

In Plate1, spheroidisation of precipitates of Ni can be seen throughout the matrix of Al, with slight white patches of primary Al around the top centre of the matrix down midway, botryoidal structures intermixed with few of twinned grain and widmanstatten side plate can be seen on the graph. Plate 2 can be seen having some patches of primary phases of Al , spread within diffused precipitates of Ni, with dark patches of precipitates at bottom left and middle right of the matrix, nodular structure intermixed with fibrous structures of $NiAl_3$ dispersoids and continuous precipitates can be seen. Plate 3 is with spread precipitate of Ni spheroidised all over the matrix of Al with some few dark portions seen by top right, bottom right and left, nodular, acicular, and dendritic structures with dark segregates of Ni precipitates concentrated at the bottom right, left and near top right.

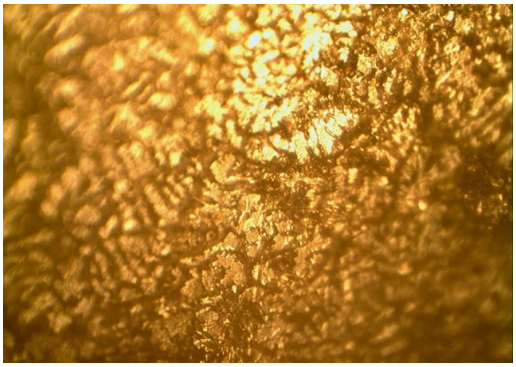


Plate 4: Al-2%Ni Hardened Alloy

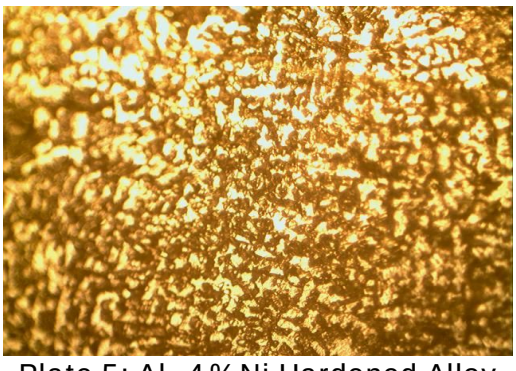


Plate 5: Al- 4%Ni Hardened Alloy

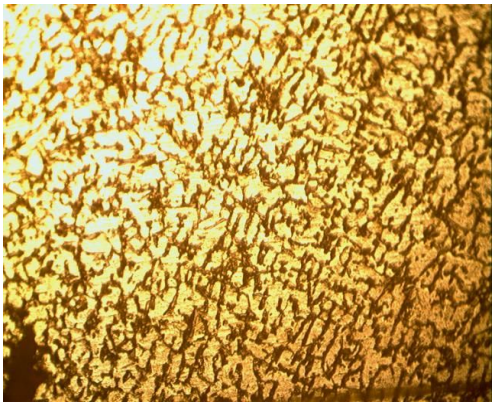


Plate 6: Al-6%Ni Hardened Alloy

In Plate 4, the diffusion of the precipitates is much pronounced, with little patch of white patch of primary Al around the top centre of the graph. Plate 5 shows patterns of mixed white primary phases and dark precipitates of Ni all over the matrix, the structure consists of small polygonal grains with patches of the eutectoid between them and interspersed with small globules of Ni and tiny acicular shapes can be seen, while Plate 6 is with lamellar precipitates of Ni throughout the Al-matrix, with a concentrated dark portion at the bottom left corner, there are recrystallized and twinned grains with straight twin lines and small grain size.

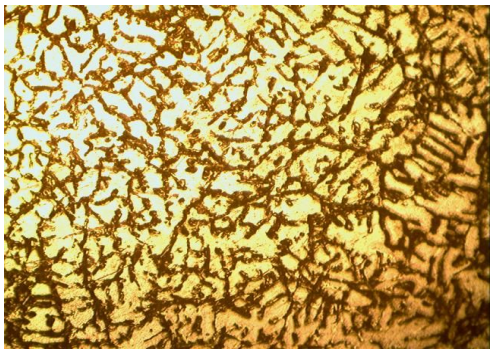


Plate 7: Al-2%Ni As Cast Alloy

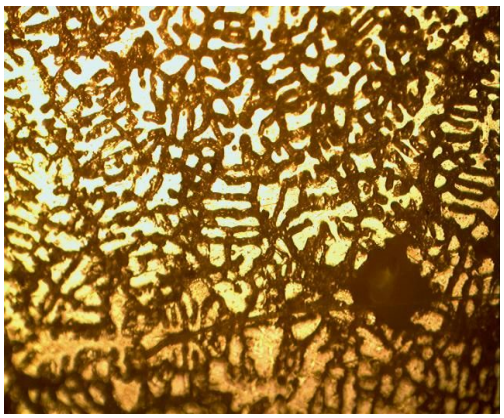


Plate 8: Al- 4%Ni As Cast Alloy

Plate 7 shows dendrites of the precipitated Ni all over the Al matrix. A cored grain with remnant of dendritic structure can be seen in the matrix, acicular and twinned structures can be seen on the right side of the graph, while Plate 8 shows dendritic networks of precipitated Ni with a concentrated dark portion near bottom right of the graph. The micrograph is made up of acicular, dendritic, bonded and lenticular structure intermixed in the matrix of Al, while Plate 9 has dendrites of primary phases of Al over the precipitates of Ni, dendritic, segregation, which brightened from right to the left intermixed with acicular structures.

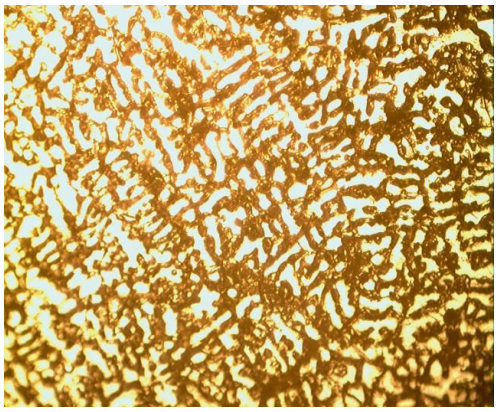


Plate 9: Al-6%Ni As Cast Alloy

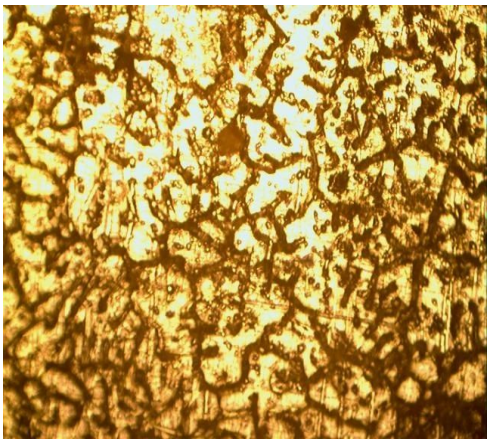


Plate 10: Micrograph of the Al-2%Zn Alloy As Cast (X100)

According to Plate10 above, it can be observed that some dark precipitate of Zn are spread, in form of fibrous structures, widmanstatten precipitates in mixture with continuous precipitates. White dendritic structures are revealed, with eutectic phases of Al and Zn.

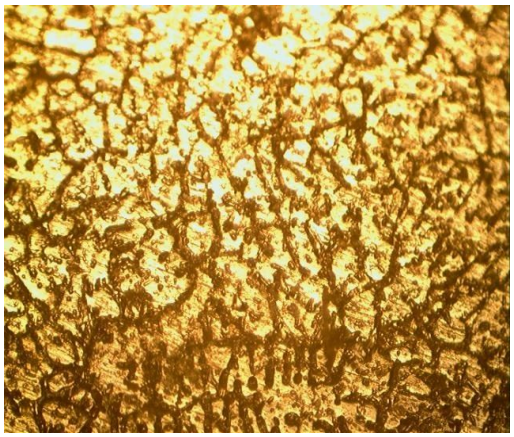


Plate 11: Optical Micrograph of the Al-4%Zn Alloy As Cast (X100)

In Plate 11 above, several acicular and fusiform structures intermixed within the centre and widmanstatten precipitates can be seen wide spread on the micrograph.

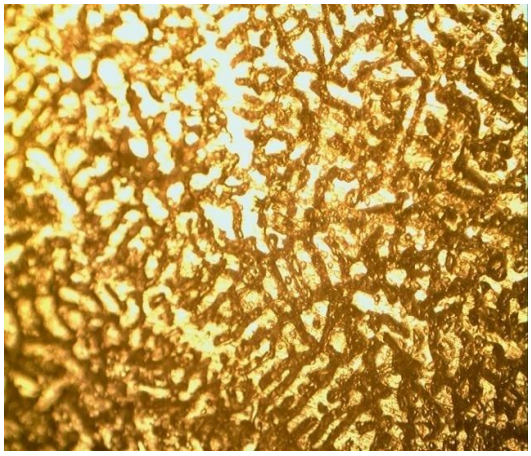


Plate 12: Optical Micrograph of the Al-6%Zn Alloy As Cast (X100)

According to Plate 12, dendritic acicular and fusiform structures, with some botryoidal structures can be seen.

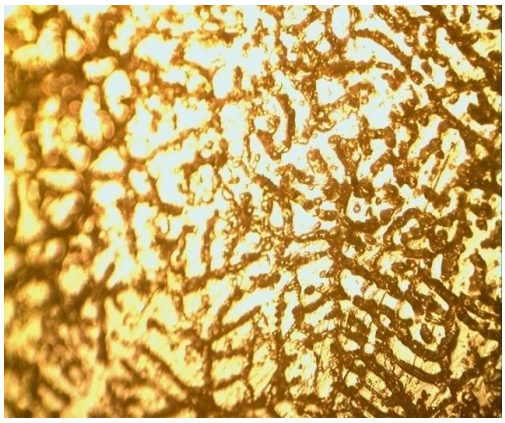


Plate 13: Micrograph of the Al-8%Zn Alloy As Cast (X100)

Plate 13 contains acicular, dendritic, and nodular structures of the primary phases as seen on the micrograph. Dark precipitates of Zn spheroidised in the Al-matrix, are also noticed.

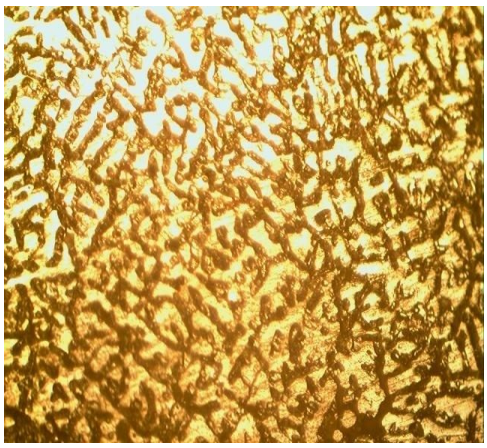


Plate 14: Optical Micrograph of the Al-10%Zn Alloy, As-Cast (X100)

The micrograph on Plate 14 above contains acicular, lenticular and angular fragments as well as nodular and botryoidal structures interspersed throughout the graph, with massed precipitates of Zn spheroidised throughout the Al-matrix.

Al-10%Zn alloy in the as cast and hardened states have high hardness and strength than other alloys of lower zinc contents, the higher the zinc content, the higher strength of the alloy for various engineering applications. The microstructures of the alloys are mostly dendritic and acicular, though some contain fibrous structures and others widely intermixed.

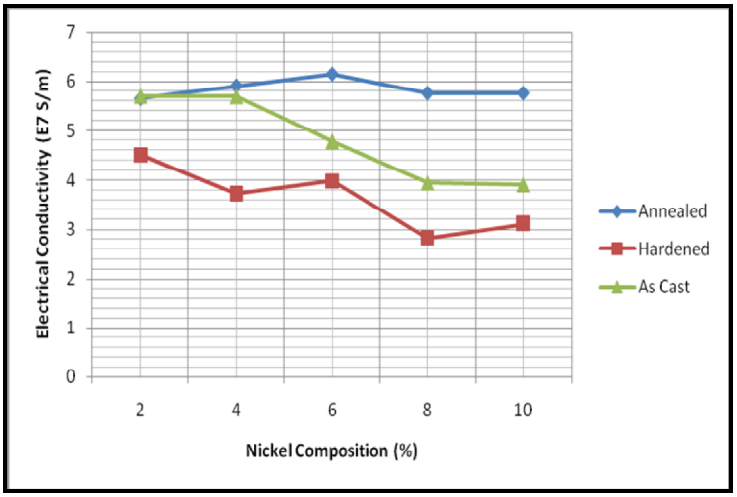


Figure 4: Electrical Conductivity of Al-Ni Alloy Samples

It can be observed in Figure 4 that for all the compositions, annealed alloy samples have the highest electrical conductivity, while as-cast follow and hardened alloy samples have the lowest electrical conductivity. Though at 2%wt composition, as-cast alloy and annealed alloy almost have the same value, while at 4% the electrical conductivity is almost the same.

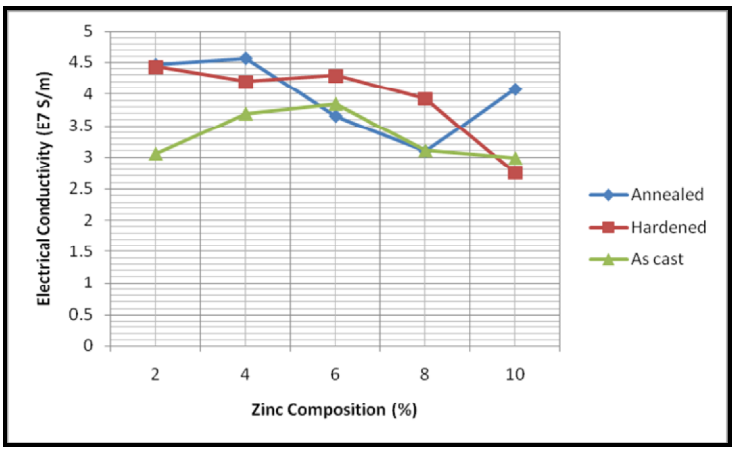


Figure 5: Electrical Conductivity of Al-Zn Alloy Samples

Observing the graph of electrical conductivity shown in Figure 5, at 2%wt composition of the alloy samples, annealed and hardened alloys have closely related values, with as-cast been the lowest, while annealed sample is the highest at 4%wt composition, followed by hardened and as-cast samples. At 6% and 8%wt compositions, hardened alloy has the highest conductivity as compared to the other two, such that at 8%, annealed and as-cast are close to each other. At 10%wt, a deviation occurred where annealed alloy sample is the highest follow by as-cast alloy and closely followed by the hardened alloy. This deviation may be owing to some errors in the experimental test carried out or some imperfection in the specimens before and after treatment, or improper treatment or a misplacement of the specimens.

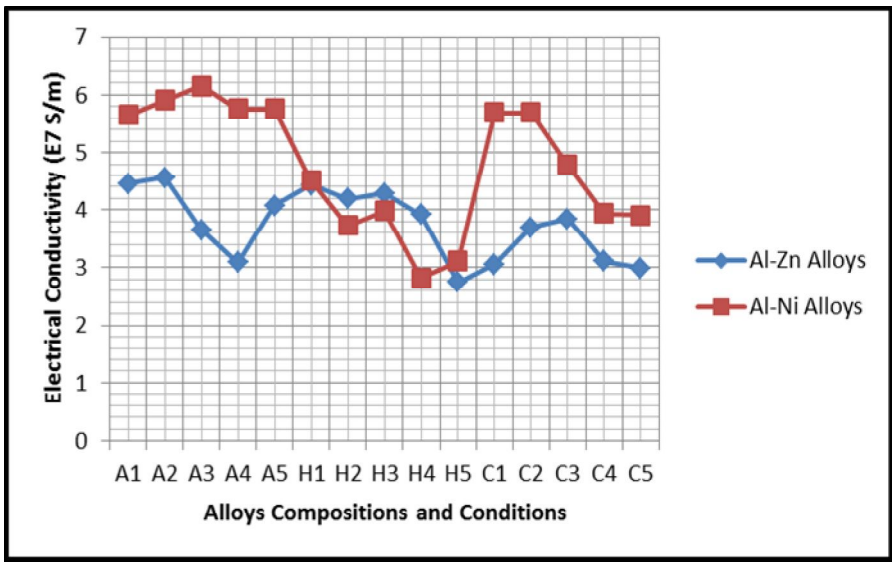


Figure 6: Comparative Electrical Conductivity of Al-Zn and Al-Ni Alloy Samples at various Compositions and Conditions

From Figure 6 above, Al-Ni alloy samples in the annealed condition have higher electrical conductivity than the Al-Zn alloys of similar treatment. The hardened alloy samples result took a different direction, such that, Al-Zn alloys have higher conductivity than the Al-Ni

alloys except in 2% wt composition, where they are almost the same, and in 10% where Al-Ni alloy is higher. In the as-cast condition, Al-Ni alloys are higher than Al-Zn alloys.

Conclusion

Annealing increased electrical conductivity of Al-Zn/Ni alloys, whereas hardening the alloys resulted in decrease in their conductivity, while untreated alloys maintained moderate conductivity. Al-10%Zn alloy has the highest HBN (411), far above 245 for pure aluminium. Ultimate tensile strength is favoured by hardening or leaving the alloy as cast, as annealing decreased the UTS of aluminium alloys. Al-4%Ni as cast alloy is the best alloy that can be adopted where high strength and electrical conductivity are paramount requirements, such as in high tension electric cable, especially in tropical region to prevent excessive sagging during the hot season.

References

Abifarin, M. S. & Adeyemi, M. B. (2003). Influence of process variables on the mechanical properties of squeeze cast aluminium alloy. *Nigerian Journal of Technological Development,* 3 (1), 1 - 7.

Aniyi, J. A.; Bello-Ochende, F. L. & Adeyemi, M. B. (1996). Effects of pressure, die and Stress relief temperatures on the residual stresses and mechanical properties of aluminium rods. *Journal of Materials Engineering and performance*, 5 (3), 399 - 404.

Aweda, J. O. & Adeyemi, M. B. (2007). Effects of applied pressure and die temperature on the electrical conductivity of squeeze cast aluminium rods. *Nigerian Journal of Technological Development,* 6 (1), 45 - 56.

Degarmo, E. P., Black, J. T. & Kohser, R. A. (2003). *Materials and processes in* l *manufacturing* (9th ed.). Wiley, pp. 133 & 277 - 286.

Pio, I. Y., Sulaimin, S. & Mamouda, A. M. (2005). Grain refinement of LM6Al-Si alloy and castings to enhance mechanical properties. *Journal of Materials Processing Technology,* 162 - 163, 435 – 441.

Riley, K. F., Bence, S. J. & Hobson, M. P. (2010).*Mathematical methods for physics and engineering* (3rd Edition). Cambridge University Press.

Rohatgi, P. K. & Prabhakar, K. V. (1975). Wrought aluminium-nickel for high conductivity applications. *Journal of Metallurgical Transactions,* 6A,12 - 18.

Wierzbinska, M. & Sieniawski, J. (2006).Effects of morphology of eutectic siliconcrystals on mechanical properties and cleavage fracture toughness of AlSi5Cu Alloy. *Journal of Achievements in Materials and Manufacturing Engineering,* 14, 31 – 36.

William, B. F., Warren, E. H., Robert, K. D., Douglas, A. G., Maurice, W. W., Kenneth, J. C.& Thomas, B. B. (2009). Aluminum in *Ullmann's Encyclopedia of Industrial Chemistry*, Wiley-VCH,Weinheim.doi:10.1002/14356007.a01_459.pub2s

HARNESSING THE POTENTIAL OF RENEWABLE ENERGY FOR AN ECONOMY LESS DEPENDANT ON FOSSIL FUEL: NIGERIA AS A CASE STUDY

OLUTOYE, M. A.[1] & YUSUFF, A. S.[2]
[1]Department of Chemical Engineering,
Federal University of Technology, Minna, Nigeria
[2]Department of Chemical and Petroleum Engineering,
AfeBabalola University, Ado-Ekiti, Nigeria
E-mail: m.olutoye@futminna.edu.ng Phone No: +234-803-405-9454

Abstract
This paper focused on the woes of Nigeria's economy in her continued reliance on energy derived from fossil and the misuse of fund derived thereof. A way out of the present predicament has been proposed for the energy sector using cleaner and renewable alternative energy systems. The use of sustainable and abundant based resources-natural (solar, wind and water) and agricultural (vegetable oil and biomass) would provide a solution to the current energy shortage and the epileptic power delivery. The immediate objective is to present the development of renewable energy sector and sustainable based energy service facilities in Nigeria that could be achieved through policy reforms, and by demonstrating that alternative energy facilities from bio resource based can provide sufficient power for meeting rural and urban community needs. Although, the potential for alternative energy is huge, it is believed that stricter regulations and commitment on the part of the policy makers are required to help in turning the tide towards a greater, stronger and virile economic state in the Sub-Saharan Africa. In the wake of the huge investments spent on the crude oil sector to generate power with little results to show for it in the country, it is believed that the advocate for investment in renewable energy option is in the right step. This will reduce dependence on the oil and gas reserves, reduce global warming and undesirable climate change as well as place the economy on a robust stand.

Keywords: Renewable energy, Oil and gas, Economy, Global warming.

Introduction
There is worldwide concerted approach to the perennial issue of energy utilization and the search for alternative renewable sources. Diversification of energy consumption in the world from fossil energy to renewable energy, as well as the desire to turn the world environment into green energy has gained wider grounds (Science Daily, 2010; Allison, Bindoff, Bindschadler, Cox, de Noblet, England, 2009). All over the world there is an increased effort towards bringing about reduction in global warming and carbon emissions target (Allison, Bindoff, Bindschadler, Cox, de Noblet, England, 2009). Also, the challenge of global warming resulting from fossil energy consumption has become daunting for the entire globe. Thus, governments around the world have been busy seeking ways of ending the danger that global warming poses to mankind. One of such ways is the diversification from fossil fuel to bio-degradable energy. In other to achieve a greener environment, it becomes necessary for Nigeria to addresses her dependence on fossil fuel that the future projections based on crude oil to meet national aspirations unrealistic in the light of the global decline in demand.

The bane of the Nigeria economy has been majorly the dearth of steady power supply which has crippled many businesses and industries and compelled some to close down because of the huge cost incurred in providing diesel for generating sets. Nigeria has relied so much on the generation of power from conventional sources such as fossil fuels (coal, gas, and oil) which are non-renewable energy. For example, the oil boom of the early 70s caused over dependence on these sources for economic and infrastructure development and led to the

neglect of harnessing alternative sources of energy. Nevertheless, these non-renewable energy sources are being depleted as they are rapidly used up. The rate of consumption has increased due to global demand. Electrical power generation from fossil fuel combustion has been threatened by escalating fuel prices and the adverse environmental consequences of large scale combustion of carbon-rich fuels. Combustion of these fuels for power supply unleashes intolerable amounts of harmful gases to the environment thus, contributing in turning the earth's atmosphere to a greenhouse with the harmful effect of producing global warming. The environmental implications of gas emissions from these sources including gas flaring are part of issues that informed the Copenhagen climate change summit at Denmark in2009 aimed at creating global awareness on climate change (Science Daily, 2010; Allison, Bindoff, Bindschadler, Cox, de Noblet, England, 2009). In line with this, many nations like United States of America, China, India and Brazil are employing this initiative to harness the alternative renewable sources of power generation with great zeal (Energy Information Administration (EIA), 2005). Renewable sources such as the use of solar for power generation, biofuel generation from wastes amongst other are geared towards making the environment free from harmful emissions (Energy Information Administration (EIA), 2005). Based on the above premise, there is the need for a decisive action to reverse the downturn that was recently experienced across the globe in business failures, and unemployment due to drastic drop in demand for fossil fuel. Thus, this article is aimed at presenting in clear terms the causes and effects of the present state of decadence, and the way forward on maximizing the country's vast potential for a transformed economy that will be less dependent on fossil fuel.

The Ripple Effect on Oil Dependence

Recently, the sting of over dependence was harder on the country as a consequence of the fact that the world's biggest companies are declaring losses resulting in decline for their demand of crude oil. The observed trend may persist until the measures being adopted by various governments begin to yield tangible dividends. The economic recession has severely affected the price of crude oil from as high $147 per barrel in the year 2010 to abysmal low of below $60 per barrel in year 2015 (Hugo, 2010). A report released by the World Bank indicated that the crude oil price could further slump if the trend in world economy recession is not properly addressed. Based on this report, the US oil demand may drop to below expectation in a decade (US Department of Energy (US DOE), 2002); US Department of Energy and Energy Information Administration (US DOE/EIA), 2010).The over dependence on crude oil by Nigeria will jeopardize the nation's ability to meet domestic and international obligations.

Effect on Current Scenario on Economy Downturn

The major consumer of crude oil, the US, has recently made several attempts to cut dependence on crude oil and the string of relying on foreign supplies. However, the US is set to invest massively in the green and sustainable energy with a whooping sum of over $100 million (GreenBiz, 2010). Based on this, the energy system has been proposed for overhaul by the plan with further investment in wind and solar power, hybrid cars, clean coal and more fuel-efficient appliances thereby reducing the cling to foreign oil. Of course, the use of renewable energy is expected to rise. In an attempt to further reduced her dependence on crude oil from foreign sources and bring about efficient fuel and green energy management, the US is making effort to order the release of millions of barrels of crude oil daily from the Strategic Petroleum Reserve (SPR) to keep the oil price within a band (U.S. Department of Energy (ASFE) (2010); US Department of Energy and Energy Information Administration (US DOE/EIA), 2010). The establishment of the SPR in the 1970s was due to the Arab oil embargo and it has a current capacity of about 700 million barrels (US Department of Energy and Energy Information Administration (US DOE/EIA), 2010).

This measure has resulted into some sort of saving several thousands of barrels of crude per day.

Alternative Energy: Nigeria's Position

The emission of carbon is no longer fashionable as the whole world is now discussing alternative, renewable sources of energy. To this end, more and more countries are working to achieving its carbon emissions target as set by international regulators of the environment. This makes the future of crude oil projections and dependence by Nigeria to be a mirage and cannot be sustained. The price slump is no doubt taking a hit on the Nigeria economy. The above argument makes the search and investment in the renewable energy imperative.

It is an established fact that most petroleum-rich countries are already facing the new reality of economic diversification. Nigeria as a case study is still lagging behind in the scheme of things with high misplacement of priorities. This is a key factor to how the concept and search for alternative energy source was lost. For example, other oil-rich African states such as Angola, South Sudan and Ghana have gone a step forward beyond Nigeria in the proper utilization of proceeds from the crude oil sales. These countries have invested heavily in infrastructure development even though most of them are democratically unstable (Key World Energy Statistics, 2014).

Causes of Dwindling Economy

In Nigeria, poverty and literacy levels are quite high. A survey showed that over 60 per cent deaths in the country could be as a result of these faceless evils (Alaneme, 2010). There is gross under-utilization, especially, in the oil sector that has the potential to catapult the country to an economic power. Also there are structural and administration deficiencies in the oil management. Despite the fact that the country is rated the world's seventh largest oil exporter, most of the petroleum products consume locally are imported (Key World Energy Statistics, 2014). There are no functional refineries in their full capacity. Most of the refineries have become drainpipe in which public funds are siphoned under the guise of maintenance. Nigeria is endowed with abundant reserves in gas and renewable energy potential. Yet the country is suffering an energy crisis, which has a major impact on its ability to reduce poverty and achieve the targeted goals. Thus, Nigeria in all ramifications, serves as a typical example of the damage that oil rents can do and is currently doing to the economy and the polity. Over-dependence on oil resources is responsible for the high level of corruption, dwindling economy and the redundant human resource found in the country. In addition, restiveness and agitation for resource control has been adduced to over-reliance on oil. Persistent fuel importation to augment local supplies is not helpful to the economy either. The working capacity of the refineries is grossly inadequate. Their production levels cannot meet the national demand requirements thereby making it unavoidable for importation to sustain the local consumption.

To further elucidate on the Nigeria situation, the oil agency of Nigeria, known as Nigeria National Petroleum Corporation (NNPC), was set up at the same time with Norway's Statoil and Malaysia's Petronas as state-owned oil companies in the 1970s. Today, the now renamed Statoil Hydro is ranked the biggest offshore oil and gas company in the world and the world's 11th largest oil and Gas Company by market capitalization. In the case of Petronas, it was ranked the 8th most profitable company in the world and also the most profitable in Asia (Renjuna, 2012). For Nigeria's NNPC, it has been slow paced.

Sustainable Energy Potential and Development

Briefly, statistical data (International Energy Agency, Ottawa (IEA) (2010) on Nigeria electricity generation is as shown in Table 1.This indicates a low value of 0.5 % energy derivable from oil when compared to other African states. For example, South Africa with a total generated of 263479 GWh has 5.1 % from oil.

Table 1: Electricity generation in Nigeria from various sources (2010 and 2014)

Source	Electricity Unit, GWh (2010)	Electricity Unit, GWh (2014)
Coal	0	0
Oil	1137	4500
Gas	15435	12000
Biomass	0	0
Waste	0	0
Nuclear	0	0
Hydro	6406	2800
Geothermal	0	0
Solar photovoltaic(SPV)	0	0
Solar thermal(ST)	0	0
Wind	0	0
Tide	0	0
Other sources	0	0
Total production	22978	19300

Sources: International Energy Agency, Ottawa (IEA) (2010); Africa Energy Outlook: A focus on energy prospects in sub-saharan Africa (nd)

Other countries that have been able to generate electricity from other sources apart from oil, gas and water are: Egypt, with a total sum of 125,129 GWh (2.4 %), United Kingdom, 396,143 GWh (7.7 %), United States, 4,348,856 GWh (84.2 %). Thus, it is would be observed that these countries were able to generate these amounts of electricity because they made use of other alternative sources of electricity generation like wind, coal, solar, nuclear, biogas, biofuel etc. Generation of energy from biogas, however, have been reported by Akinbami, Ilori, Oyebisi, Akinwumi and Adeoti (2001) to be a means of conserving the natural environment if properly invested. What then could be the source of the problem? A critical study shows that Nigeria has tremendous potential to develop its non-oil sector-the renewable sources but little progress has been made due to lack of political will from the government to solve this problem. Nigeria's power generation comes mainly from oil and gas, as well as water. Power generation in full capacity seems unachievable due to corruption in the award of contract to build infrastructure, poorly motivated workforce, theft and vandalisation of cables and equipment, illegal connection and over-loading of electricity distribution lines. The growth in agricultural sector to produce feedstock for the biofuel industry has been slow due to lack of infrastructure and consistent microeconomic policies needed to encourage private sector investment to induce this growth. The effect of this power problem in Nigeria affects every sphere of its existence. These effects range from all forms of domestic discomfort to national catastrophy, as this has negatively affected the economy of the nation in no small measure. Further, the departure of some companies from Nigeria has further increased unemployment, which has, in turn, increased trauma, as many of the workers of these companies lost their jobs. All these and many more are the ripple effects of the abysmal power situation in Nigeria. The country should be ready to harness the huge potentials for renewable energy sources, including solar, biomass and bio-fuel which would help boost the nation's clean energy and diversify her energy mix. It should be

noted thatelectricity production in Nigeria over the last 40 years has varied from gas-fired, oil fired, hydroelectric power stations to coal-fired stations with hydroelectric power systems and gas fired systems taking precedence. Presently, there are a total of 16 power plants in Nigeria out of which ten are owned by the government of the federation and six by independent power producers. The expectation of all these plants is to generate 6426 MW of electricity in order to achieve the target mandate of 6,000 MW of electricity by December 2010 (Africa Energy Outlook: A focus on energy prospects in sub-saharan Africa (nd); Akinbami, Ilori, Oyebisi, Akinwumi & Adeoti (2001). Figure. 1 shows the power generation capacity of the available stations and their installed capacity.

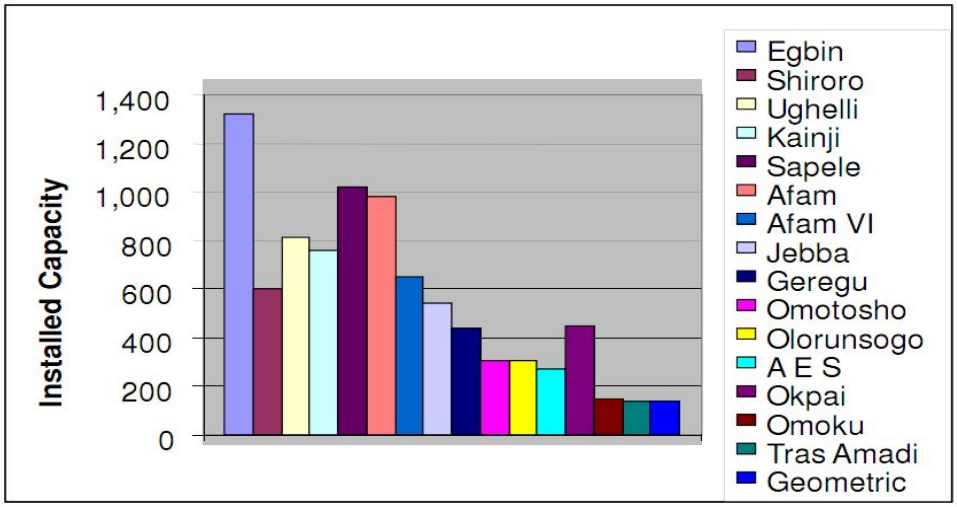


Figure1: Power generating stations and their installed capacity

The identified problems confronting the power generation are poor maintenance planning; inadequate funding; poor electricity pricing; monopoly; lack of energy mix; inadequate gas supply; vandalization; generation facilities; poor inventory management and drought. However, the proposed solutions to some of these numerous problems are full deregulation; energy mix; structured maintenance; adequate funding; and power sharing with neighboring countries. Other measures that should be considered in resolving the power crisis include provision of community and military security personnel to stop illegal activities in the oil industry, gas and electrical equipment lines; provide a value of 25% annual budget to tackle power generation, maintenance and expansion; indigenous engineers should be adequately represented in the planning and implementation of all aspects of the power program; government should ensure level playing fields for the independent power producers and other genuine investors in the power business; and there is need for efficient pricing of electricity.

Energy-favoured Policy

In line with the above argument, the Government of Nigeria must tackle the energy crisis facing it as a matter of urgent demand and embark on renewable energy projects such as medium scale hydro, wind and solar power systems. This should be located nationwide to give a geographical spread structure. Nigeria is endowed with abundant renewable alternative sources of energy at different locations within the country which can be harnessed to generate power and improve the energy situation. This will enhance security of supply and increase rural access to energy services. The government would have to provide an enabling environment for integration of renewable energy based power supply and energy efficiency by removing barriers to investment and market development through appropriate regulatory framework. This will give impetus to the development and

scale-up in renewable energy projects through local and foreign investment as well as the promotion of end-user technologies. The importance of the energy sector as the major engine of social, economic and industrial growth cannot be underestimated and renewable energy if properly harnessed has proved to be more economical compared to grid-based extension of electricity network. This is because itis environmentally-friendly and carbon neutral that could address the nation's erratic energy needs. With oil prices hovering presently at around $60 a barrel and with the country's production down to 1.9 mbs a day, Nigeria's fiscal situation is a challenge now and will be for as long as oil prices are on a downward trajectory.

Conclusion

Based on the views presented above, the authors asked this poser "So what does the future hold for the nation if crude oil goes out of demand?" It should not matter whether or not oil price would recover in the future. There is the need for urgent task of improving basic infrastructure, entrench transparency and accountability in economic management, minimize wastages, and pursue diversification of the economy with commitment. For Nigeria to stand tall in the comity of developed world in the area of alternative energy generation, it must properly harness, manage and invest huge income derivable from oil to the advantage of other sectors of the economy in order to get out of the hole of resource management challenges. This will practically make economic diversification and foreign investment in the economy a reality. Similarly, except alternative sources of energy to supplement income from crude are developed and quickly too, the unpleasant reality is that overdependence on oil will sooner or later cripple the economy. The orientation of overdependence on oil should be changed to give way for well-coordinated and committed policy initiatives in the direction of renewable alternative sources of energy. This will make Nigeria to overcome its current energy shortages and achieve the objective of being among the top 20 economies in the world by the year 2030, there is need to go behind the rhetoric realizing the urgent need to seek alternative energy sources that will provide regular power for both domestic and industrial usage. It is wise to look at other alternative sources so as to reduce over-dependence on gas and oil.

References

Science Daily (2009). *Rising sea levels set to have major impacts around the world*. Available at http://www.sciencedaily.com/releases/2010.html.

Allison, I., Bindoff, N., Bindschadler, R., Cox, P., de Noblet, N. & England, M. (2009). *The copenhagen diagnosis: Updating the world on the latest climate science.* Sydney, Australia: The University of New South Wales Climate Change Research Centre (CCRC); 2009. p.60. Available at: http://www.copenhagendiagnosis.org.

Energy Information Administration (EIA) (2005). *International energy annual on CO_2-world carbon dioxide emissions from the consumption of coal.* Available at http://www.eia.doe.gov

Hugo, C. (2010). *Oil between $80 and $90 is sufficient*. Available at http: //www.bloomberg.com

US Department of Energy (US DOE) (2002). *A national vision of America's transition to a hydrogen economy-to 2030 and beyond.* Washington, DC.

US Department of Energy and Energy Information Administration (US DOE/EIA) (2010). *International Energy Outlook*, DOE/EIA-0484. Washington, DC.

GreenBiz, (2010). *U.S. recovery act awards $100 million in green job training grants.* Available At http://www.greenbiz.com/us-recovery-act-awards-100-million-green-job-training-Grants.

U.S. Department of Energy (ASFE) (2010). Strategic petroleum reserve annual report. Available at http://www.fossil.energy.gov/programs/reserves/spr_annual_rpt_06.pdf

Key World Energy Statistics (2014). International energy agency. Available at www.iea,org

Alaneme, E. (2010). *Nigeria: Napep laments high level of poverty.* Available at http:// www.allafrica.com/stories/2010.html

Renjuna, C. (2012). *Petronas among 10 most profitable companies in the world*. Available at http://www.renjuna.com/2012/07/02/petronas-among-10-most-profitable-companies-in-the-world.

International Energy Agency, Ottawa (IEA) (2010). *IEA's Implementing Agreement for Hydropower Technologies and Programmes.* Available at http://www.small-hydro.com.

Africa Energy Outlook: A focus on energy prospects in sub-saharan Africa (nd). *World energy outlook special report.*www.iea.org.

Akinbami, J. F. K., Ilori, M. O., Oyebisi, T. O., Akinwumi, I. O. & Adeoti, O. (2001). Biogas energy use in Nigeria: Current status, future prospects and policy implications, Renewable and Sustainable Energy. *Reviews*, 5(1), 97 – 112.

OPTIMIZATION OF YELLOW DEXTRIN FOR THE PRODUCTION OF STARCH BASED ADHESIVE

AZEEZ, O. S.[1] UBADIKE, C. J.[2], NASIR, A.[3] & AGBAJELOLA, D. O.[4]
[1,2&4]Department of Chemical Engineering ,[3]Department of Mechanical Engineering,
Federal University of Technology Minna, Niger State, Nigeria.
E-mail: tosin.azeez@tutminna.edu.ng Phone No: +234-806-836-0923

Abstract
This study investigates the optimization of yellow dextrin for the production of starch based adhesive using cassava starch. It involves the optimization of process variables namely, roasting temperature, roasting time and concentration of acid using Minitab 17 software in order to achieve the optimum combination of the variables that will give the best solubility for yellow dextrin. In the dextrinization process, a temperature range of 80 to 100ºC was adopted while acid concentration range of 0.25 to 0.3 M and time range of 60 to 120 minutes were used. The results obtained shows that roasting temperature of 100ºC and roasting time of 120 minutes with concentration of 0.25 M gave a yellow dextrin with the highest solubility of 42.8 %. The individual and combined (interaction) effects of the process parameters were determined using factorial analysis. An empirical model was also developed for the factorial analysis. The analysis showed that the process variables (roasting temperature, roasting time and concentration of acid) have significant effects on the solubility of the yellow dextrin produced. It also suggested that the best of yellow dextrin was produced at a roasting temperature of 100ºC, concentration of 0.3 M and roasting time of 120 minutes and the model equation for the predicted value of yellow dextrin solubility as 42.55%. Yellow dextrin of the highest solubility was consequently used to prepare adhesive. The viscosity, drying time and the pH of the adhesive produced are 1.5 Pas, 4.13 minutes and 7.54 respectively.

Keywords: Adhesive, Starch, dextrin, solubility, design.

Introduction
Adhesives as defined by Akpa (2012) are polymer substances that can join materials together by a process of adhesion. It is a semi-synthetic low molecular weight carbohydrate formed by the hydrolysis of starch that can be obtained from any of cassava, potatoes, rice and corn. it can also be produced by pyrolysis or roasting after mixing starch with quantified amount of hydrochloric acid (HCl) or nitric acid (HNO_3). An adhesive is said to be effective if it is able to bind materials together properly and it is able to show resistance to moisture (Ubadike, 2015). As reported by Baumann and Conner (1994), adhesive may be classified according to their origin which maybe semi synthetic, natural or synthetic. Dextrin usually exists in white, yellow or brown colour which may be fully or partially soluble in water. Even though, various types of adhesives available in the market nowadays, adhesives made from cassava starch is normally desirable for domestic use because of its smooth texture, non-poisonous and non-staining nature (Ubadike, 2015).

Starch is a very important food crop to man and it has been observed that approximately 60-70 % of calories taken by man is derived from starch (Lawton, 2004). Apart from been suitable for consumption, it is also used as raw material in food, pharmaceutical, paper, and construction industries. It is also applicable in non-food industries such as packaging, paper industry, match header in explosives, pill coating and dispersing agent in pharmaceuticals (Burrell, 2003). The uses highlighted depend on the functional properties like pasting, gelatinization and solubility which normally vary from one botanical source to another with variety and environmental condition (Yuan *et al.,* 2007). As reported by Vaclavik and

Christian, (2008), the use of starch in food and non-food industries needs a good understanding of their functional, physicochemical and structural properties. Buba and Kabiru (2014) reported that cassava has also become a food crop of high potential and industrial value. The aforementioned therefore suggest the need to encourage farmers to do more in production of cassava to be able to meet up with these competing demands to avert possible food crisis.

Montgomery (2005) stated that essential method to process and product design and development which include design of experiment involves three phases namely characterization, control and optimization. It is therefore important to employ design of experiment in a process where optimization of variables is been sought.

This research seeks to optimize the production of yellow dextrin before using the dextrin to produce adhesive. The adhesive produced will then be characterized. Design of experiment was used for the optimization of dextrin through the use of Minitab.

Materials and Methods

Materials, Chemicals and Equipment

Cassava starch used for this experiment was gotten from Minna, Niger State in Nigeria. The equipments used for the experiment includes Stop watch, viscometer, electric oven, plastic funnel, thermometer, mesh sieve (250 µm), spatula, hot plate with magnetic stirrer, centrifuge, pH meter, digital weighing balance, 250 ml volumetric flask, 50 and 100 ml measuring cylinders and 250 ml beakers. All the chemicals used in this study are of analytical grade with high level of purity. The chemical reagents used include distilled water, hydrochloric acid (HCl), sodium hydroxide (NaOH), borax ($Na_2B_4O_7.10H_20$) and formaldehyde (CH_2O).

Experimental procedure

The processed cassava starch was sieved using a 250 µm mesh sieve. The dextrinization process was developed using a 2^3 experimental design. The variables considered are concentration of acid, roasting time and roasting temperature. Minitab 17 software was chosen for the factorial design and sixteen experiments were run as shown in Table 1.

The method used by Gumus and Udezue (2011) with slight modification was employed for the preparation of dextrin. In this study, 25 g of the sieved dried cassava starch was mixed with 200 ml of 0.30 M HCl (gelatinization enhancer) and aged for 24 hours. This mixture was then heated at a temperature of 100 ºC using a heater with magnetic stirrer for 60 minutes. This step was repeated for all other experiments but with changes in the variables as shown in Table 1.

The solubility of the produced dextrin was determined by method similar to those of previous researchers (Aytunga *et al.,* 2010; Leach *et al*. 1959). 2.5 g of the prepared dextrin was measured out and dissolved in 30ml of distilled water and heated for 15 minutes using hot plate with magnetic stirrer maintained at 50 ºC. It was allowed to cool and then centrifuged at 2000 rpm for 10 minutes. The supernatant was separated and heated for 15 minutes after which the percentage solubility was determined.

In preparing adhesive for sealing carton, 106.7 g of yellow dextrin having 42.3 % solubility in water was mixed with 16 g borax, 2.7 formaldehyde and 0.2 g of liquid paraffin the mixture was heated at 85ºC for 30minute and cooled to 50ºC and 0.2 g of 50 % NaOH was added to the mixture. The pH of the adhesive produced was determined using a digital pH

meter. 20 ml of the sample was put into a sample bottle and the pH meter electrode was inserted into it. The value was gotten from the display of the pH meter. The viscosity was determined using Brookfield viscometer at room temperature. It was set at a speed of 60 rpm with spindle number 29 and expressed in pa.s. The drying time which is the time required for the adhesive to set after it is covered with substrate was determined manually, using a stop watch.

Results and Discussions

The solubility of dextrin as described by Peroni *et al.,* (2006) is the evidence of interaction between water molecules and starch chain. It increases with increase in temperature since water penetrates more into the amorphous region of the starch granules. Temperature increase therefore results to more hydration and dissolution due to the swelling of the starch granules. Table 1 shows the temperature (80 to 100ºC), acid concentration (0.25 to 0.3 M) and roasting time (60 to 120 minutes) range that were employed in the production of yellow dextrin. Yellow dextrin gave solubility values ranging from 25.7 to 42.8 %.The highest solubility which is 42.8 % was gotten at temperature of 100ºC, roasting time of 120 minute and concentration of 0.25 M.

Table 1: Solubility (response) at different roasting temperatures, time and concentrations for yellow dextrin

Run order	Temperature (ºC)	Roasting Time (min.)	Acid Concentration (M)	Solubility (%)
1	100	60	0.30	40.4
2	100	120	0.25	42.3
3	80	120	0.25	36.8
4	80	60	0.30	36.3
5	100	60	0.30	40.7
6	80	120	0.30	39.0
7	80	120	0.25	37.4
8	80	120	0.30	39.6
9	80	60	0.25	25.7
10	100	120	0.25	42.8
11	100	60	0.25	37.7
12	100	120	0.30	31.8
13	80	60	0.25	26.3
14	100	120	0.30	32.6
15	80	60	0.30	36.7
16	100	60	0.25	37.0

This is an improvement on the highest solubility of 32 % obtained by Azeez (2005) for yellow dextrin where 50 g of starch diluted with 0.3M HCl (acid) was heated at 90^{o}C for 180 minutes. The highest solubility obtained in this research is in line with the observation of Peroni et al. (2006) since the temperature at which the highest solubility is obtained in this research is higher than that of Azeez (2005).

Table 2 shows the estimated coefficient and effects for the solubility of yellow dextrin. It shows that the model contains three main effect which are significant since there p value is less than 0.05. The p-value result from Table 2 shows some important information regarding the effect of a single process variable and combination of process variables on yellow dextrin solubility. It indicates that there is a significant interaction between roasting temperature and roasting time (0.000) roasting temperature and concentration of acid (0.000) and also

between roasting time and concentration of acid (0.000) as they have p-value less than 0.05. Table 2 also shows that the interaction between time and concentration has the greatest effect (-5.462) on yellow dextrin solubility. The interaction between roasting temperature and concentration of acid has the second greatest effect (-4.962). In addition, setting the roasting temperature high and concentration of acid low will produce yellow dextrin of high solubility. The interaction between the three variables roasting temperature, roasting time and concentration of acid has the smallest effect (-1.312) on the solubility.

Table 2: Estimated effects and coefficients for yellow dextrin solubility response

Term	Effect	Coef	SE Coef	T-Value	p-Value
Constant		36.444	0.103	354.21	0.000
Temperature	3.437	1.719	0.103	16.71	0.000
Time	2.687	1.344	0.103	13.06	0.000
Concentration	1.388	0.694	0.103	6.74	0.000
Temperature*Time	-4.263	-2.131	0.103	-20.71	0.000
Temperature*Concentration	-4.962	-2.481	0.103	-24.12	0.000
Time*Concentration	-5.462	-2.731	0.103	-26.55	0.000
Temperature*Time*Concentration	-1.312	-0.656	0.103	-6.38	0.000

Pareto chart of the standardized effect for yellow dextrin solubility response shown in Figure 1 shows that there are also three significant effects effect (α=0.05), which are roasting temperature (A) roasting time (B) and concentration of acid (C). It is also observed that Pareto plot shows the largest effect to be the interaction between time (B) and concentration (C) because it extends the farthest and that the smallest effect is the interaction between the three variables roasting temperature (A) roasting time (B) and concentration of acid (C). The plot shows that all the variables are significant including their interaction with each other.

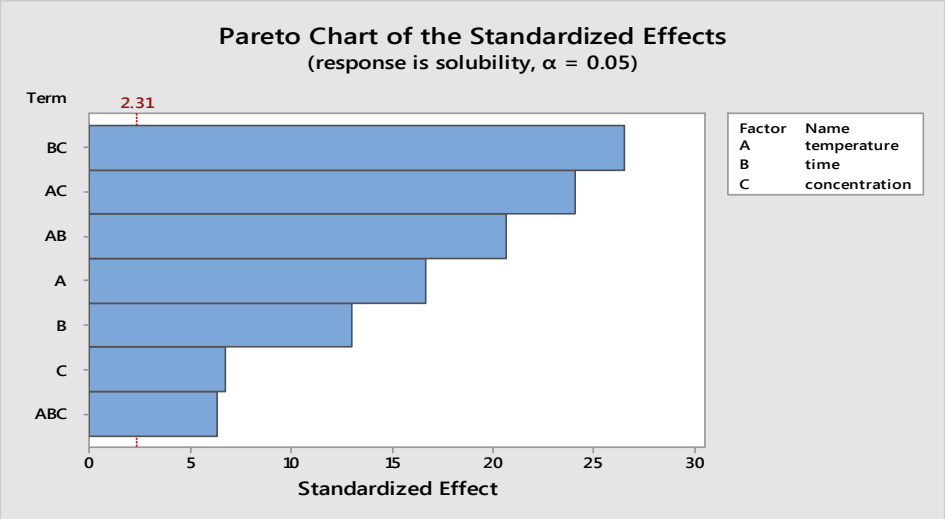


Figure 1: Pareto chart of the standardized effect for yellow dextrin solubility

Normal plot of the standardized effect for yellow dextrin solubility response of Figure 2 indicates that there are three significant effect (α= 0.05) and these effect include all the three main effects roasting temperature (A) roasting time (B) and concentration of acid (C). Roasting temperature has the highest effect because it lies furthest from the line. In addition it indicate the concentration of acid and roasting time has a positive effect since they reside to the right of the line. This means that if the roasting time changes level from

low to high the solubility increases. The combined effect of temperature time and concentration all have negative effect since they reside to the left of the line meaning when the process variables change level from low to high the solubility decreases. Also the significant of the process factor and their ranking is in agreement with the result of the estimated effects and the coefficients for the solubility of yellow dextrin in Table 2.

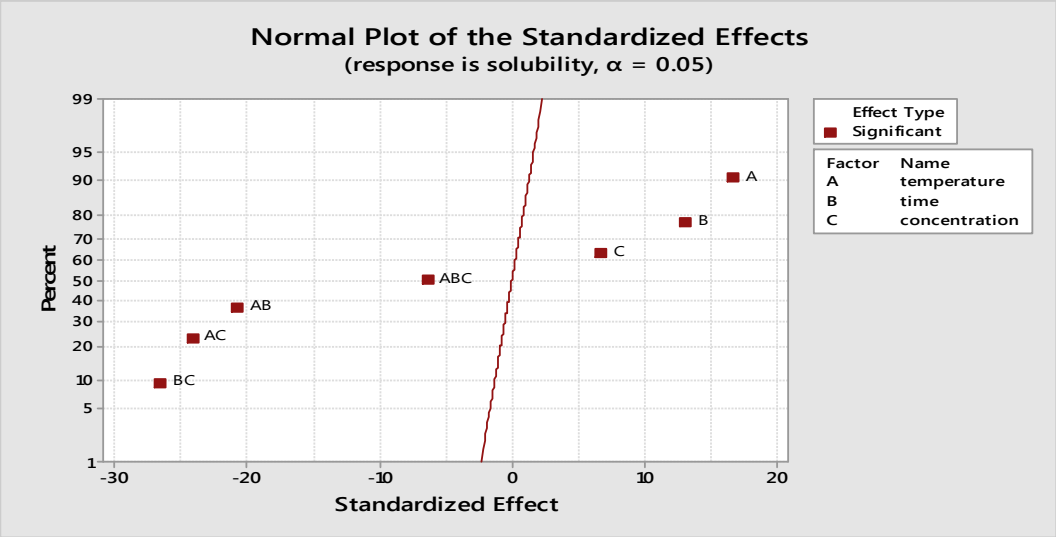


Figure 2: Normal plot of the standardized effect for yellow dextrin solubility

Half normal plot of the standardized effect for yellow dextrin solubility of Figure 3 shows that there are also three significant effect (α= 0.05). All the three main effects roasting temperature (A) roasting time (B) and concentration of acid (C) are significant. The interaction between roasting time and concentration of acid has the largest effect because it lies furthest from the line.

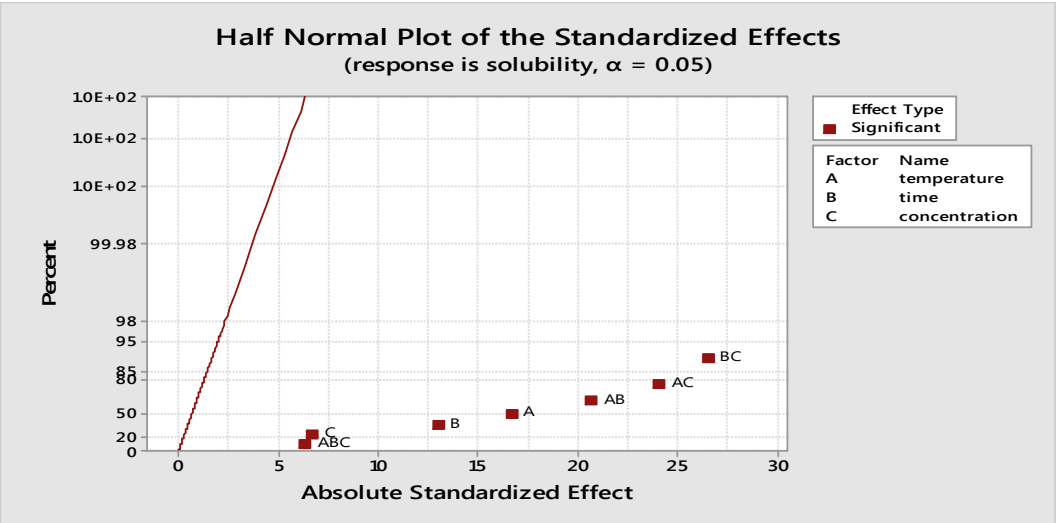


Figure 3: Half normal plot of the standardized effect for yellow dextrin solubility

The cube plot of Figure 4 shows that when acid concentration of 0.25 M, roasting temperature of 100°C and roasting time of 120 minutes is used the quality of the dextrin solubility is 42.55 %.

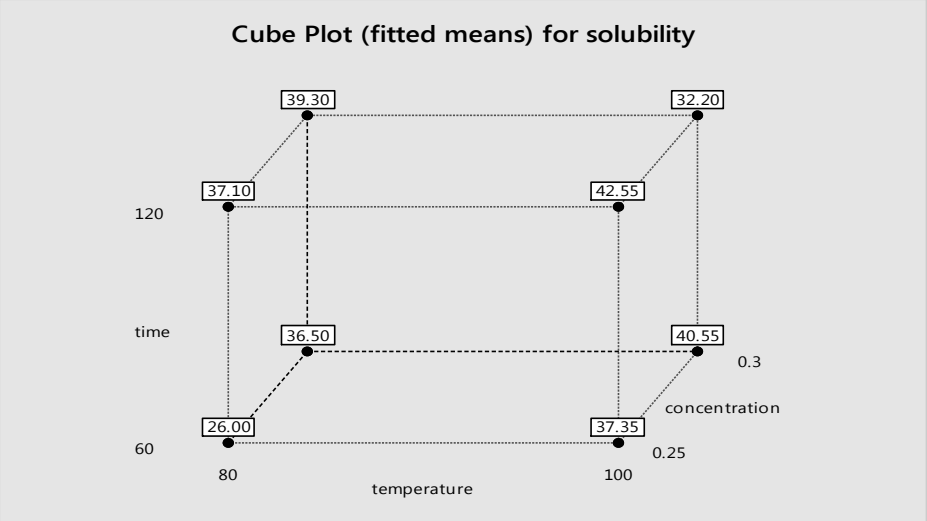


Figure 4: Cube Plot for Yellow Dextrin Solubility

The linear regression model equation for yellow dextrin can be built up from the estimated coefficients for yellow dextrin solubility in Table 2 and it's shown in Equation 1.

$$Y_y = 36.444 + 1.719x_1 + 1.344x_2 + 0.694x_3 - 2.131x_1x_2 - 2.481x_1x_3 - 2.731x_2x_3 - 0.656x_1x_2x_3 \quad (1)$$

Y_y: The predicted value of yellow dextrin solubility
X_1: The roasting temperature which has two levels coded 1 and -1
X_2: The roasting time which has two levels coded 1 and -1
X_3: The concentration of acid which has two levels coded 1 and -1
The model equation via the combination of the main effect shown above and the interaction plot can be shown as:

$$Y_y = 36.444 + 1.719(1) + 1.344(1) + 0.694(-1) - 2.131(1)(1) - 2.481(1)(-1) - 2.731(1)(-1) - 0.656(1)(1)(-1)$$

Y_y = 42.55% which is the percentage solubility.

The characterization of the sealing carton adhesive produced shows that the viscosity of the adhesive produced is 1.5 Pa.s as indicated in Brookfield viscometer. The drying time and the pH of the adhesive are 4.13 minutes and 7.54 respectively.

Conclusions

Based on the results obtained from various analyses conducted in this study, the following conclusions can be drawn:

(i) The optimum condition for yellow dextrin was obtained at temperature of 100°C, roasting time of 120minutes and concentration of 0.25 M and gave a solubility of 42.8 %.

(ii) From the factorial analysis carried out roasting temperature, roasting time and concentration has significant effect on the solubility of dextrin. It also suggested that there are significant interactions between the individual variables in other to produce dextrin with high solubility.

(iii) Yellow dextrin was used in the production of sealing carton adhesive which has a viscosity of 1.5 pa.s, drying time of 4.13 minutes and pH of 7.54.

References

Akpa, J. G. (2012). Production of cassava starch base adhesive. *Research Journal in Engineering and Applied Sciences,* 1(4), 219 - 214.

Aytunga, A. K., Gonenc, I. & Ferhunde, U. S. (2010). Gelatinization of waxy, normal and high amylose corn starches. *Gida,* 35(4), 237 - 244.

Azeez, O. S. (2005). Production of dextrin from cassava starch. *Leonardo Journal of Sciences, Issue,* 7, 9 - 16.

Buba, A. A. & Kabiru, B. A. (2014). Re-inventing the production of adhesive from Cassava starch as a career opportunity in chemistry education. *International Letters of Natural Sciences,* 13(1), 12 - 19.

Burrell, M. M. (2003). Starch: The need for improved quality or quantity—an overview. *Journal of Experimental Botany,* 54(382), 451 - 456.

Coker, J. M. (2001). *Kinetic Study of the Production of Starch Adhesive.* Unpublished Thesis. Federal University of Technology, Minna, Niger state, Nigeria.

Conner, N. (1994). Carbohydrate Polymers as Adhesives: Handbook of adhesive technology. *New,* 15. 299 - 313.

Gumus, R. H. & Udezue, D. N. (2011), Investigation of rheological properties of cultivar TME 419 for potential adhesive material. *Journal of the Nigerian Society of Chemical Engineering,* Pp 78 – 87.

Lawton J. W. (2004). Uses of native starch. *Encyclopaedia of Grain Science*, 1-3, 195 - 202.

Leach, H. W., McCowen, D. L. & Schoch, T. J. (1959). Swelling and solubility patterns of various starches. *Structure of Starch Granules,* 1(36), 534 - 544.

Montgomery, D. C. (2005). *Design and analysis of experiment.* New York: John Wiley & Sons.

Peroni, F. H. G., Rocha, T. S. & Franco, C. M. L. (2006). Some structural and physicochemical characteristics of tuber and root starches. *International Journal of Food Science and Technology,* 12(6), 505 - 513.

Ubadike, C. J. (2015). *Optimization of white and yellow dextrin for the production of starch based adhesive.* B.Eng. Thesis, Federal University of Minna, Niger State, Nigeria.

Vaclavik, V. A. & Christian, E. W. (2008). Starches in food. In D. R. Heldman (Ed.), *Essentials of food science*.. New York, USA: Springerlink. Pp. 49 - 67.

Yuan, Y., Zhang, L., Dai, Y. & Yu, J. (2007). Physicochemical properties of starch obtained from Dioscorea nipponica Makino comparison with other tuber starches. *Journal of Food Engineering,* 82, 436 - 442.

COMPARATIVE ASSESSMENT OF PHYSICOCHEMICAL PROPERTIES OF LOCALLY AND MECHANICALLY PRODUCED GROUNDNUT (*ARACHIS HYPOGAEA*) OIL STORED OVER A PERIOD OF TIME

ORHEVBA, B. A.; OLORUNSOGO, S. T. & JIMADA, S. A.
Department of Agricultural & Bioresources Engineering,
Federal University of Technology, Minna, Niger State, Nigeria
E-mail: borhevba@yahoo.com, olorunsogo@yahoo.com, Phone No: +234-806-168-8880

Abstract

Groundnut oil was extracted using both local and mechanical methods of extraction. 5litres of each of the oil samples were measured into a plastic gallon and kept in a cool and dry place (average temperature of 28^{O}C). The effect of extraction method and Period of storage were examined. The oil samples from both methods of extractions were analyzed for physicochemical and proximate composition at fresh state and subsequently during storage, using standard methods. The result revealed that free fatty acid, Peroxide value, Saponification value, Iodine value, Viscosity, and Crude Protein were significantly (P<0.05) different during the storage periods and between the extraction methods. The result showed that the physicochemical characteristics of the oil samples extracted from both local and mechanical method were FFA 7.393, 5.61; Peroxide value 1.8, 1.2, Saponification value 193.2, 189.51; Iodine value 95.71, 92.46; Specific gravity 0.9305, 0.91, Viscosity 88.68, 84.24 and Refractive index 1.473, 1.475 respectively. The oil extracted locally had higher value in FFA whereas the mechanically extracted oil had lower value even after six months of Storage. Similar trends were observed in most of the other physicochemical properties.

Keywords: Crude Protein, Groundnut oil, Physicochemical Properties, Proximate Composition, Storage Period

Introduction

Groundnut, *Arachis hypogeal L,* also known as peanut or earthnut is native to a region in Eastern South America (Weiss, 1983). It is grown as an annual crop principally for its edible oil and protein rich kernel seeds, borne in pods which develop and mature below the soil surface. Groundnut is herbaceous and has varieties. It is common in the United States, grows up to 30-46 cm high and does not spread. Runner varieties, the most common in West Africa are shorter and run along the ground for 30-60cm (Asiedu, 1992). Groundnut is now grown worldwide in the Tropics and temperate zones primarily as an oil seed crop (Bansal *et al.*, 1993). Groundnut seed makes important contribution to the diet in many countries. The fat content in groundnut has been largely studied. In general, groundnut contains 50-55 % fat of which approximately 30 % is linoleic acid, 45 % is oleic acid. High oleic groundnuts rather than normal groundnuts have increased shelf life and thus improve the oxidative stability of groundnut products (Isleib *et al.*, 2006).

Groundnut oil is an organic material oil derived from groundnut, noted to have the aroma and taste of its parent legume. Groundnut oil is most commonly used when frying foods, because its high smoke point is relative to many other cooking oils. Most vegetable oils such as groundnut oil, sunflower oil, soybean oil and corn oil are rich in mono-and polyunsaturated fatty acids such as alpha-linolenic acid, and w-3 fatty acid, and linoleic acid, and w-6 fatty acid. Groundnut seeds are rich in proteins, lipids, and fatty acids for human nutrition. (Grosso *et al.*, 1997 and Sanders, 2002).

Groundnut oil is pale yellow in colour with distinctive nutty taste and odour obtained from the processing of peanut kernel. Its odor is almost removed with refining (Sanders, 2002). It

has a high oleic content that has good oxidative and frying stabilities. It is non-drying oil that solidifies from 0 to 3 ^{0}C (Padley, *et al.*, 1994, Young, 1996 and O´Brien, 2004). It is considered a premium cooking and frying oil due to its high smoke point and excellent oxidative stability relative to many other cooking oils (O´Brien, 2004).

Materials and Methods

Sample Collection and Preparation of Samples

Groundnut seeds used for the extraction of oil were obtained from a farm at Gidan Kwanu village, Minna-Bida road, Niger State, Nigeria. The collected seeds were properly cleaned by careful visual inspection; dirt, discoloured seeds, shells and stones were removed. The clean groundnut seeds were thereafter subjected to oil expression using both local and mechanical methods. The fresh oils were then left to clarify. The physicochemical properties and proximate compositions were initially determined using the methods described by the Association of Official Analytical Chemists (AOAC), 2005. The fresh oils were filled into 5 L gallon each and stored at an average temperature of 28 ^{0}C. During the period of storage, the extent of variations in both the proximate value and physico-chemical properties were determined at interval of one month for six months

Local Extraction Method

The groundnut seeds were roasted lightly in a pan over fire. The roasted nuts were then skinned by pouring them over a mat and rolling a wooden batting over them, and winnowing them to separate the skin from the nuts. Thereafter, the skinned nuts were then pounded with mortar and pestle to obtain a smooth paste (little quantity of water was sprinkled on the nuts to make pounding easier). The paste was then kneaded and pressed by hand to express the oil-water mixture. The oil-water mixture was finally fired to remove most of the water by evaporation, since the boiling point of groundnut oil is higher. The boiling point of groundnut oil falls within 130^{0}C-150^{0}C and this decreases with increase in treatment temperature (Makeri, *et al.*, 2011).

Mechanical Extraction Method

The groundnut seeds were first fed into an electrical toaster for roasting. After proper toasting, the seeds were then transferred into the screw press expeller through the feeding hopper. The expeller consisted of worm shaft, cylindrical barrel, feeding hopper, gear box, cake outlet, cake tray, oil outlet, and main frame. The groundnut seeds introduced into the machine through the feeding hopper, were conveyed, crushed, ground and pressed inside the cylindrical barrel with the aid of the worm shaft until oil was squeezed out of the seed. The oil extracted was then drained through the oil channel into the oil tray where it was collected; the residual cake was discharged at the cake outlet and collected at the cake tray. The oil was allowed to settle and clarify before measuring into a 5 litre gallon.

Determination of Physiochemical Properties of the Extracted Oils

All the physicochemical analysis of the oils with the exception of viscosities and refractive indices were carried out at the laboratory of the Department of Animal Production Technology, Federal University of Technology, Minna, Niger State, Nigeria. The refractive indices and viscosities of the oils were determined at the laboratory of the Department of Chemistry, Federal University of Technology, Minna, Niger State, Nigeria. The physicochemical properties which included; refractive index, specific gravity, viscosity, colour, odour, free fatty acid, Peroxide value, Saponification value, and iodine value were determined using the methods of the Association of Analytical Chemists (AOAC, 2005).

Determination of Proximate composition of the Extracted oils

The proximate composition of the groundnut oils was determined at the Laboratory of the Animal Production Technology department, School of Agricultural and Agricultural Technology, Federal University of Technology Minna, Niger State, Nigeria. The analyses were determined using the method described by the Association of Analytical Chemists (AOAC, 2004).

Results and Discussion

Table 1: Effect of extraction method and period of storage on proximate composition of groundnut oil

Treatment	Moisture (%)	Crude Protein (%)	Crude Fibre (%)	Ash (%)
Extraction method (E)				
Local	1.56a	10.69a	0.00	0.00
Mechanical	0.94b	8.97b	0.00	0.00
SE±	0.01	0.01	0.01	0.01
Storage Period (S) (Months)				
1st	1.24a	12.31a	0.00	0.00
2nd	1.23a	11.25	0.00	0.00
3rd	1.24a	10.89c	0.00	0.00
4th	1.26a	9.38d	0.00	0.00
5th	1.26a	8.03e	0.00	0.00
6th	1.27a	7.13f	0.00	0.00
SE±	0.01	0.01	0.01	0.01
Interaction				
E X S	NS	**		

Values followed by the same letter(s) in a column do not differ significantly by Duncan Multiple Range Test (DMRT) at 5% level of probability
SE = Standard error, NS = Not Significant Interaction, ** = highly Significant Interaction

Table 2: Effect of extraction method and period of storage on physicochemical properties of groundnut oil

Treatment	FFA	PV	SV	IV	SG	Viscosity	RI
Extraction Method (E)							
Local	11.43a	2.02a	197.53a	96.92a	0.9363a	86.27a	1.467a
Mechanical	9.89b	1.55b	195.6b	93.3b	0.9075b	75.29b	1.467a
SE±	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Storage Period (S) (Months)							
1st	8.82f	1.60e	192.24f	94.13f	0.9091c	85.86a	1.472a
2nd	10.16e	1.69d	194.08e	94.45e	0.9158b	84.47b	1.471a
3rd	10.5d	1.71d	198.71b	95.01d	0.9142bc	78.93c	1.467b

4th	11.22c	1.82c	196.98d	95.31c	0.9286ab	78.60d	1.465c
5th	11.46b	1.92b	198.34c	95.84b	0.9293ab	78.44e	1.462c
6th	11.80a	1.97a	199.04a	95.95a	0.9344a	78.38f	1.463c
SE±	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Interaction							
E X S	**	NS	**	**	NS	**	NS

Values followed by the same letter(s) in a column do not differ significantly by Duncan Multiple Range Test (DMRT) at 5% level of probability
SE = Standard error, NS = Not Significant Interaction, ** = highly Significant Interaction

Figure 1: Effect of extraction method and period of storage on physicochemical properties of groundnut oil

Results of the physico chemical properties and proximate composition of groundnut oil samples extracted using two methods and stored over a six month period are presented in Tables 1and 2. From Table 1, it can be seen that the method of extraction had a significant difference on the moisture content and crude protein of the oil samples; although the period of storage did not affect the moisture content significantly. Significant differences were observed in the crude protein content over the storage period.

From Table 2, significant differences were observed in the values obtained for FFA, peroxide value, saponification value, iodine value, specific gravity and viscosity using both methods of oil extraction. There was no significant difference in the refractive indices of the two oil samples. Significant differences were also observed in the values of FFA, peroxide value, saponification value, iodine value, specific gravity and viscosity over the storage period. The value of 13.64 % obtained could be compared with 13.01% obtained by Atasie, *et al.* (2009). The high value of crude protein in the locally produced oil could be attributed to the improper removal of the sludge impurities from the oil, which is believed to be rich in Nitrogen.

Similarly, from Table 1, it can be seen that storage period had a significant effect on crude protein composition with the one month storage accounting for the highest value and subsequently decreased as the storage period increased. This could possibly be attributed to the depletion in Nitrogen composition present in the polymer of amino acids when it reacted with the oxygen and moisture absorbed by the oil forming oxides and Nitric acids during hydrolysis (AOAC, 1998). At the end of the storage period, locally produced oil still maintained a higher crude protein composition.

Moisture content differed significantly between the oil samples, such that locally produced oil had higher moisture than the mechanically produced groundnut oil. The moisture content obtained for both oils fell within the range of 0.94% and 1.56% which is in agreement with that reported by Atasie, *et al.* (2009). The characteristic higher moisture content of the locally produced oil could be attributed to its characteristic high FFA, leading to the fast rancidity as a result of hydrolysis and oxidation. Furthermore, storage period had no significant effect on this parameter, even though the fluctuations in the moisture were not constant during the storage period. This could be as a result of correspondent fluctuation in the room temperature and humidity.

From Table 2, it can be seen that the FFA for both oil samples differed significantly with the locally extracted oil having higher value of 11.43 compared to the mechanically extracted oil with the value of 9.89. Both values fall within the limit set by the Codex Alimentarius Commission for groundnut seed oils for groundnut oil (Abayeh, *et al.,* 1998). The FFA obtained for both extraction methods is slightly lower than that obtained for Olive oil 17mgKOH/g (Davine and Williams, (1961) and higher than Shear nut fat 10.49mgKOH/g reported by Oyedele (2002). The higher value of FFA recorded for locally produced oil may be as a result of the extraction method used. Moreover, the locally produced oil might have been subjected to more hydrolysis considering the fact that it has higher initial moisture content. Also, during the period of six months storage, the FFA had experienced an unprecedented increase from 8.82mgKOH/g to about 11.80mgKOH/g. The quantity of FFA in oils is an indicator of its overall quality irrespective of the storage period (Overhults, *et al.,* 1974).

The mean Peroxide value measured for locally produced groundnut oil was higher in comparison to the mechanically produced oil. The values obtained for locally produced oil is very much close to the 2.26MeqKOH/g obtained by Hook *et al.* (2011), while that of mechanically produced oil is lower (1.55). However, during the period of storage there was no significant difference in the peroxide values throughout the months. Generally, PV of oils may be influenced by much exposure of the seeds to sunlight and heating during drying and frying respectively, causing the lipid oxidation resulting from absorption of oxygen which increases the formation of peroxide (Cheftel and Cheftel, 1992). Peroxide value of the two oil samples were lower than that reported by Ebuehi and Avwobobe (2006). The low peroxide values of the oils gave an indication that they have good storage potential. There was a significant difference as the storage period of the oils increased. However, there was a slight decrease in the peroxide value after one month storage and then increased partially as the storage period was prolonged which could be due to the oxidation of unsaturated fatty acid in the oils.

The result of the saponification values obtained for both oil samples compared favorably with 199.42mgKOH/g of cotton seed reported by Warra *et al.* (2011) and lower than 213mgKOH/g in neem seed oil (Akpan *et al.,* 2000). This indicates that the oils can be used in soap making since its saponification value falls within the range of these oils. Higher saponification value justifies the usage of fat or oil for soap production (Warra *et al.,* 2011).

The saponification value was also influenced by the extraction method with the locally produced sample having the highest value. This could be attributed to the characteristic high FFA obtained in the oil. The saponification value at the sixth month gave the highest value which is consistent with the increasing behavior of the FFA.

The iodine value of the oils (96.92 and 93.30) was less than 100gI_2/100g which shows that the oils belong to the class of non-drying oils which are useful in the production of soap and margarine (Odoemelam, 2005). The iodine value of the oil samples were also lower than 104.3g I_2/100g reported for sesame seed oil by Warra *et al.,* (2011) and higher than 84.8gI_2/100g for groundnut oil (Warra *et al.,* 2010). The iodine values significantly differed during the period of storage with the highest value recorded at the sixth month.

The refractive indices of the oils are well compared with 1.460-1.465 obtained by Odoemelam (2005) and also in close agreement with those reported for other conventional oils for soyabean (1.466-1.470) and Palm kernel (1.449-1.451) (Hook *et al.,* 2011). The high refractive indices of these oils seem to confirm the number carbon atoms in their fatty acids (Falade *et al.,* 2008) and it increased as the double bond increased (Eromosele and Pascal, 2003). There was no significant difference in refractive indices of the oil samples during the period of storage and even between the extraction methods. The refractive indices remained almost the same throughout the period, only slight changes were recorded which could have been caused by loss in viscosity and contamination with impurities.

The specific gravities for both samples ranged from 0.9075-0.9363, this is close to 0.918 reported by Akpan *et al.* (2000). The specific gravity slightly increased during the period of storage even though the differences were not significant.

The viscosity recorded for both oil samples were higher than those of soyabean (31cSt), cottonseed oil (36cSt) and sunflower (43cSt) at 300^0C (Kammann and Philips, 1985). However, the viscosity of both forms of oils differed significantly, with the locally produced oil recording higher value of 86.27 compared to the 75.29 of the mechanically produced oil. It was observed that as the period of storage increased, the value gradually decreased for both oils.

Conclusion

This study showed that the proximate composition and physicochemical properties of groundnut oils were affected by the method of extractions and the period of storage. The FFA and other physicochemical properties of the two samples are comparable to those of some conventional oils. The groundnut oils are unsaturated and can be classified in the oleic-linoleic acid group. The increase in FFA was more notable compared to other properties towards the last 3 months of storage for both oils. The difference of the increase of those values in the two samples could be explained by the absorption of light into packaging material, the degradation of oil compound due to initial oxygen concentration, hydrolysis due to moisture and permeability of oxygen through the 5L gallon. The studies also showed that locally produced was of lower quality and was prone to go rancid faster compared to the mechanically produced oil, which could be attributed to its characteristic high moisture content and FFA. It is concluded from this study that the stability of groundnut oil is dependent on the method of production and its initial physical and chemical properties, time and storage condition.

References

Abayeh, O. J., Aina, E. A. & Okounghae, C. O. (1998). Oil content and oil quality characteristics of some Nigerian oils seeds. *Science Forum: J. of pure and applied sci., 1(1),* 17 - 23.

Akpan, U. G. A. A., Eyo, P. O. & Aloku, S. A. (2000). Extraction and characterization of neem seed oil. *Biotechnology and sustainable development in Nigeria*, pp. 63 - 66.

AOAC. (1998). *Official methods of analysis of the association of analytical chemists (14th Edition ed.).* USA: Gaithersburg.

AOAC. (2004). *Official methods of analysis of the association of analytical chemists (15th edition).* Washington DC, USA, P. 858

AOAC. (2005). *Official methods of analysis of the association of analytical chemists (18th edition).* Washington DC, USA, (16th ed.). Washington.

Asiedu, J. J. (1992). *Processing tropical crops: A technological approach.* NY: The Macmillan Press Publication Ltd (Second ed.). pp:43-84.

Atasie, V. N., Akinhanmi, T. F. & Ojiodu, C. C. (2009). Proximate analysis, physico-chemical properties of groundnut (Arachis hypogaea L.). *Pakistan Journal of Nutrition* , 3(2).

Bansal, U. K., Satija, D. R. & Ahuja, K. L. (1993). Oil composition of diverse groundnut (arachis hypogaea) Genotype in relation to other environment. *J. Sci. Food Agric. , 63*, 17 - 19.

Cheftel, J. C. & Cheftel, H. (1992). Introduction a la biochimie et a la technologie des aliments. *Technique et documentation,* 243 - 330.

Davine, J. & Williams, P. N. (1961). *The chemistry and technology of edible oils and fats (1st edition ed.).* London: Pergamon press.

Ebuehi, O. A. T. & Avwobobe, O. K. (2006.). Physico-chemical and fatty acid composition of water melon (*Citrullus lanatus*) and melon (*Colocynthis citrullus*) seed oils. *Nigerian Food Journal, 24(1),* 25 - 33.

Eromosele, C. O. & Pascal, N. H. (2003). Characterization and viscosity parameters of seed oils from wild plants. *J. Bioresoures Tech., 86*, 203 - 205.

Falade, O. S., Adekunle, S. A., Aderogba, M. A., Atanda, O. S., Harwood, C. & Adewusi, S. R. A. (2008). Physicochemical properties, total phenol and tocopherol of some acacia seed oils. *J. Sci. Food Agric.*, 263 - 268.

Grosso, N. R., Zygadlo, J. A., Lamarque, A. L., Maestri, D. M. & Guzmán, C. A. (1997). Proximate, fatty acid and sterol compositions of aboriginal peanut (arachis hypogaea l) seeds from bolivia. *J. Sci. Food Agric.*, *73,* 349 – 356.

Hook. F., Muibat, O. B., Temitope, L. A. & Deborah, O. A. (2011). Physicochemical properties and fatty acids profile of seed oil of telfairia occidentalis. *International Journal of Basic & Applied Sciences IJBAS-IJENS , 11(6)*, 4 - 6.

Isleib, T. G., Wilson, R. F. & Novitzky, W. P. (2006). Partial dominant, pleiotropism, and epistasis in the inheritance of the high-oleate trait in Peanut. *Crop Sci. 46,1331 - 1335*.

Kammann, K. D. & Philips, A. I. (1985). Sulfurized vegetable oil products as lubricant additives. *Am oil chem. Soc. , 62*, 917 - 923.

Makeri, M. U., Bala, S. M. & Kassum, A. S. (2011). The effects of roasting temperatures on the rate of extraction and quality of locally-processed oil from two Nigerian peanut (*Arachis hypogea* L.) cultivars. *African Journal of Food Science, 5 (4),* 194 – 199.

O´Brien, R. D. (2004). *Fats and oils: Formulating and processing for applications.* Boca Raton, USA: CRC press*,* Pp. 45 - 67.

Oyedele, A. O. (2002). The skin tolerance of shea fat employed as excipient in topical preparations. *Nigerian J. Nat. Prod. Med.*; 66, 26-29.

Odoemelam, S. A. (2005). Proximate composition and selected physico-chemical properties of the seeds of african oil bean (Pentaclethra marcrophylla). *Pakistan Journal of Nutrition, 4(6),* 382 - 383.

Overhults, D. G., White, G. M., Hamilton, H. E., Ross, I. J. & Fox, J. D. . (1974). Effect of heated air drying on soyabeans oil quality. *Transaction of ASAE* , 72 – 150.

Padley, F. B., Gunstone, F. D. & Harwood, J. L. (1994). Occurrence and characteristics of oils and fats, In F. D. Gunstone, J. L, Harwood & F. B. Padley (Eds.). *The Lipid Handbook, Chapman and Hall*. London, UK, Pp. 47-223.

Sanders, T. H. (2002). Groundnut (Peanut) oil*,* In F. D. Gunstone (Ed.), *Vegetable oils in food technology. composition, properties and uses.* Oxford, UK: Blackwell Publishing Ltd, Pp*.* 231 - 243*.*

Warra, A. A., Hassan, L. G. Gunu, S. Y. & Jega, S. A. (2010). Cold- process synthesis and properties of soaps prepared from different triacylglycerol sources. *Nigerian J. Basic Appl. Sci ,* 18, 315 - 321.

Warra, A. A., Suraj, L.G. & Jega, S. A. (2011). Extraction and physicochemical analysis of some selected northern nigerian industrial oils. *Bayero J. Pure Appl. Sci ,* 4(1), 180 - 183

Weiss, E. A. (1983). *Oilseed crops (Tropical Agriculture series, ed. G. Wrigley, AICTA) groundnut.* London: Longman Publisher. Pp. 100 - 160.

Young, C. T. (1996). Peanut oil in bailey's industrial oil and fat products, 5th ed., Vol 2, *Edible oil and fat products: Oils and oilseeds,* Y.H. Hui (Ed.),pp. 337-392. New York: John Wiley and Sons, Inc.

JOSTMED, VOLUME 11(3), DECEMBER, 2015

ARTICLES AND RESEARCH REPORTS ON MATHEMATICS

RELATIVITY IN NUMERICAL PERFORMANCES OF CERTAIN POLYNOMIALS IN TAU METHOD

YISA, B. M.
Department of Mathematics,
University of Ilorin, Ilorin, Nigeria
E-mail: yisa.bm@unilorin.edu.ng Phone No: +234-8108192432

Abstract
This paper examines the order of numerical usefulness of the four kinds of Chebyshev polynomials, especially in the differential formulation of the Lanczos' Tau method. Their practical applications on selected numerical problems, which are constant and variable coefficients, homogeneous and nonhomogeneous problems of varied orders, showed correlation between the accuracy of first and fourth kinds. The second kind was next in performance, while the third kind performed least.

Keywords: Chebyshev Polynomials, Canonical Polynomials, Differential Formulation, Tau Approximant, Ordinary Differential Equation

Introduction
The usefulness of various types of orthogonal polynomials like Laguerre, Hermite, Legendre and Chebyshev polynomials can never be over – emphasized. This is evidenced in the works of many earlier scientists like Gauss, in his popular integration method called Gauss Quadrature formula, where he derived the nodes for any given problem by equating to zero the polynomial of equivalent order, mostly Legendre. Lanczos (1938, 1956) elucidated more on the properties of these polynomials and came to the conclusion that Chebyshev polynomial is the best, considering the mini – max property of the latter in the error propagation. Fox (1962) and Fox and Parker (1972) concentrated on the analysis of Chebyshev polynomials of the first and second kind.

In Yisa (2015a), it was reported that although Chebyshev polynomial has its usefulness as emphasized by Lanczos and some other scientists, but Legendre polynomial in certain instances could out-perform it. Yisa (2015a) was not the first to maintain this position, but rather it was the position maintained by Ortiz (1975). In the present work, the attention is focused on the relativity in accuracy of the results obtained when the four kinds of Chebyshev polynomials are used as bases functions within the same interval [0, 1], that is when it was shifted from the usual interval [-1, 1] to a more usable interval [0, 1]. Similar efforts were made in the Recursive formulation of the Tau method (see Yisa (2015b)). The The beauty of extending it to the Differential Formulation is that of showing that the other kinds of Chebyshev polynomial can as well be used to get results with acceptable level of accuracy.

Application of the Four Kinds of Chebyshev Polynomials in the Differential Formulation of the Tau Method
The applications of these polynomials as bases functions were made to the class of general *mth* order ordinary differential equation (ODE)

$$\sum_{r=1}^{m}\left(\sum_{k=0}^{N_r} P_{r,k}\,x^k\right)y^{(r)}(x)=\sum_{r=0}^{F} f_r x^r \qquad (2.1a)$$

with the supplementary conditions

$$L^*y(x_0)=y^{(k)}(x_o)=\alpha_k\,, \qquad k=0(1)m-1 \qquad (2.1b)$$

where m is the order of the ODE, N_r and F are non – negative integers and x_0, $\propto_k$, f_r, $P_{r,k}$, are given real numbers.

Application of Chebyshev Polynomial of the First Kind

In solving (2.1), we consider an approximant

$$y_n = \sum_{r=0}^{n} a_r x^r, \qquad n < +\infty \tag{2.2}$$

which is the exact solution of the corresponding perturbed problem

$$Ly_n(x) = \sum_{r=0}^{F} f_r x^r + H_n(x) \tag{2.3}$$

where the perturbation term

$$H_n(x) = \sum_{k=1}^{m} \tau_k T_{n-k+1}^*(x) \tag{2.4}$$

and

$$T_r^*(x) = \csc\left\{r \cos^{-1}\left[\frac{2x-a-b}{b-a}\right]\right\} \equiv \sum_{k=0}^{r} C_k^{(r)} x^k \tag{2.5}$$

is the *rth* degree Chebyshev polynomial valid in the interval $[a, b]$ (assuming that (2.1) is defined in this interval).

After obtaining $T_0^*(x) = 1$ and $T_1^*(x) = 2x - 1$ (when the interval is narrowed in (2.5) to [0, 1]), the subsequent terms are generated recursively from

$$T_{n+1}^*(x) = 2T_1^*(x)T_n^*(x) - T_{n-1}^*(x), \qquad n \geq 1 \tag{2.6}$$

Thus, using all these in (2.3), the tau system is now written as

$$Ly_n(x) = \sum_{r=0}^{F} f_r x^r + \sum_{k=1}^{m} \tau_k \sum_{r=0}^{n-k+1} C_r^{(k)} x^r \tag{2.7}$$

When expanded, (2.7) generates a system of equations from which the values of the unknown constants and those of the free tau parameters τ_r, $r = 1(1)m$ are obtained.

Application of Chebyshev Polynomial of Second Kind

In this case, (2.4) takes the form

$$H_n(x) = \sum_{k=1}^{m} \tau_r U_{n-k+1}^*(x) \tag{2.8}$$

where $U_r(x)$ is defined as

$$U_r(x) = \frac{\sin(r+1)\theta}{\sin\theta} \tag{2.9}$$

as can be found in Mason and Handscomb (2013).

In (2.9) $x = \cos\theta$, $U_0(x) = 1$ and $U_1(x) = 2x$. But with the interval shifted to [0, 1], $U_0^*(x) = 1$ and $U_1^*(x) = 4x - 2$. Subsequent members are obtained from the general recurrence formula

$$U_{n+1}^*(x) = 2(2x-1)U_n^*(x) - U_{n-1}^*(x), \qquad n \geq 1 \tag{2.10}$$

Equations (2.10) and (2.8) are used in equation (2.7) to derive the required Tau system. The Tau system thus obtained is solved for the unknowns, including the free tau parameters.

Application of Chebyshev Polynomial of Third Kind

Chebyshev polynomials of the third kind is generated in Mason et al.(2013) using the trigonometric relation

$$V_n(x) = \frac{\cos(n+\frac{1}{2})\theta}{\cos\frac{1}{2}\theta}, \quad n \geq 0 \qquad (2.11)$$

which gives $V_0(x) = 1$ and $V_1(x) = 2x - 1$, and the equivalents in [0, 1] are $V_0^*(x) = 1$ and $V_1^*(x) = 4x - 3$. The other members are generated recursively from

$$V_{n+1}^*(x) = 2(2x-1)V_n^*(x) - V_{n-1}^*(x), \qquad n \geq 0 \qquad (2.12)$$

Equation (2.12) is now used in equation (2.7) to develop the required Tau system using Chebyshev polynomial of the third kind as the basis function. The Tau system thus developed will be solved as usual to get the values of the unknown constants and the free tau parameters.

Application of Chebyshev Polynomial of Fourth Kind

The differential formulation of the tau method equally admits the use of Chebyshev polynomial of the fourth kind as a basis function. This kind is generated in Mason and Handscomb (2013) from the trigonometric relation

$$W_n(x) = \frac{\sin(n+\frac{1}{2})\theta}{\sin\frac{1}{2}\theta}, \qquad n \geq 0 \qquad (2.13)$$

from where we get $W_0(x) = 1$ and $W_1(x) = 2x + 1$. When the interval is shifted from [-1, 1] to [0, 1], $W_0^*(x)$ and $W_1^*(x)$ are now derived as

$$W_0^*(x) = 1 \text{ and } W_1^*(x) = 4x - 1 \qquad (2.14)$$

and the general recursive form of generating other members as

$$W_{n+1}^*(x) = 2(2x-1)W_n^*(x) - W_{n-1}^*(x), \qquad n \geq 1 \qquad (2.15)$$

This is again used in (2.7) to develop the required tau system in terms of Chebyshev polynomial of the fourth kind. The system thus developed is solved for the unknown constants and the free tau parameters.

Numerical Experiments

To demonstrate what was discussed in the preceding sections, four numerical problems were considered, namely: first order variable coefficient homogeneous initial value problem (IVP); first order constant coefficient non - homogeneous IVP; third order constant coefficient homogeneous IVP; and second order constant coefficient non – homogeneous IVP.

Problem 3.1

Consider the following first order variable coefficient initial value problem

$$(1+x)y' + y = 0, \qquad x \epsilon [0, 1]$$

subject to y(0) = 1.

The exact solution of this problem is $y(x) = \frac{1}{1+x}$.

Note that this problem and the remaining three were handled with the aid of Mathematica 7.0.

This and the remaining three problems were solved for $y_n(x)$ (the approximate or numerical solution) with n = 5(1)10. The table of results presents the absolute errors given by

$Error = |y(x) - y_n(x)|$ for $n = 5(1)10$.

In each case, the approximate solution is written for all the problems when n=5, just to conserve space.

First Kind:

$$y_5(x) = 1 - \frac{2339}{2342}x + \frac{1132}{1171}x^2 - \frac{932}{1171}x^3 + \frac{512}{1171}x^4 - \frac{128}{1171}x^5$$

Second Kind:

$$y_5(x) = 1 - \frac{2441}{2450}x + \frac{1168}{1225}x^2 - \frac{944}{1225}x^3 + \frac{512}{1225}x^4 - \frac{128}{1225}x^5$$

Third Kind:

$$y_5(x) = 1 - \frac{29378}{29543}x + \frac{27728}{29543}x^2 - \frac{21568}{29543}x^3 + \frac{11008}{29543}x^4 - \frac{2560}{29543}x^5$$

Fourth Kind:

$$y_5(x) = 1 - \frac{19442}{19457}x + \frac{18992}{19457}x^2 - \frac{16192}{19457}x^3 + \frac{9472}{19457}x^4 - \frac{2560}{19457}x^5$$

Problem 3.2

Consider the following first order constant coefficient non – homogeneous IVP

$y' - 2y = -2x^3 - 3, \quad x \epsilon [0,1]$

subject to the initial condition $y(0) = 2$.

The exact solution is

$$y(x) = \frac{1}{4}(9 - e^{2x} + 6x + 6x^2 + 4x^3).$$

The approximate solution for n = 5 for the four kinds are as shown below.

First Kind:

$$y_5(x) = 2 + \frac{1327}{1328}x + \frac{169}{166}x^2 + \frac{48}{83}x^3 - \frac{16}{83}x^5$$

Second Kind:

$$y_5(x) = 2 + \frac{447}{448}x + \frac{43}{42}x^2 + \frac{4}{7}x^3 - \frac{4}{21}x^5$$

Third Kind:

$$y_5(x) = 2 + \frac{2411}{2422}x + \frac{2521}{2422}x^2 + \frac{635}{1211}x^3 + \frac{64}{1211}x^4 - \frac{256}{1211}x^5$$

Fourth Kind:

$$y_5(x) = 2 + \frac{2953}{2954}x + \frac{2983}{2954}x^2 + \frac{901}{1477}x^3 - \frac{64}{1477}x^4 - \frac{256}{1477}x^5$$

Problem 3.3

Consider the following third order constant coefficient homogeneous IVP

$y''' - y'' - y' + y = 0, \quad x \epsilon [0,1]$

Subject to the initial conditions $y(0) = 2, \quad y'(0) = 1, \quad y''(0) = 0.$

The exact solution is $y(x) = -e^x(x-2)$.

The approximate solution for n = 5 for the four kinds are:

First Kind:

$$y_5(x) = 2 + x - \frac{27480800}{158536731}x^3 - \frac{8786176}{158536731}x^4 - \frac{7956608}{158536731}x^5$$

Second Kind:

$$y_5(x) = 2 + x - \frac{116422064}{647668587}x^3 - \frac{35224064}{647668587}x^4 - \frac{10727168}{21588529}x^5$$

Third Kind:

$$y_5(x) = 2 + x - \frac{37750544}{196575195}x^3 - \frac{1568384}{39315039}x^4 - \frac{10934528}{196575195}x^5$$

Fourth Kind:

$$y_5(x) = 2 + x - \frac{11859008}{698944299}x^3 - \frac{46329728}{698944299}x^4 - \frac{31322368}{698944299}x^5$$

Problem 3.4

Solve the following second order constant coefficient non – homogeneous IVP

$y'' - 2y' + y = xe^x - x, \qquad x\epsilon[0,1]$

subject to the initial conditions $y(0) = 0, y'(0) = 0.$

The exact solution is $y(x) = \frac{1}{6}(-12 + 12e^x - 6x - 6xe^x + x^3e^x)$.

The exponential term on the right hand side of the IVP was expanded using Taylor series up to the term x^{10}. And unless that is done, it will be impossible to apply the tau method to solve it.

The approximate solution for the four kinds when n = 5 are:

First Kind:

$$y_5(x) = -\frac{10444}{1577829}x^2 + \frac{246607}{3681601}x^3 - \frac{8537003}{132537636}x^4 + \frac{46847939}{265075272}x^5$$

Second Kind:

$$y_5(x) = -\frac{1100100}{67109687}x^2 + \frac{15591755}{201329061}x^3 - \frac{52724095}{805316244}x^4 + \frac{279753527}{1610632488}x^5$$

Third Kind:

$$y_5(x) = -\frac{647828}{19668151}x^2 + \frac{7450859}{59004453}x^3 - \frac{9687637}{78672604}x^4 + \frac{92597431}{472035624}x^5$$

Fourth Kind:

$$y_5(x) = -\frac{223356}{75627781}x^2 + \frac{504209}{13346079}x^3 - \frac{16905437}{907533372}x^4 + \frac{282127621}{1815066744}x^5$$

Table I: Absolute Error for Problem 3.1

n	First Kind	Second Kind	Third Kind	Fourth Kind
5	1.111950E-4	9.555480E-5	1.688811E-4	7.720191E-5
6	1.671442E-5	1.667203E-5	2.934306E-5	1.277401E-5
7	2.778982E-6	2.883493E-6	5.099220E-6	2.135890E-6
8	4.831527E-7	5.003264E-7	8.763733E-7	3.581129E-7
9	8.157911E-8	8.470255E-8	1.501434E-7	6.069182E-8
10	1.361626E-8	1.487140E-8	2.595823E-8	1.027940E-8

Table II: Absolute Error for Problem 3.2

n	First Kind	Second Kind	Third Kind	Fourth Kind
5	1.543975E-4	2.421037E-4	5.889893E-4	1.076266E-4
6	8.538861E-6	1.874403E-5	3.900965E-5	6.597075E-6
7	4.861735E-7	1.093217E-6	2.391575E-6	4.110882E-7
8	2.490964E-8	6.394749E-8	1.272931E-7	2.097047E-8
9	1.163636E-9	3.055830E-9	6.325908E-9	1.047145E-9
10	4.957146E-11	1.439382E-10	2.792939E-10	4.498446E-11

Table III: Absolute Error for Problem 3.3

n	First Kind	Second Kind	Third Kind	Fourth Kind
5	2.769667E-3	2.111608E-3	5.840958E-3	9.502988E-4
6	5.946880E-4	5.946880E-4	3.046912E-4	3.456934E-5
7	3.541969E-6	5.898922E-6	1.392815E-5	1.276627E-6
8	1.078388E-7	1.078388E-7	5.485130E-7	4.099256E-8
9	2.503951E-9	8.427159E-9	1.887393E-8	1.229457E-9
10	7.845502E-11	2.602425E-10	5.738374E-10	3.265788E-11

Table IV: Absolute Error for Problem 3.4

n	First Kind	Second Kind	Third Kind	Fourth Kind
5	1.358168E-3	2.055562E-3	4.962947E-3	3.456127E-4
6	2.855565E-4	9.222670E-5	1.611892E-4	2.375255E-4
7	1.877631E-4	1.967308E-4	2.050510E-4	1.893681E-4
8	1.879043E-4	1.875189E-4	2.857980E-4	1.878417E-4
9	1.875322E-4	1.875466E-4	1.875603E-4	1.875341E-4
10	1.875111E-4	1.875106E-4	1.875102E-4	1.875111E-4

Discussion

In all the problems considered, the first and fourth kinds Chebyshev polynomials performed very well with errors of the same order, with the fourth kind performing relatively better than the first in most cases. Next to these two was the second kind which results were mostly closer but not as accurate. The tabulated results also exposed the weakness of Chebyshev polynomial of the third kind in terms of accuracy for all the problems considered. Problem 3.4 gave results with peculiarities. The errors were reducing as n increases up to $n = 8$. From that point, the error was still decreasing though, but the order remained the same for whatever values considered for n, even with increase in the number of terms retained in the Taylor's series expansion of the exponential term. The situation was similar for the four kinds of Chebyshev polynomials considered. This strange behavior was as a result of the exponential term in the non – homogeneous part of Problem 3.4, because the situation was not like that for Problem 3.2 despite it was also non – homogeneous type, but with the right hand side terms completely polynomial.

Conclusion

From the foregoing, it is very clear that the Chebyshev polynomials of the first and fourth kinds are the best in terms of accuracy, while the second kind is also good. The third kind performed least and may not be recommended for numerical purposes. And this corroborates the author's position in Yisa (2015b).

References

Lanczos, C. (1938). Trigonometric interpolation of emperical and analytical functions, *J. Math. Phys,* 17, 123 – 199.

Lanczos, C. (1956). *Applied analysis*. New Jersey: Prentice – Hall, Englewood Cliffs.

Fox, L. (1962). Chebyshev method for ordinary differential equations. *Comp. J.* 4, 318 – 331.

Fox, L. & Parker, I. B. (1972). Chebyshev polynomials in numerical analysis. London. Oxford University Press.

Yisa, B.M. (2015a). Numerical performances of two orthogonal polynomials in the Tau method for solutions of ordinary differential equations. *J. of NAMP*, 30, 15 – 20.

Ortiz, E. L. (1975). Step by step Tau method – Part I piecewise polynomial approximation. *Comp. and maths. with appls.,* 1, 381 – 392.

Yisa, B. M. (2015b). Comparative analysis of the numerical effectiveness of the four kinds of chebyshev polynomials. *J. of NAMP,* 32, 193 – 198.

Mason, J. C. & Handscomb, D. C. (2003). *Chebyshev Polynomials.* Washington, D.C.: CRC Press Company.

DETECTION OF BLOCKAGE IN A RADIALLY SYMMETRIC CYLINDRICAL PIPE USING DIFFUSION MAGNETIC RESONANCE EQUATION

YUSUF, S. I.[1], AIYESIMI, Y. M.[1], JIYA M.[1] & AWOJOYOGBE, O. B.[2]
[1]Department of Mathematics and Statistics,
Federal University of Technology, Minna, Nigeria
[2]Department of Physics, Federal University of Technology, Minna, Nigeria
[1]Email: shakirudeen.yusuf@futminna.edu.ng; amaams5@yahoo.com
Phone No: +234-706-929-7464

Abstract
In this study, Magnetic Resonance Imaging (MRI) is used to detect partial and total blockage of a cylindrical pipe by unused engine oil. Diffusion Magnetic Resonance (DMR) equation is solved analytically for flow of fluid in a radially symmetric cylindrical pipe. Appropriate boundary conditions were imposed and the radial axis varied to depict partial and total blockage in the pipe. The results show that for free flow, the magnetization is between 0.004 and 0.005. For partial blockage, the magnetization reduces (signal loss) in value to 0.00001, and for total blockage it is zero (0). This method is a viable alternative for detecting blockage in fluid pipelines in oil and gas industry due to its non invasive analysis of flow in fluid. The MRI model also registers signal in its first few seconds or micro-seconds. The analysis is also applicable to process industries where different network of pipes are used, or machines use cylindrical pipes or tubes in transporting materials especially when there is a partial or total blockage at any point in the network.

Keywords: Bloch NMR Equations, DMR equation, Cylindrical pipe, Magnetization.

Introduction
Diffusion Magnetic Resonance Imaging (DMRI) is one of the most rapidly evolving techniques in the MRI field. It provides accurate assessment of the individual component or multi-component systems in a matter of minutes whereas traditional radioactive tracer techniques may take weeks for each component (Awojoyogbe *et al*., 2011). Diffusion and flow can be measured very delicately and accurately using Magnetic Resonance Imaging (Hazlewood *et al*., 1974). Diffusion coefficient of a substance, defined as the amount of material that diffuses in a certain time plays a vital role in the detection of blockage in a pipe using MRI. Random diffusion motion of water molecules has intriguing properties depending on the physiological and anatomical environment of the organisms being studied. This is the principle being exploited by the method of DMRI. Though not widely known, it has been noted for long that nuclear magnetic resonance is capable of quantifying diffusion movement of molecules as a result of uniqueness in relaxation rates - T_1 and T_2 (Yusuf *et al*., 2010).

Some attempts have been made in the past to detect blockage. Yuan used time splitting algorithms and Godunov mixed format to simulate the pulse propagation in the blocked pipelines (Yuan *et al.,* 2014). Another technique used by Sattar is by the system frequency response. This is a technique whereby the frequency response is used in the detection of partial blockages in a pipeline (Sattar *et al*., 2008). Similar to this is the method adopted by Mohapatra for the detection of partial blockages in single pipelines by the frequency response method (Mohapatra *et al.,* 2006). Wang also investigated analytically the effects of a partial blockage on pipeline transients. A partial blockage is simulated using an orifice equation, and the influence of the blockage on the unsteady pipe flow is considered in the equation using a Dirac delta function (Wang *et al.,* 2005).

In this work, the principle of Magnetic Resonance is applied to a cylindrical oil pipe under the influence of radiofrequency field as a probe to perturb the molecules of the unused engine oil. This causes the nuclei to absorb energy from the applied electromagnetic (EM) pulse(s) and radiate this energy at a specific resonance frequency which depends on the strength of the magnetic field and other factors. This allows the observation of specific magnetic properties of an atomic nucleus. A Radio Frequency (RF) transmitter is needed to transmit energy into the fluid under consideration in the cylinder in order to "activate" the nuclei so that they emit a signal (Waldo & Arnold, 1983). The relaxation process itself is referred to as the free induction decay (FID). It is the observable NMR signal generated by non-equilibrium nuclear spin magnetization precessing about the magnetic field conventionally along z direction (Hopf *et al.,* 1973). This time-domain signal is typically digitized and then Fourier transformed in order to obtain a frequency spectrum of the NMR signal i.e. the NMR spectrum (Duer, 2004). The study of the behaviour of diffusion or flow of engine oil at the point of partial and total blockage is here now undertaken.

The Bloch NMR Equations

The x, y, z components of magnetization of fluid flow are given by the Bloch equations which are fundamental to understanding Magnetic Resonance Images:

$$\frac{dM_x}{dt} = -\frac{M_x}{T_2} \tag{1}$$

$$\frac{dM_y}{dt} = \gamma M_z B_1(x) - \frac{M_y}{T_2} \tag{2}$$

$$\frac{dM_z}{dt} = -\gamma M_y B_1(x) - \frac{M_o - M_z}{T_1} \tag{3}$$

where

M_o = equilibrium magnetization

M_x = component of transverse magnetization along the x-axis

M_y = component of transverse magnetization along y-axis

M_z = component of magnetization along the field (z -axis)

γ = gyro-magnetic ratio of fluid spins

B_0 = static magnetic field

$B_1(x,t)$ = radio-frequency (RF) magnetic field

T_1 = Longitudinal or spin lattice relaxation time

T_2 = Transverse or spin-spin relaxation time

V = the flow velocity

From the fundamental Bloch equations (1) - (3), the diffusion equation was evolved with the diffusion coefficient D evolving intrinsically without any additional term as done by Torrey (1956). The NMR diffusion equation as derived by Awojoyogbe *et al.* (2011) is given as:

$$\frac{\partial M_y}{\partial t} = D\frac{\partial^2 M_y}{\partial r^2} + \frac{F_o}{T_o}\gamma B_1(r,t) \tag{4}$$

where the diffusion coefficient $D = -\frac{V^2}{T_o}$ was accurately defined in terms of MRI flow parameters fluid velocity, V, T_1 and T_2 relaxation rates (as $T_0 = \frac{1}{T_1} + \frac{1}{T_2}$) and $F_o = \frac{M_o}{T_1}$.

The above diffusion equation with $D = -\frac{V^2}{T_o}$, called diffusion coefficient was evolved as an intrinsic part of the Bloch Nuclear Magnetic Resonance (NMR) equations.

Solution of the Diffusion Equation in Radially Symmetric Cylinder

Since the cylinder under consideration is radially symmetric, then it is independent of θ. Therefore M_y can be expressed as

$$M_y = M_y(r, z, t) \quad (5)$$

where M_y is the transverse magnetization.

In cylindrical coordinates, Equation (4) transforms to

$$\frac{\partial M_y}{\partial t} = D\left(\frac{\partial^2 M_y}{\partial r^2} + \frac{1}{r}\frac{\partial M_y}{\partial r} + \frac{\partial^2 M_y}{\partial z^2}\right) + \frac{F_o}{T_o}\gamma B_1(t) \quad (6)$$

Consequently, the solutions to the Equation (6) are:

$$U(t) = C_1 e^{-\lambda^2 D t} \qquad \lambda = 1, 2, \ldots, \ldots, \quad (7)$$

$$F(r) = C_2 J_0(\mu r) + C_3 Y_m(\mu r) \quad (8)$$

$$Z(z) = C_4 e^{\beta z} + C_5 e^{-\beta z} \quad (9)$$

Combining the solution to the diffusion equation (6), this gives the product of the quantities in (7), (8) and (9) plus $\int_0^{t_o} w_c(t)\,dt$ i.e.

$$M_y = M_y(r, z, t) = F(r)Z(z)\,U(t) + \int_0^{t_o} w_c(t)\,dt \quad (10)$$

$$M_y(r, z, t) = \{C_2 J_0(\mu r) + C_3 Y_m(\mu r)\}\{C_4 e^{\beta z} + C_5 e^{-\beta z}\}\{C_1 e^{-\lambda^2 D t}\} + \int_0^{t_o} w_c(t)\,dt \quad (11)$$

The last function on the right hand side is the radio-frequency field applied to perturb the molecules of the fluid. Therefore for the solution of

$$w_c(t) = \int_0^{t_o} \frac{F_o}{T_o}\gamma B_1(t)\,dt \quad (12)$$

The radio frequency field (rf) field is defined as

$$B_1(t) = bB_1(t)\cos wt \quad (13)$$

which implies

$$w_c(t) = \int_0^{t_o} \frac{F_o}{T_o} b\gamma B_1(t)\cos wt\,dt \quad (14)$$

$$\int_0^{t_o} \frac{bF_o}{T_o}\cos(wt)\,dt = \frac{bF_o}{wT_o}\gamma\sin(wt) \quad (15)$$

Consequently,

$$M_y(r, z, t) = \{C_2 J_0(\mu r) + C_3 Y_m(\mu r)\}\{C_4 e^{\beta z} + C_5 e^{-\beta z}\}\{C_1 e^{-\lambda^2 D t}\} + \frac{bF_o}{wT_o}\gamma\sin(wt) \quad (16)$$

Solution using the Initial and Boundary Conditions

We shall examine the behaviour of diffusion or flow of engine oil at the point of free flow, partial and total blockage as shown in Figures 1a, 1b and 1c below:

(a)

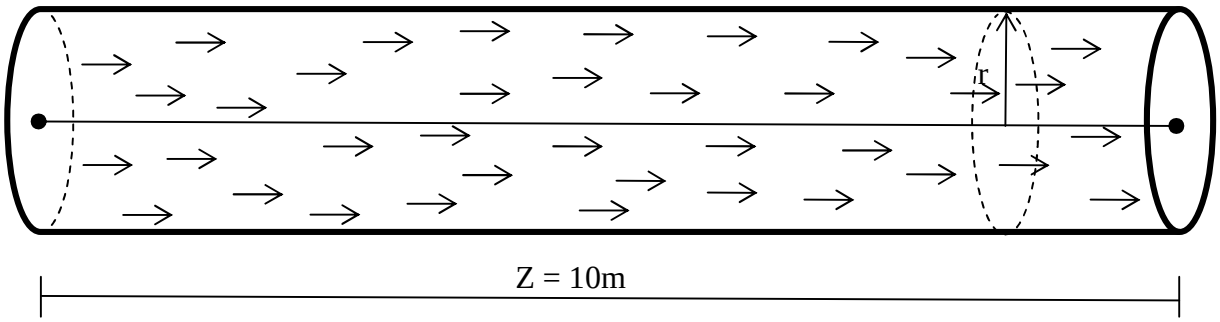


Figure 1(a): Free flow of Unused Engine Oil in the cylinder

(b)

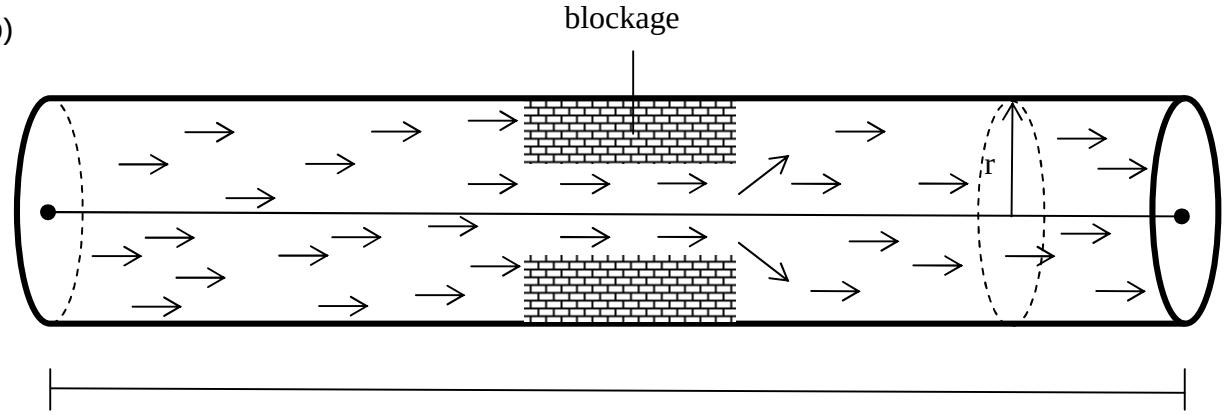


Figure 1(b): Partial blockage of Unused Engine Oil in the cylinder

(c)

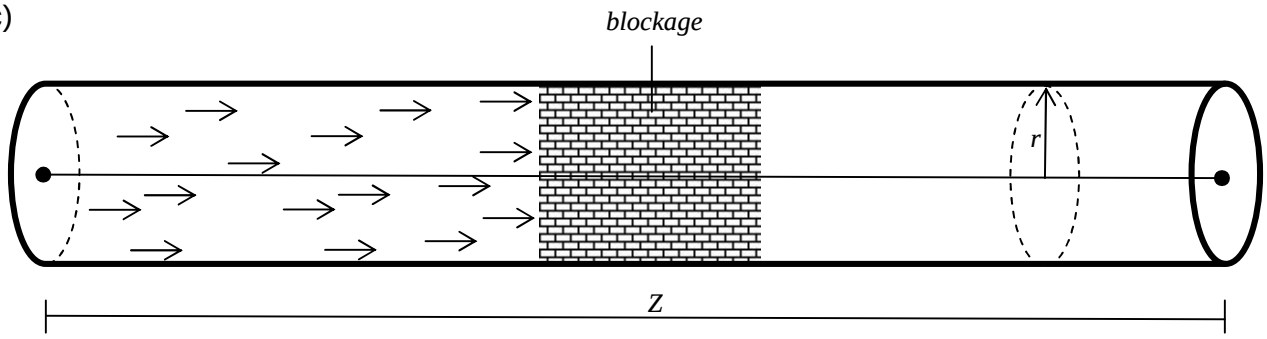


Figure 1(c): Total blockage of Unused Engine Oil in the cylinder

The following conditions shall be imposed:

$$\begin{aligned} &i) && M_y(r,z,0) = M_i(r,z); \\ &ii) && M_y(r,0,t) = 0; \\ &iii) && M_y(r,L,t) = 0; \\ &iv) && M_y(a,z,t) = 0; \\ &v) && \left|M_y(r,z,t)\right| = M, \end{aligned} \qquad (17)$$

where r *is the space depicting the blockage* and z is the direction of flow and both are defined as follows -

$$0 \leq r < a; \quad 0 < z < L; \quad t > 0 \qquad (18)$$

Finally, the solution for the magnetization of any molecule of the fluid at any point r and time t is given as:

$$M_y(r,z,t) = \frac{4\sigma_0}{\pi}\sum_{k=1}^{\infty}\sum_{m=1}^{\infty}\left\{\frac{(1-cosk\pi)}{k\frac{s_m}{a}J_1(\frac{s_m}{a})}e^{-Dt(\frac{s_m}{a})^2+(\frac{k\pi}{L})^2}\right\}\left\{J_0\left(\frac{s_m}{a}r\right)\right\}sin\frac{k\pi z}{L} + \frac{bF_0}{w^2T_0}\gamma sin\,(wt) \quad (19)$$

Results and Discussion

The fluid under consideration is unused engine oil and its diffusion coefficient is $8.9\ x\ 10^{-8}m^2s^{-1}$. T_1 and T_2 values of unused engine oil were used and the following substitution made for free flow, partial and total blockages of the pipe:

$$\left.\begin{aligned} s_m &= \gamma G\delta \\ F_o &= \frac{M_o}{T_1} \end{aligned}\right\} \quad (20)$$

Based on our computational algorithm, Figures 1a, 1b and 1c were obtained for free flow, partial and total blockages respectively.

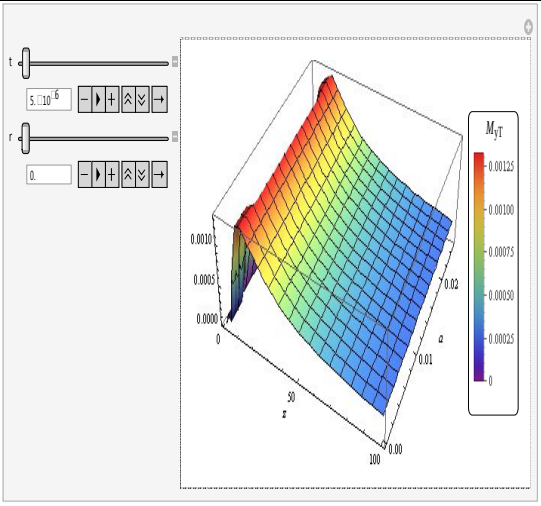


Figure 2a: Magnetization (My) against time (t = 0.000005 sec.) for unused engine oil when there is no blockage (r = 0)

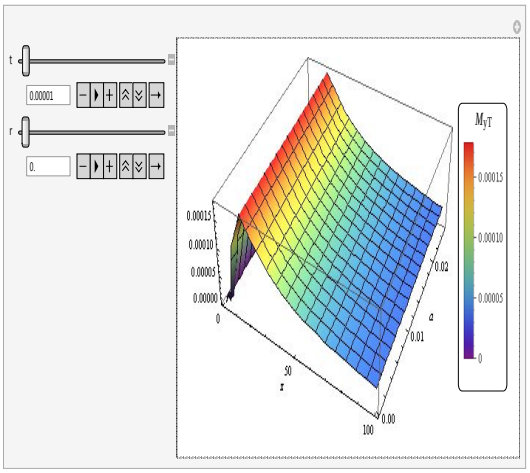


Figure 2b: Magnetization (My) against time (t = 0.00001 sec.) for unused engine oil when there is no blockage (r = 0)

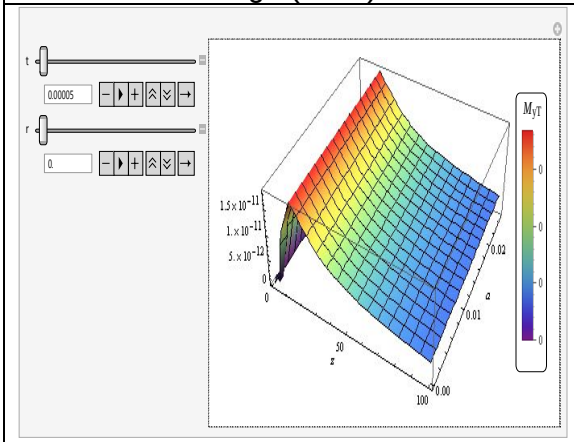


Figure 2c: Magnetization (My) against time (t =0.00005 sec.) for engine oil when there is no blockage (r = 0)

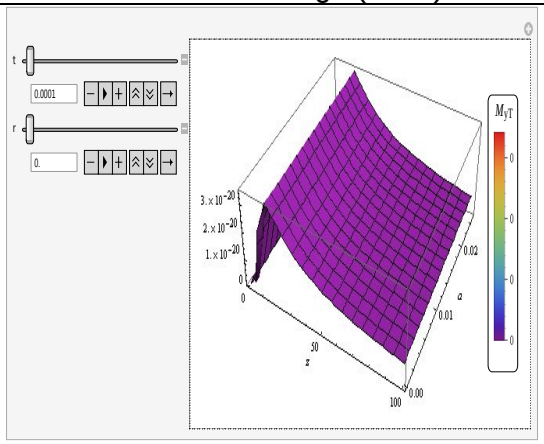


Figure 2d: Magnetization (My) against time (t =0.0001 sec.) for unused engine oil when there is no blockage (r = 0)

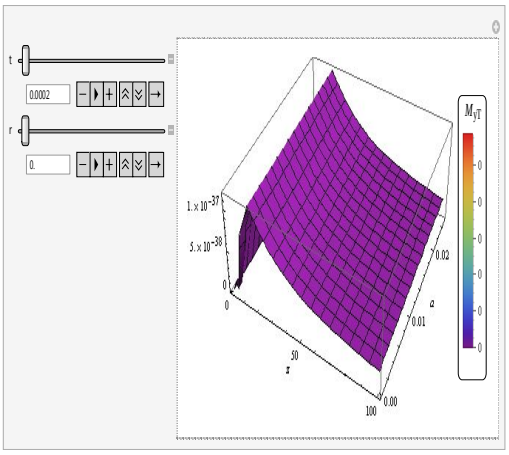


Figure 2e: Magnetization (My) against time (t =0.0002 sec.) for unused engine oil when there is no blockage (r = 0)

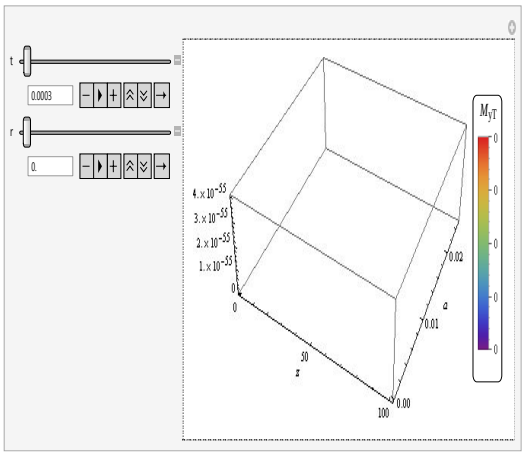


Figure 2f: Magnetization (My) against time (t =0.0003 sec.) for unused engine oil when there is no blockage (r = 0)

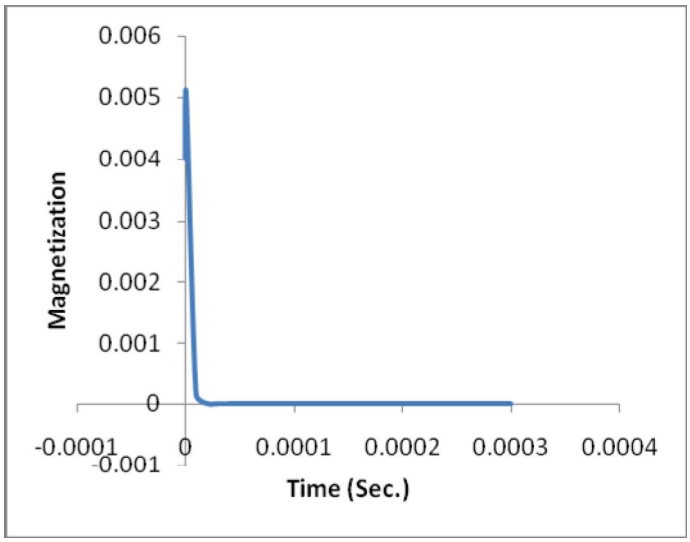


Figure 2g: Flow in a Cylinder of Unused Engine Oil when there is No Blockage (Free Flow)

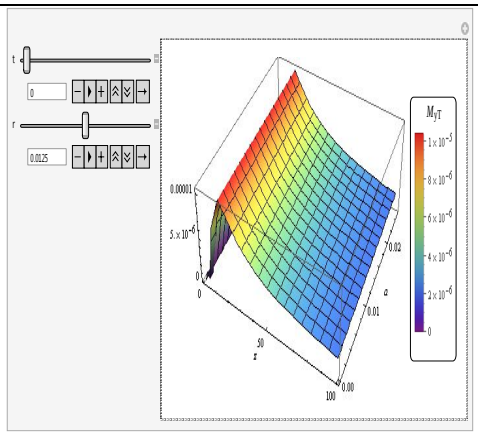


Figure 3a: Magnetization (My) against time (t = 0 sec.) when blockage is half the radius (r = 0.0125m)

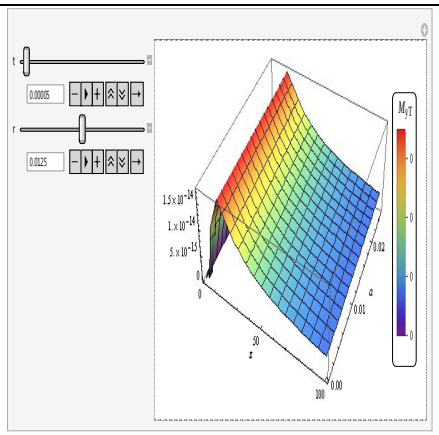


Figure 3b: Magnetization (My) against time (t = 0.00005 sec.) when blockage is half the radius (r = 0.0125m)

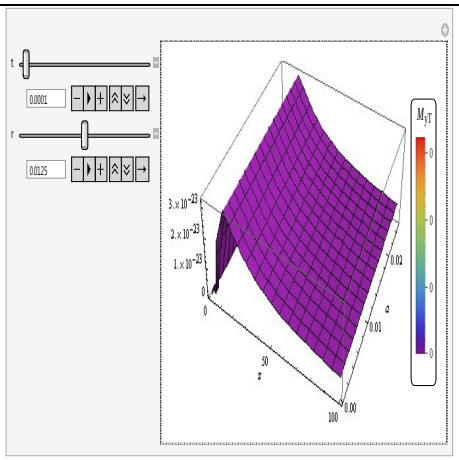


Figure 3c: Magnetization (My) against time (t = 0.0001 sec.) when blockage is half the radius (r = 0.0125m)

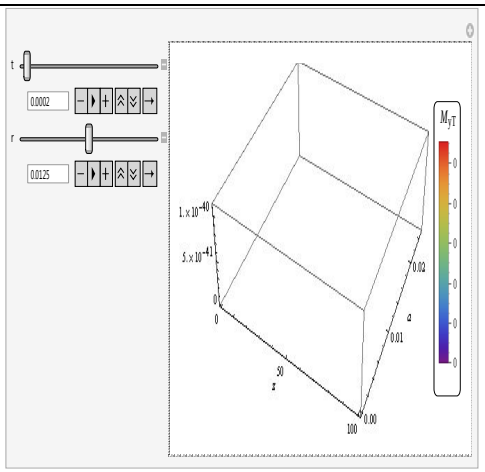


Figure 3d: Magnetization (My) against time (t = 0.0002 sec.) when blockage is half the radius (r = 0.0125m)

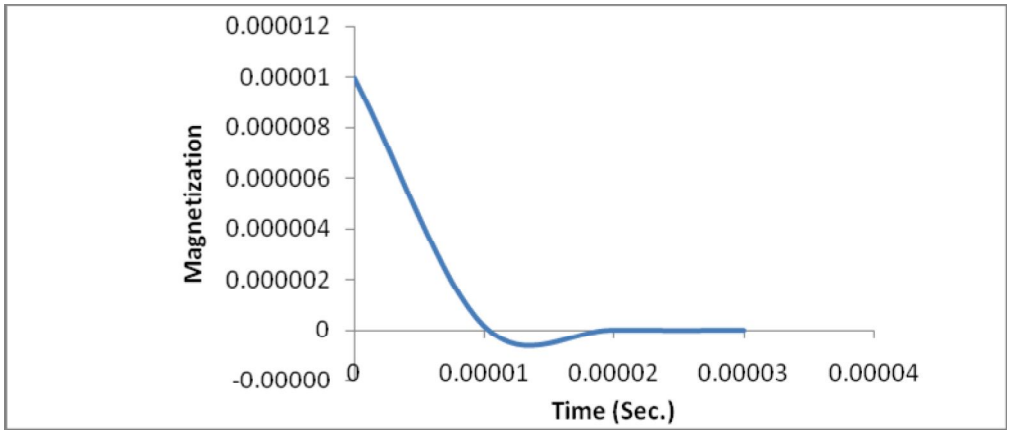


Figure 3e: Flow in a Cylinder of Unused Engine Oil When the Blockage is half its Radius (Partial Blockage)

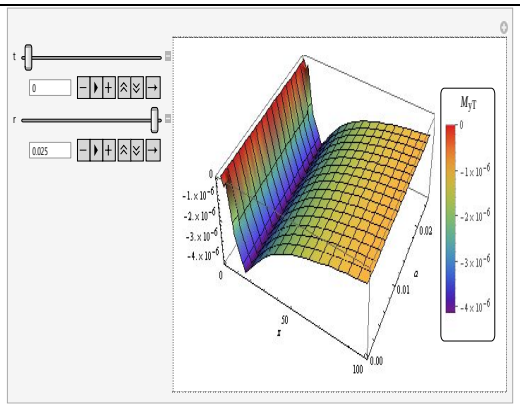


Figure 4a: Magnetization (My) against time (t = 0sec.) when there is total blockage (r = 0.025m)

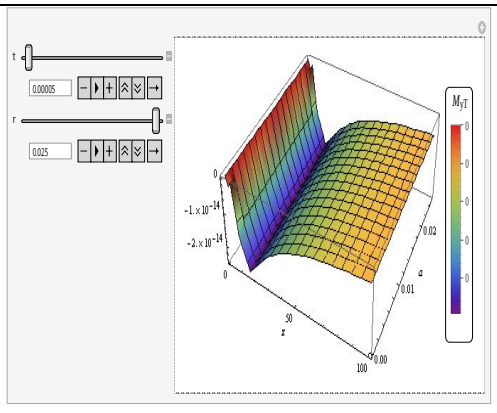


Figure 4b: Magnetization (My) against time (t = 0.00005 sec.) when there is total blockage (r = 0.025m)

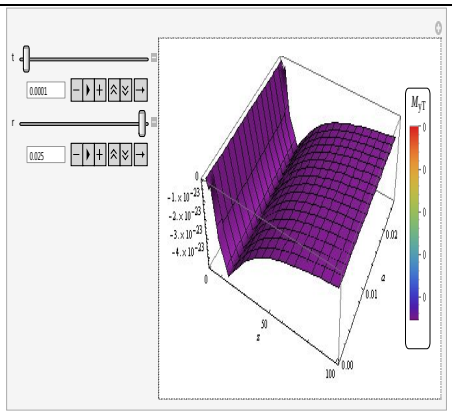


Figure 4c: Magnetization (My) against time (t = 0.0001 sec.) when there is total blockage (r = 0.025m)

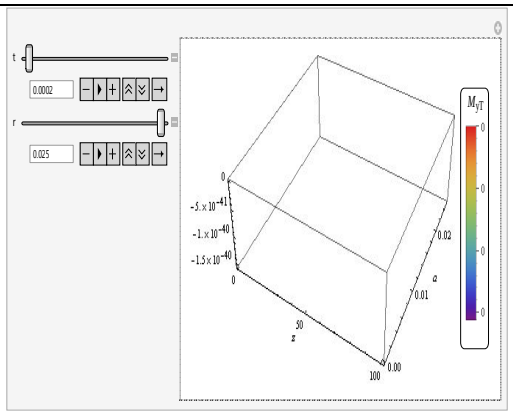


Figure 4d: Magnetization (My) against time (t = 0.0002 sec.) when there is total blockage (r = 0.025m)

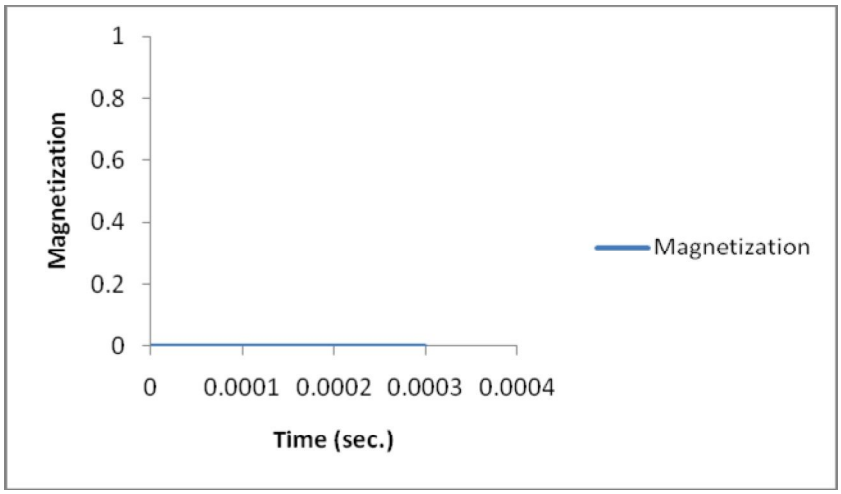


Figure 4e: Flow in a cylinder of unused engine oil when there is total blockage

Conclusion

We have developed a mathematical procedure for detailed analysis of fluid flow in a cylindrical pipe based on the analytical solution of the Bloch NMR diffusion equation with appropriate boundary conditions. The simple analytical solution obtained contains very important magnetic resonance flow parameters which can be useful for the non invasive analysis of flow in fluid leakages and oil spill. For example, the free induction decay (FID) is demonstrated signifying no blockage and the magnetization is between 0.004 - 0.005. Under partial blockage, the magnetization reduces (signal loss) in value to 0.00001 and for total blockage it is 0.0. This may lead to quick identification of problems whenever it arises so as to elicit immediate control and solution before much damage is done. The analysis can also be useful in process industries where different network of pipes are used or machines that use cylindrical pipes or tubes in transporting materials especially when there is a partial or total blockage at any point in the network.

It is noted with keen interest that this study focused on the assessment of degree of blockage in a cylindrical pipe. However, an anomaly may occur that blockage or plaque size may not always be the only determining factor in the assessment of degree of blockage; plaque composition can be a more significant determinant than plaque size. Thus, risk may correlate more closely with plaque morphology and surface features than with size. This

possibility emphasizes the importance of developing non-invasive imaging methods for characterizing plaque morphology and composition in addition to determining area and wall thickness. This possibility will be studied in details in our next investigation especially as applied to gas and oil industry.

References

Awojoyogbe, O. B., Faromika, O. P., Dada, M., & Dada, O. E. (2011). Mathematical concepts of the bloch flow equations for general magnetic resonance imaging: A Review. 38A (3) 85 - 101.

Duer, M. J. (2004). *Introduction to solid-state NMR spectroscopy.* Blackwell Publishing, p. 43 - 58.

Hazlewood, C. F., Chang, D. C. & Nichols, B. L. (1974). Nuclear magnetic resonance relaxation times of water protons in skeletal muscle. *Biophys J.,* 14, 583 - 606.

Hopf, F. A., Shea R. F. & Scully, M. O. (1973). Theory of optical free-induction decay and two-photon super radiance. *Adsabs.harvard.edu,* 7(6), 2105 – 2110. Bibcode: 1973 PhRvA 7.2105H. doi:10.1103/ *Physical Review* A., 7. 2105.

Mohapatra, P., Chaudhry, M., Kassem, A., & Moloo, J. (2006). Detection of partial blockage in single pipelines. *J. Hydraul. Eng.*, 132(2), 200 – 206.

Sattar, A., Chaudhry, M., & Kassem, A. (2008). Partial blockage detection in pipelines by frequency response method. *J. Hydraul. Eng.*, 134(1), 76 – 89.

Torrey, H. C. (1956). Bloch equations with diffusion terms. *Physical Review*; 104 (3), 563 - 565.

Waldo, S. H. & Arnold, H. L. (1983). An introduction to NMR imaging: From the bloch equation to the imaging equation. P*roceedings of the IEEE,* 71, 3.

Wang, X., Lambert, M., & Simpson, A. (2005). Detection and location of a partial blockage in a pipeline using damping of fluid transients. *J. Water Resour. Plann. Manage.*, 131(3), 244 – 249.

Yuan, T., Xuefen, Z., Dan, T., Rui W., & Huan T. (2014). *Applied mechanics and materials,* 490 - 491. Trans Tech Publications, Switzerland Doi:10.4028/www.scientific.net/AMM, 490 - 491.

Yusuf, S. I., Aiyesimi, Y. M. & Awojoyogbe, O. B. (2010). An analytic investigation of bloch nuclear magnetic resonance flow equation for the analysis of general fluid flow. *Nigerian Journal of Mathematics and Applications,* 20, 82 – 92.

JOSTMED, VOLUME 11(3), DECEMBER, 2015

ARTICLES AND RESEARCH REPORTS ON EDUCATION

ASSESSING THE IMPACT OF STUDY HABIT AND GENDER ON SCIENCE ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN KATSINA STATE, NIGERIA

OLUTOLA, ADEKUNLE T. (Ph.D) & DOSUNMU, SIMEON A. (Ph.D)
Department of Educational Foundations,
Faculty of Science and Education,
Federal University, Dutsin-Ma, Katsina State, Nigeria.
E-mail: aolutola@fudutsinma.edu.ng, Simipure@yahoo.com
Phone No: +234-806-029-7940; +234-809-785-0451

Abstract
This study assessed the impact of study habit and gender on science achievement of secondary school students in Katsina State. The researchers adopted descriptive survey research design for the study. Two hundred and eighteen (218) senior secondary school students' in Katsina State were randomly selected for the study. A researchers' designed questionnaire titled "Students' Science Achievement Test and Study Habit Questionnaire" (SSATASHQ) with Cronbach's Alpha show a reliability test coefficient of 0.81 was used to collect data for the study. Analysis of data was carried out using regression, t-test and Pearson correlation coefficient statistics at 0.05 alpha level. Findings revealed that there is significant combine relative effect of study habit and gender on science achievement of secondary school students in Katsina State; there is significant difference between gender and students science achievement and there is significant relationship between students' study habit and science achievement. Based on these findings, it was recommended that teachers and parents should assist the students to cultivate effective study habit in other to improve their achievement in science subjects in Nigerian secondary schools. Also, Government should provide reinforcement to motivate the students to improve their study habit.

Keywords: *Assessing, Gender, Science Achievement, Study Habit*

Introduction
Science and Technology have been at the centre stage of every field of life including education. It is important for national development and educational attainment. Science is an organized body of knowledge that involves concepts, laws, theories and generalizations. Urevbu (2001) defines science as a study of nature and natural phenomena in order to discover their principles and laws. Students' academic achievement of an individual student in the school system is an important aspect in teaching and learning process. Assessing the factors affecting the students' achievement in science subjects is crucial to the development of science education in any nation, Nigeria inclusive.

Assessment can be seen as all activities undertaken by teachers and by their students in assessing themselves, which provides information to be used as feedback to modify the teaching and learning activities in which they are engaged (Black & William, 1998). Anikweze (2013) explains assessment to include teacher, peer and self-assessment processes where the goal is to develop new models of assessment geared to fostering life-long skills. Assessment is a major instrument in the process of appraising candidates' or students' achievement in the school system. One of the ways of assessing students is through the use of test or examination.

Examination is a frequently used assessment tool which provides indices for students' achievement. Students' academic achievement is considered as a key criterion to judge one's total potentialities and capacities which are frequently measured by the examination

results (Nuthana & Yenagi, 2009). It is used to pass judgement on the quality of education offered in the school. Students' achievement has been the focus of discourse in education worldwide. Students' achievement is important in the school system and any factors or variables that can make or mar this must be investigated. The performance of students in Senior Secondary Sciences in Nigeria has remained an issue of concern to all stake holders (Ajagun, 2000). Adebule (2004) submitted that there is a consensus of opinion about the fallen standard of education in Nigeria. He further stated that parents and government are in total agreement that their huge investment on education is not yielding the desired dividend. Teachers also complain of students' low performance at both internal and external examinations (Asikhia, 2010). The keys to better learning and better academic achievement in schools are good teachers, good study environment, course of study, parents' cooperation, high quality books and, the most important, the study habits (Robinson, 2000). It is important to note that, for academic achievement, being smart is more important than being intelligent and hardworking, but involves being practical, having common sense, using better organization and application of good study habits (Clark, 1996).

Azikwe (1998) describes study habit as the adopted way and manner a student plans his private readings, after classroom learning, so as to attain mastery of the subject. Study habits determine the academic achievement of students to a great extent and students can have good or bad study habits. Students with poor study habits has chance to fail, compare with students who has good study habit. Good study habits act as a strong indicator for the students to excel in life, if students do not possess good study habits they cannot excels in life (Amandeep & Raj, 2015). Lawrence (2014) in his study revealed a non-significant difference between study habits and academic achievement of higher secondary school students. Rusell and Petrie (1992), Onwuegbuzie, Slate and Schwartz (2001) and Singh (2011) studies revealed that there is positive correlation between study habit and academic achievement of elementary, secondary and college students. Amandeep and Raj (2015) noted that there is highly significant relationship between study habits and students' academic achievement.

Study habit can be measured directly through assessment, inventories, reports, examinations and rating scales. Study habit can be the students' way of study whether systematic, efficient or inefficient. It literally means that good studying habit produces positive academic performance while inefficient study habit leads to academic failure (Ayodele & Adebiyi, 2013). Good students are not born but are made by constant and deliberate practice of good study habits, for which there is no substitute (Ames & Archer, 1988). Many students are not performing very well in the school not because they lack ability, but because they do not have adequate study habits. Study habit is the tendency of a student to learn in a systematic and efficient way, when opportunity is given (Rana and Kausar (2011). Nuthana and Yenagi, (2009) found significant correlation between study habits and academic achievement. It further revealed that reading and note-taking habits, habits of concentration and preparation for examination had significant correlation with academic achievement.

De-Escober (2011) observed that students need to be familiar with the relation of good study habits and academic achievement to accomplish great success in any level of education. According to Nneji (2002) study habits are learning tendencies that enable students work privately. Crede and Kuncel (2008) noted that study habits denote the degree to which the student engages in regular acts of studying that are characterised by appropriate studying routines (for instance, reviews of material) occurring in an environment that is conducive to studying. Thus, in order to improve academic performance of students, it seems essential to improve their study habits without which desired outcomes cannot be

achieved. Development of good study habits in children depends upon the combined efforts of parents and teachers (Kizlik, 2001). Gettinger and Seibert (2002) stated that students, who demonstrate poor study habits, are most likely the ones to have low academic achievement. Having good study habits could reduce the failure rate within educational institutions since studying tends to increase a student's academic ability (Gettinger & Seibert, 2002). Garner-O'Neale and Harrison (2013) in their study discovered that those students with poor study habits achieved relatively the same grades as those students with good study habits for the group theory test that were taken. They further noted that one would think that those with better study habits would have scored higher on the test but a student may possess average good study habits but it is possible that he/she is lacking in a particular area. This shows that study habits may affect male and female students positively or negatively in Nigerian schools.

The issues of gender on students academic achievement in science subjects has become the global debate. Gender refers to the social meanings associated with being a male or a female, including the construction of identities, expectations, behaviours and power relationships that derive from social interactions (Ambe-Uva, Iwuchukwu & Jibrin, 2008).

Some researchers have reported their findings on male and female performance in science subjects. Aremu (1999) reported that boys are better than girls in Mathematics and other science subjects Okwo and Otunba (2007) revealed that boys performed better than girls in physics essay test. Gender differences in science achievement on the National Assessment of Educational Progress (NAEP) and science courses taken between boys and girls in United States of America (USA) were minimal (Coley, 2001). Raimi and Adeoye (2002) in their study on gender differences among college students as determinants of performance in integrated science found out that there is significant difference between male and female students in terms of their science achievement. However, the findings showed that males performed better than their female counterparts in integrated science achievement scores. Olasehinde and Olatoye (2014) reported that there is no significant difference between male and female students in science achievement. This is against the finding of Aremu, (1999); Okwo and Otunba, (2007); Raimi and Adeoye, (2002) that reported significant difference between male and female students in science achievement. Olatoye and Agbatogun (2009) reported that there is no gender difference in science. This is in agreement with Bhan and Gupta (2010) who found that gender had no significant impact on the study habits and academic achievement of students.

Based on these findings, it is important to assess the effect of study habit and gender on science achievement among secondary school students. This study therefore assessed the effect of study habit and gender on science achievement of secondary school students in Katsina State.

The purpose of this study is to assess the relative effects of study habits and gender on science achievement of secondary school students in science subjects. The combine effect of study habit and gender were analyzed by the researchers.

Research Hypotheses

(i) There is no significant combine relative effect of study habit and gender on science achievement of secondary school (SS) students' in Katsina State.
(ii) There is no significant difference between gender and science achievement of secondary school (SS) students' in Katsina State.
(iii) There is no significant relationship between students' study habit and science achievement in Katsina State.

Research Methodology

The researchers adopted a descriptive survey research design. The population of this study consists of all the secondary school students in Katsina State while the target population is made up of all the science class of senior secondary school in Katsina State in 2014/2015 academic session. A total of two hundred and eighteen (218) students were selected using simple random sampling techniques. All the students selected participated in the study. The researchers' designed questionnaire titled "Students' Science Achievement Test and Study Habit Questionnaire" (SSATASHQ) was used to collect the data. The questionnaire was divided into three sections namely: Section A contained personal information of the respondents such as name of school, gender, school type and age. Section B contained twelve items on study habit with a four-point Likert-type rating scale of Strongly Agree, Agree, Disagree and Strongly Disagree while Section C contained 40-items multiple choice objective test (students' science achievement test) with four options for each item. The items covered the topics on science subjects (Mathematics, Biology, Chemistry and Physics) syllabus. Expert's judgment was used in validating the instrument. The Cronbach alpha reliability coefficient of 0.81 was obtained for the instrument. Collected data were analyzed based on hypotheses formulated for the study. Linear regression was used to analyze hypothesis 1, while hypothesis 2 and 3 were analyzed using *t*-test and Pearson Correlation Coefficient statistics respectively. All the hypotheses were tested at 0.05 alpha level of significance.

Results

Hypothesis 1: There is no significant combine relative effect of study habit and gender on science achievement of secondary school (SS) students' in Katsina State.

Table 1: Regression analysis showing combine relative effect of study habits and gender on science achievement of secondary school (SS) students

R=0.299
R Square = 0.089
Adjusted R Square = 0.081
Standard Error = 3.815
Analysis of Variance

	Sum of Square	df	Mean Square	F	P	Remark
Regression	307.140	2	153.570	10.552	.000	Significant
Residual	3128.989	215	14.553			
Total	3436.128	217				

Significant (P<0.05)

Table 1 shows that study habits and gender accounted for 8.9% of the total variance in science achievement test (R square = 0.089, P<0.05). Thus, this percentage showed to be statistically significant. Therefore, study habits and gender have significant relative effect on science achievement of secondary school (SS) students' in Katsina State. Thus, hypothesis one is rejected.

Hypothesis 2: There is no significant difference between gender and science achievement of secondary school (SS) students' in Katsina State.

Table 2: t-test summary of difference between gender and science achievement of secondary school (SS) students' in Katsina State

Variable	N	X	SD	df	Cal.t-value	P	Remark
Male	95	10.6947	4.4889				
				216	4.181	.000	Significant
Female	123		3.2451				
		8.5041					

Significant (P<0.05)

Table 2 reveals that there is significant difference between gender and science achievement of secondary school (SS) students' in Katsina State (t-value of 4.181, P<0.05). This implies that gender is an important factor that can influence science achievement of secondary school (SS) students' in Katsina State. Therefore, hypothesis 2 is rejected.

Hypothesis 3: There is no significant relationship between students' study habit and science achievement.

Table 3: Showing Correlation between Students' Study Habit and Science Achievement

		Science Achievement	Study Habits
Science	Pearson Correlation	1	.161*
Achievement	Sig. (2-tailed)	_	.017
	N	218	218
Study Habits	Person Correlation	.161*	1
	Sig. (2-tailed)	.017	-
	N	218	218

Note: Positively significant (P<0.05) correlated and significantly related.

Table 3 shows that there is significant relationship between students' study habit and their science achievement (correlation co-efficient r = 0.161, P = 0.017). Therefore, hypothesis three was rejected. Thus, students' study habit is positively related to their science achievement. Hence, increases in students' study habit will improve their science achievement.

Discussion

The findings of this study revealed that there is significant combine relative effect of study habit and gender on science achievement of secondary school students' in Katsina State. This implies that students' level of study habit and their gender can determine achievement in science subjects including mathematics.

The study discovered that there is significant difference between gender and science achievement of secondary school (SS) students' in Katsina State. This finding was supported by the findings of Okwo and Otunba, (2007); Raimi and Adeoye, (2002) that reported significant difference between male and female students in science achievement. But oppose the study of Olatoye and Agbatogun (2009) and Olasehinde and Olatoye (2014) reported that there is no significant difference between male and female students in science achievement that is there is no gender difference in science. It also negates Bhan and Gupta (2010) who found that gender had no significant impact on the study habits and academic achievement of students.

The study further shows that there is significant relationship between students' study habit and science achievement. This finding supported Amandeep and Raji (2015) finding that reported highly significant relationship between study habits and students' academic achievement. The finding also supported Rusell and Petrie (1992), Onwuegbuzie, Slate and Schwartz (2001) and Singh (2011) studies which revealed that there is positive correlation between study habit and academic achievement of elementary, secondary and college students. This contradicts Lawrence (2014) that revealed a non-significant difference between study habits and academic achievement of higher secondary school students. Therefore, study habit and gender are important variables in predicting students' science achievement.

Recommendations

From the findings of this study, the researchers recommended that:

(i) Teachers and Parents should assist the students to cultivate the effective study habit in other to improve their achievement in science subjects in our secondary schools.
(ii) Government should provide reinforcement to motivate students to improve their study habit.
(iii) School heads and teachers should discourage laziness among the students and mass promotion of students must be discouraged.
(iv) There should be a proper monitoring of male and female students study habit by teachers in our secondary schools.

References

Adebule, S. O. (2004). Gender differences on a locally standardized anxiety rating scale in mathematics for Nigeria secondary school. *Nigeria Journal of Counseling and Applied psychology 1(1) 22-29.*

Ajagun, G. A. (2000). A study of the performance of students in the senior secondary school certificate examination in selected schools in Kano State. Tambori: *Kano Journal of Education 6(1), 10 - 21.*

Amandeep, K. & Raj, P. (2015). Study habits and academic performance amomg late adolescents. *Stud. Home Com Sci,* 9(1), 33 - 35.

Ambe-Uva T. N., Iwuchukwu, O. & Jibrin L. J. (2008). Gender analysis in national open university of nigeria (NOUN): implication and policy issues in bridging the divide. *Journal of Applied Science Research,* 4 (7), 814 – 825.

Ames, R., & Archer, J. (1988). Achievement goals in the classroom: students learning strategies and motivation process. *Journal of Psychology,* 80, 260 - 267.

Anikweze, C. M. (2013). *Assessment Practices and the Challenges of Innovations in Nigerian Education.* Being a Paper Presented at an Institutional Seminar Organized by the Joint Admissions and Matriculation Board (JAMB), Abuja on 3rd September, 2013 at the JAMB Auditorium.

Aremu, S. A. (1999). *Games and primary school pupils' achievement in some aspect of Geometry.* Unpublished Ph.D Thesis, Department of Teacher Education, University of Ibadan, Ibadan.

Asikhia, D. A. (2010). *Students and teachers' perceptions of the causes of poor academic performance in Ogun state secondary schools (Nigeria): Implication for counseling for national development.* Retrieved from http://www.eurojournal.com/ejss on august 28th, 2010.

Ayodele, C. S. & Adebiyi, D. R. (2013). Study habits as influence of academic performance of university undergraduates in Nigeria. *Research Journal in Organizational Psychology and Educational Studies,* 2(3), 72 - 75. Available at *www.emergingresource.org.*

Azikwe, U (1998). Study approaches of university students. *World Council of Curriculum and Instruction (WCCI), Region II Forum,* 2, 106 - 114.

Bhan, K. S. & Gupta, R. (2010). Study habits and academic achievement among the students belonging to scheduled caste and non-scheduled caste group. *Journal of Applied Research in Education,* 15(1), 1 - 9.

Black, P. & William, D. (1998). *Inside the black Box: raising standards through classroom assessment.* Phi Beta: Kappan.

Clark, D. (1996). *Schools as learning communities*. London: Cassell, Wellington House Preface.

Coley, R. (2001*). Differences in the gender gap: Comparisons across racial/ethnic groups in education and work (policy information report*). NJ: Educational Testing Service. Princeton.

Crede, M. & Kuncel, N. R. (2008) Study habits, skills and attitudes: The third pillar supporting collegiate academic performance. *Perspectives on Psychol. Sci.,* 3(6), 425 - 453.

De Escobar, U. M. (2011). *Good study habits and academic achievement walk hand in hand.* Retrieved on 4th February, 2013 from: http://ezinearticles.com? Expert = Venonica M. De-Escobar.

Garner-O'Neale, L. D. & Harrison, S. (2013). An investigation of the learning styles and study habits of chemistry undergraduates in Barbados and their effect as predictors of academic achievement in chemical group theory. *Journal of Educational and Social Research,* 3(2), 107 - 122.

Gettinger, M., & Seibert, J. K. (2002). Contributions of study skills to academic competence. School Psychology Review, 31(3), 350 - 365. Retrieved from http://www.wce.wwu.edu/Depts/SPED/Forms/Kens%20Readings/Instruction/Instruct%20Contributions%20of%20study%20skills%20Gettinger%202002.pdf

Kizlik, R. D. (2001). *ABC of academic success*. London: Harper & Co.

Lawrence, A. (2014). Relationship between study habits and academic achievement of higher secondary school students. *I J Applied Research,* 4(6), 143 - 145.

Nneji, L. (2002). Study habits of nigerian university students in quality conservations. *Proceedings of the 25th HERDSA Annual Conference, Perth, Western Australia, 7-10 July, 2002: PP: 490/ Available e-http//www.herdsa-org.n/wp-content =/uploads/conference/2002/paper/Nneji.pdf.*

Nuthana, P. & Yenagi, G. (2009). Influence of study habits, self-concept on academic achievement of boys and girls. Kartanaka Journal of Agricultural Science, 22, (5), 1135 - 1138.

Okwo, F. A. & Otunba, S. (2007). Influence of gender and cognitive styles in science achievement in physics essay test. *Journal of Science Teachers Association of Nigeria,* 42 (1&2), 85 - 88.

Olasehinde, K. J. & Olatoye, R. A. (2014).Comparison of male and female senior secondary school students' learning outcomes in science in Katsina State, Nigeria. *Mediterranean Journal of Social Sciences MCSER Publishing, Rome-Italy,* 5 (2), 517 - 523.

Olatoye, R A. & Agbatogun A. A. (2009). Parental involvement as correlates of pupils' achievement in mathematics and science in Ogun state, Nigeria. *Educational Research and Review,* 4(10), 457 - 464.

Onwuegbuzie A. J., Slate, J. R., Schwartz, R. A. (2001). Role of study skills in graduate level educational research courses. *The Journal of Educational Research,* 94(4), 238 - 246.

Oxford Dictionary & Thesaurus of English Language (2003). *Oxford*: Oxford University Press.

Raimi, S. A. & Adeoye, F. A. (2002).Gender difference among college students as determinant of performance in integrated science. *African Journal of Educational Research,* 8(1&2), 41 - 49.

Rana, S. A. & Kausar, R. (2011). Comparison of study habits and academic performance of Pakistani British and white British students. *Pakistan Journal of Social and Clinical Psychology,* 9, 21 - 26.

Robinson, H. H. (2000). *Effective study.* New York: Harper and Brothers.

Russell, R. K. & Petrie, T. A. (1992). Academic adjustment of college students: Assessment and counseling. In Steven D Brown, Robert W Lent (Eds.): *Handbook of Counseling Psychology*. New York: Wiley.

Singh, Y. G. (2011). Academic achievement and study habits of higher secondary students. *International Referred Research Journal,* 3(27), 19 - 20.

Urevbu, A. O. (2001). *Methodology of science teaching*. Lagos: Juland Education Publishers.

NATIONAL POLICY ON EDUCATION AND CHALLENGES OF IMPLEMENTATION

HASATU ABDULLAHI UMAR GANDUJE, Ph.D.; WUNTI YAKUBU IBRAHIM, Ph.D & IGBAJI CLEMENT, Ph.D
Department Education, Bayero University, Kano
E-mail: Hafsatmohd@yahoo.com, yakubuibrahim@yahoo.com, clementigbaji@gmail.com
Phone No: +234803-323-1925, +234-807-599-1701, +234-803-207-6249

Abstract
It has been recognized globally that education has become a political agent for knowledge certain values, norms and attitudes in individuals. It is a process of transmitting knowledge and skills from one generation to another. It is also a political agent, used for either preserving the stands-quo or promoting change. Polities through its leadership is meant to touch live of influencing peoples' feeling and behavior; through its policies and programmes. Political leadership, especially under a democratic dispensation, is expected to formulate, implement and oversee government's policies, projects and programmes that will positively impact in the citizens, for the purpose of achieving national objectives. This paper examined policies in education policies and programmes implementation, with specific reference to Nigerian education system; its influence on national policy on education, universal basic education, admission into tertiary institutions, Quota system and among others. A brief background educational policy in Nigeria was discussed. the interference of government into critical issues and policies has become a source of certain to educational administrators. It seems education has become a political weapon employed by a successive government in Nigeria to support or favour from its people. Thus, it si imperative to examine this interface between political system and education policy and programme implementation, the paper among others recommended that government and its agencies involve in education delivery must carefully sever politics from education, in order to achieve the goals and objective of the national policy on education.

Keywords: policies, education and programmes implementation, political leadership, national policy on education.

Introduction
Education is a tool for the acquisition of skills, relevant knowledge and habits for surviving in the changing world (Adepoju, 2007) it is a medium through which positive transformation takes place in an individual and society. That is why the opening statement of the national policy on education maintains that "education in Nigeria is an instrument for excellence affecting national development "(Federal Republic of Nigeria 2004) education is also a process of acquiring new values and skills for the purpose of effective functioning in the society. In the view of Dickson (1985). education involves a pedagogical process, which if properly carried out should lead to the maturing of the person who has received it, to the extent that he/she is in a position to think and act meaningfully and in relevant interaction with members of society for their mutual benefit.

Education teaches values and norms for peaceful living in the society, which enhances political institutions and system. In return, education gains from the political system of the day through the government or political leadership in power. Hence, education has been recognized globally as a political agent for inculcating certain values, norms and attitudes in people. It can also be used for preserving the status-quo and promoting change, depending on who plans it, how it is planned and how it is used. Politics on the other hand is about formulating visions and finding ways to achieve them, which entails setting goals and mobilizing resources to attain them (Hernes, 2002), It is difficult, if not impossible, to

exclude political system from formulation and implementation of public policies and programmes. This is in agreement with Nwagwu's (2002) view that it may be impossible to exclude politicians and political influence from the policy making process in education, since the education system is a public enterprise funded by government. Furthermore, Olubor (2004) stated that "as is the State so is the school" and "What you put in the state, you must put in the school".

This paper examined politics in education policies and programmes implementation. Politics and political leadership is good because man is not only a social being but also a political being. Politics and education are in a circular fashion; therefore, politics should aid the actualization of education goals und objectives through policies and programmes implementation.

There are many areas of our education policies and programmes implementation that have been influenced by politics. These areas cannot he exhausted in a publication like this. Areas to be examined in this paper are:

(i) Brief Background of educational Policy in Nigeria;
(ii) Politics of educational imbalance in policies and programmes implementation;
(iii) Politics in National Policy on Education implementation;
(iv) Politics in the policy and implementation of the quota system;
(v) Politics in policy of university admission; and
(vi) Politics in policy of establishment of educational institutions.

Brief Background of Educational Policy in Nigeria

The first major intervention in education policy and programme in Nigeria by the government was the promulgation of the 1882 Education Ordinance by the colonial government (Fafunwa, 1974). It was aimed at introducing control and supervision into the educational work in British West African territories, including Lagos, following the separation of Lagos colony from Gold Coast in 1886. When it became necessary that a purely Nigerian education ordinance be enacted, a new ordinance was enacted in 1887 to consolidate and amend the law relating to the promotion of education in the colony of Lagos. This was the first effective attempt by government to promote education and control the funds and sporadic expansion of education by missions (Taiwo, 1980).

In 1920, Phelp Stokes Fund, U.S.A. in co-operation with the International Education Board, set up a commission to study education in West, South and Equatorial Africa. The commission published its report in 1922 after a tour of these areas. Based on the findings and recommendations of the commission, the 1925 Memorandum on Education Policy in British Tropical Africa was published. This was a comprehensive policy statement, which identified the principles, aims and objectives of British colonial education in Africa (Fafunwa, 1974). The 1925 colonial education policy was translated into action in Nigeria by Sir Hugh Clifford, the country's governor in 1926 as Education Ordinance.

A report of the Director of Education appointed in 1944 and Sir Sydney Phillips on report on the procedure for assessing grants-in-aid of 1948 led to the promulgation of the 1948 Education Ordinance, which encouraged the establishment of local education committees and Local Education Authorities (Phillipson, 1948 in Fafunwa, 1974). The concern for raising the standard of work in schools in order to control expansion led to the promulgation of the 1952 Education Ordinance. The ordinance reflected the Macpherson constitution of 1951.

The need for a National Policy on Education arose from the National Curriculum Conference of 1969 which was a culmination of expressions of dissatisfaction from generality of

Nigerians with the existing education system. To many, it had become irrelevant to national needs, aspirations and goals. So in 1973, experts from a wide range of interest groups convened a seminar to deliberate on what a National Policy on Education for an independent and sovereign nation like Nigeria should be. The outcome of the seminar was a draft which after due consultation with stakeholders led to the final document tilled, National Policy on Education. Since then, other editions (2nd, 3rd and 4th) have been published. The 4th was slightly modified in line with current global trend. However, the most outstanding addition to the 2004 policy was the 9-3-4 education structure.

Politics in National Policy on Education implementation

Human conduct is generally governed by what is sometimes loosely referred to as "policy" (Echikweonye & Beetseh, 2011). Olubor (2004) pointed out that education policy like any other policy is dynamic and is reviewed to take care of the exigencies of the moment and the unanticipated. She added that what is most apparent in all of these is that both the content and structure of schooling reflect the structure of the political power and domination, and as such serve the programmes and goals of political regime. On the other hand, an educated citizenry to an extent is expected to either act independently of the political system or at least imposes certain restraints on the system (Fagerlind & Saha, in Olubor, 2004).

The current policy n education was derived from the 1999 Constitution policy directives on education, which states as follows:

(i) free, compulsory and Universal primary education;
(ii) free secondary education;
(iii) free university education; and
(iv) free adult literacy programme.

The Universal Basic Education (UBE) was different in policy from the military government policy of National primary Education. The most important objectives of the Universal Basic Education programme is the provision of free, compulsory and universal education for every Nigerian child. Beautiful as this objective may be, it has generated political conflict among different tiers of government in Nigeria.

The UBE law stipulates that every government in Nigeria should provide compulsory, free and universal education from primary to junior secondary school. It has been discovered that some States, especially in the southern part have not been able to provide a holistic UBE programme to its citizenry because they do not have the resources and infrastructures or the programme has been politicized. It appears some States, are playing politics with the UBE programme, especially during electioneering period. The inability of some States to access the UBE fund is more of politics than logistic problem. for any State to qualify for the Federal Government block grant, it must have contributed not less than 50% of the total cost of the project as its commitment to the execution of the project (FRN 2000).

Some States, whether deliberately or not, have not been able to pay their counterpart funding until recently. It appears some State governors are objecting to the modality on counterpart funding and sharing. They want the federal government to bear the bulk of the cost and give contributions to States without conditions attached. The reason for this being that some States have different political objectives, and the general belief that politicians or all tiers of government want to have control of primary education.

Another area of politics in the implementation of UBE programme is while the Federal government through Universal Basic education commission (UBEC) and Federal Inspectorate

Service (FIS) monitor and evaluate Federal and States' involvement in the implementation of the programme, can States monitor or evaluate federal government and possibly sanction her if she err or default? These are the reasons why States arc not forthcoming in implementing some aspects of the National Policy of Education and universal Basic Education programme.

Politics in the Policy of Quota System

The policy of Quota system was approved in order to bridge the gap in the level of education between northern and southern part of Nigeria so as to create education parity. During the missionary and colonial involvement in education there was no quota system. Federal character, educationally advantaged or educationally backward states in the education system. The policy of quota system especially in admission into university establishment of higher institutions and appointment of principal officers of Federal institutions crept into the system in the late 1970s. These policies were aimed at addressing ethnic representation in the public sector.

There are two schools of thought on the side of polities in admission process in Nigeria. One school of thought argued that quota system has created hatred and inequality among Nigerians (Lassa, 2014). TGheyt added that quota system, federal character, catchment areas and educational disadvantaged and advantaged States have caused polarization of citizens. For example, an Ibo man who felt his child has been denied admission based on quota system will not see Hausa man whose child gained the admission, even with a lesser score as his brother Ogbemudia (2004) corroborated this view when he explained that while these measures, protected certain areas, they brought hardship on others, suppressing the bright ones. He added that while it lowered standards, in the protected areas, it heightened same in other areas, thus introducing disparity and dichotomy that have since festered into other spheres, breeding social discord and despoiling the moral fiber guiding society. He asked some questions, namely; firstly, if education is so integral to the life of a man, why restrict access to it? Secondly, why impose conditions and erect hurdles and barriers on a person's way to attaining formal education? Thirdly, is quota system still relevant in our educational placement in a democratic society like Nigeria?

Another school of thought quoted the constitution of Nigeria (since 1979 to present version) as making provisions for Quota System. Aduje (2009) quoted that in a plural society like Nigeria, all citizens should feel a sense of equal voice, equal representation and equal participation. Diversity needs to be actively and purposely encouraged and even legally enforced, so that all Nigerians and Nigeria will be the beneficiaries of such good policies that encourages the grooming and nurturing of opportunities for all. He added that all States, but especially the educationally disadvantaged States, need special provisions and protections in the admission process in Nigeria's education system, especially in higher education.

My take on this is let there be good policies that will favour all Nigerians, devoid of political consideration but based on natural justice, fairness and equity Good public policies will lead to progress, development and advancement of Nigeria, for our collective benefit.

Politics in the Policy of University Admission

The discrepancies and imbalance in admission into university led to the establishment of the Joint Admission Matriculation Board (JAMB) in 1977, though the decree was given effect in 1978, AS a central body for entrance and admission into tertiary institutions (Ivowi, 2014). This policy of central admission was meant to take into account State of origin, geographical area (to determine educationally advanced or educationally backward States). JAMB was set up following the acceptance by the Federal Government of the recommendations of the

committee who considered the possibility of setting up a joint matriculation board; which itself was set up by the Committee of Vice-Chancellors of Nigerian Universities to examine the .system of admission in Nigerian Universities (Ivovi, 2014).

The politics in this policy is that admission into tertiary institutions, especially university, which should be on merit or academic excellence has been subjected to political consideration. But Aduje (2009) believed that 'merit" is not the exclusive preserve or monopoly of any particular region of Nigeria; culture/environment and available opportunities and exposure have a great deal to do with what any human being attains to achieve or accomplish in Nigeria and outside it. It is the superiority of nurture over nature.

It has been alleged that JAMB is forced to lower scores in order to accommodate and admit students from some States, it is sad to note that politics in the admission policy creates educational imbalance, backwardness in some States, disintegration, repress or stifle academic freedom and gradually remove the autonomy of university. Another twist in the admission process in Nigeria is the issue remedial programme. While it is very operational and allowed in some States, it is not in existence in some States. Lassa (2014)

Opined that for some political reasons, new academic criteria are being established to circumvent traditional mode of acquiring academic qualifications into universities. Added that if remedial programmes were meant to remedy some deficiency at Senior School Certificate Examination, then, the students should be expected to re-take their deficiency before taking the UTME. But what we see today is that students use remedial result to gain admission into the university (directly) without writ lag the UTME. Secondly the result of remedial programme of one university is not accepted by another university.

Implementing education policies and programmes is a critical and conscious activity or process because they are the products of decision making process which determined the thrust of development and changes in the education system. Nwagwu (2004) postulated that political considerations can therefore critically determine not only how decisions should be made but what decisions should be made and as such partisan leadership is often forceful in demanding concessions and preferential treatment in policy and decision making. She added that in education, the fear of political intimidation is real; therefore politicians and top government officials are usually allowed not merely to influence decision, but also to determine what policies exist.

Politics in the Implementation of Policy on Establishment of Educational Institutions

The 1999 constitution of (The Federal Republic of Nigeria put education under the concurrent list, meaning that the Federal, State and Local governments can legislate on it, as long as their actions do not contravene constitutional guidelines. In many developing countries of the world, including Nigeria, establishment of schools has been influenced by the political leadership of the day. According to Nwadinni (2010) location of educational establishment has been influenced more than anything by politics, because he who plays me, piper dictates the tune. Therefore, education is at the mercy politics. The result is that educational institutions are located purely on political ground and in most cases in the strongholds of those in power against the wisdom of educational planning. This has suited in many on-coordinated expansion of the educational system against the felt needs of the people.

This perhaps is the reason Thomas (2012) said that governors and president) (representing politicians) are no better suited to run schools than they are to run construction sites, and

its time our education system reflect that fact. Personal pronoun has advocated that government should leave education alone, so as not to cripple public education. Supporting this view, a legal reformer, (Philip in Thomas, 2012) argued that "successful leaching and good school principals must feel free to act on their best instincts...-This is why school must bulldoze bureaucracy or political leadership.

Presently, all the Slates of the federation have at least one Federal University find Federal Government College or unity school. This is in line with the National Policy on distribution to provide a fairer spread of high education facilities" (FRN, 1981). In the last political dispensation, the way federal universities established and licenses given to individuals and corporate bodies seem more of politics than social demand for education.

The establishment of private universities in Nigeria date back to 1979, when education was placed on the concurrent list in the nation's constitution, permitting individuals and organizations to establish private universities. Within a couple of years till September 2015, 61 private universities have been establish in this country (Vanguard, 2015).

Adesulu (2015) stated that some of these universities were hurriedly established without proper planning, that it was observed that during this period the threat to qualitative universities education was so real that its subsequent devastating effect in Nigeria would be irreparable. This, in the view of Nwadiana, (1993), arose from the tendency to see the supply of university education and the location of institutions ways of expressing the endemic federal character of the polity, even when there is no fell need for such, subsequently leading to the proliferation of universities and a serious trade-off. of economic benefits for political consideration,

It has been alleged that the establishment of Almajiri schools by Dr. Goodluck Jonathan's administration in the north was more of politics than social demand. Social demand is the total number of individual demand for education places over time (Nwadianni, 2010). In the Almajiri's case, the Conner president it seems wanted to favour the northerners ahead of the 201 5 presidential elections.

There are many children with special education needs in Nigeria that need inclusive or special education inclusive education is the latest programme initiative to provide children with disability access not only to basic education but also to all levels of education (Ozoji & Ozoji 2014). This is the key element of the education reform agenda (Slee, 1979).

Conclusion

Polities in education policies and programme: implementation as have been discussed is of crucial concern education administrators and planners because education is a tool for individual and national development. The presentation in this paper has clearly shown among other things that there is an interface between politics and education policies and programmes, implementation. There is no doubt that these politics and programme are tools for human and societal development. Therefore, no meaningful educational objectives can be attained if education is politicized, especially when (here are different ethnic, religious and political.

Political leadership in Nigeria seems not to be sincere to the citizenry, and can hardly implement a sincere policy. We need to accept the fact that the problem of education imbalance cannot be solved if the implementation of education policies and programmes is politicized. In the long run the pace of development in the country will be hindered.

Recommendations

(i) If Nigeria is to compete favourably with other nations of the world in the area of Technology and skilled manpower, the implementation of education policies and programmes must be accorded utmost priority devoid of policies.

(ii) Equal educational opportunity should be given to every Nigerian child in order to provide him/her the needed human, physical and financial inputs to excel academically. These inputs should be adequate in the same proportions as at the when due. Policies and programmes should be designed and implemented to satisfy the generality people, not a particular interest group.

(iii) Policies and programmes should be weighed, both positive and negative impact should be considered, so that when it is implemented, it will get the support of the majority. From formulation through implementation evaluation, they should be in hands of experts. The practice whereby politicians and the ruling class hijack the decision making process is unacceptable. Specialists in their fields should be invited to make and implement policies and programmes, especially those that require professional touch.

(iv) Admission process (especially quota system) and establishment of institutions should be reviewed holistically and conscientious implemented. The peace and development of Nigeria should be uppermost in implementation of education policies and programmes.

References

Abernethy, D. B. (1969). *The political dilemma of popular education.* Stanford: Stanford Universities Press.

Adepoju, A. & Fabiyi, A. (2007). Universal basic education challenges and prospects. Retrieve online on 6/09/15 at http://uaps2007.princeonedu/download.aspx?submissionid=70830

Adesulyu, D. (2015) *Alarm, as private varsities can't enroll enough students.* Vangauge, September 10th, 2015.

Adeju, P. I. (2009). Federal character and quota system in Nigeria – A good public policies of education, in N.A Nwagwu, M.E. Ijeoma and C.C Nwagwu (eds). Organization and administration of education perspectives and Coleman, J. S. (1965). Educational and political development, in Olubor, R.O. (2004). Politics Policies of education, in N. A. Nwagwu, M. F. Ijeoma and C. C. Nwagwu (eds) *Organization and administration of education perspectives and prospects.* Benin: Fiesta Printing Press Ltd.

Dickson, K. A. (1985). Educational culture and development in E. N. Echikwonye, E. Okoli & S. N. Ali (eds) *Education culture and development Africa.* New York: PWPA

Echikwonye, R. A. & Beetseh, K. (2011). The role of public policy making and development in Nigeria. *Journal of Social Science and Public Policy*, 3, 53 - 54.

Fafunwa, A. B. (1974). *History of education in Nigeria (4th edition).* London: Allen and Unwin.

Fagerlind, I. & Saha, I. J. (1989). Education and national development in Olubor, R. O. (2004). *Politics and policies of education,* in N. A. Nwagwu, M. E. Ijeoma and C. C. Nwagwu (eds) Organization and Administration of Education: Perspectives and Prospects. Benin: Fiesta Printing Press, Ltd.

Federal Republic of Nigeria (2000). *Implementation guideline for universal basic education (UBE) Programme.* Abuja: Federal Ministry of Education.

Federal Republic of Nigeria (2004). *National policy on education*. Yaba: NERDC.

Hernes, G. (2002). Education for All: Getting there, in Olubor, R. O. (2004) Politics and policies of Education, in N,. A. Nwagwu, M. E. Ijeoma and C. C. Nwagwu (eds) *Organization and administration of education perspectives and prospects*. Benin: Fiesta Printing Press Ltd.

Ivowi, U. M. O. (2014). Curriculum development agencies and projects in Nigeria, in N. A. Nwagwu & U. M. O. Ivowi (2014). Education n Nigeria development and challenges. Lagos: The CIBN Press.

Lassa, P. N. (2014). The politics of educational planning and policy formulation in Nigeria, In N. A. Nwagwu and U. M.O. Ivowi (2014). *Education in Nigeria: Development and challenges.* Lagos: the CIBN Press.

Nwadiani, M. (1992). The relationship between human planning and availability of places in Higher Education in Nigeria. *Higher Education in Europe,* vvii (3), 89 - 98.

Nwadiani, M. (1993). Planning Nigeria's higher education in 1990s and beyond: Rationale for challenges. *Journal of Higher Education,* 16, p. 286.

SURVEY OF BELIEF AND ATTITUDE ON PRE-SERVICE SCIENCE TEACHERS' BEHAVIOURAL INTENTION TOWARDS INFORMATION TECHNOLOGY USE FOR TEACHING IN A NIGERIAN UNIVERSITY

SHITTU, AHMED TAJUDEEN (Ph.D)[1], GAMBARI, AMOSA ISIAKA (Ph.D)[1] & OMIOLA MATTHEW ADETAYO (Ph.D)[2]
[1]Department of Science Education, Federal University of Technology Minna, Nigeria
[2]Department of science Education, Federal University Dutsin-Ma, Nigeria
Email/: t.shittu@futminna.edu.ng, gambari@futminna.edu.ng
Phone No: +234-816-218-2220

Abstract
This study investigated the influence of pre-service teachers' beliefs and attitudes on behavioural intention towards information technology (IT) use for teaching. The study used a descriptive survey method and a questionnaire to gather the data of the study. The sample of the study comprises of pre-service science teachers' at various levels of study. One hundred and ninety-two students were purposively used as respondents. The instrument used for the study was an adapted one but subjected to reliability check. A cronbach alpha computed to ascertain the internal consistent of the instrument yielded .76, .82 and .80 on the three variables (belief, attitude and behavioural intention) of the study. Based on the theoretical framework of the study, three alternate hypotheses was generated and tested. Regression and Analysis of Variance were used to analyse the data. The findings of the study showed that pre-service teachers' behavioural intention toward information technology use can be explain by their belief and attitude. Though, pre-service teachers' belief stood to be the strongest determinant. Based on this findings the study suggest among others the deployment of IT tool for teaching pre-service teacher so as to sustain their belief about ease of use and usefulness of IT tool for teaching when they get to the field of practice.

Keywords: Belief, attitude, behavioural intention, pre-service teachers, information technology

Introduction
The use of IT in education is so tremendous in the recent time so much that all over the world educational institution are increasingly using different range of IT tools for supporting classroom instruction and for educational administration (Teo, Luan & Sing, 2008). Though, IT use in education is growing, but its use in education are more felt for administrative than for implementing the curriculum (Becker, 2001; Teo et al, 2008).

Given the current role of IT in education, it is expected that in-service teachers should be adequately equipped with IT skill from their training school in the pedagogical use of different IT application for implementing the curriculum. Arising from this notion, pre-service teacher attitude and intention towards IT use is receiving greater attention among researchers' in the recent time more than ever before. For instance, Anderson, Groulx and Maninger (2011) conducted a study was conducted to probe pre-service teachers technology related belief and intention toward technology use for classroom instruction. The study was carried out because possession of IT skill was not sufficient as a reason to predict or prompt teacher to support his/her teaching with IT tools (Anderson et al, 2011).

Another related study was carried out by Cuhadar (2014) on factor that influence pre-service teachers' acceptance of Tablet PC in Turkey revealed that preservice teachers' demonstrate

to accept and use Tablet PC, which in-turn influence their positive attitude and their intention toward its use for instructional related activities.

Studies continue to show the relationship between belief and intention regarding the use of technology in the recent time. Some of these studies include Teo (2009) study on intention of preservice teacher use of technology, using structural equation modeling approach; Bozdogan and Ozen (2004) study of technology factors affecting pre-service ELT teachers' perceived IT self-efficacy; Oigara and Wallace (2012) study on modeling training and mentoring teacher candidate's use of Smart board technology; Wong, Osman, Goh and Rahmat (2013) study on understanding student teachers' behavioural intention toward technology use for teaching. These studies were conducted due to empirical evidence of the influence attributed to belief and attitude as a precondition for acceptance of new innovation in teaching and learning.

Though, it is important to understand factor predicting pre-service teachers' intention toward IT use because of their professional role after graduation, such study has not been given deserve attention in the present setting of this study. This explains the imperative of understanding pre-service teacher belief, attitude and intention towards IT use for teaching before they get to the field of practice.

Literature Review on Beliefs and Attitudes of Pre-service Teachers to ICT Use

Attitude refers to an expression of favor or disfavor towards something, a person, place or event. Attitude can be positive or negative and influences the way and manner a person reacts or responds to another person, something or event. Attitudes are determined by the analysis of the information regarding the result of an action and by the positive or negative evaluation of these results (Ajzen & Fishbein, 1980; Yusuf & Balogun, 2011).

There is a common saying that attitude determines altitude. Studies have established close links between teachers' attitude and their use of ICT. More positive attitude towards the computer were associated with a higher level of computer experience (Dyck & Smitter, 1995; Teo, 2008). Students' confidence on IT can also be explained through the attitude and behavior of their teacher towards their use of IT tools. Teachers' behavior to a greater extent has a lasting influence on students' confidence which in-turn affects attitude towards IT as they are seen as a role model to their students (Derbyshire, 2003; Yusuf et al. 2011). The literature revealed that inadequate training and experience is one of the main reasons why teachers resist the use of technology in their teaching. This also reflects in teacher's negative attitude towards computer and technology as a whole.

Attitude is a major predictor of future computer use. Lee (1997); Yusuf et al. (2011) study indicated the importance of appropriate responses to the trainee's feeling about IT as one of the factors critical to success. Thus, there is the need to take care of the emotional needs of pre-service teachers' as attitude is a major predictor of future IT use (David, 2013). As a result of this, a lot research on the attitude of both students and teachers towards the use of ICT in teaching has being done. For example, Becta (2004); David (2013) found that negative attitude is a barrier towards integration of IT in teaching and learning while Rhoda and Gerald (2000); David (2013) observed that positive attitudes towards IT use are widely recognized as a necessary condition for effective computer use in teaching and learning. Also, Selewyn (1999); David (2013), observed that integration of IT in an education environment depends on teachers' and students' attitude towards its use. It therefore appears that teachers' and students' attitudes may influence adoption of IT in the teaching and learning process. Therefore, pre-service teachers' attitude towards the integration of IT in their future classroom is very important.

Studies about anticipated outcomes of technology use have shown that self efficacy beliefs to a greater extent determined outcome expectations, because those who are confident always anticipate success in what they do (Pajaries, 2002; Anderson et al., 2012). Belief according to Keller (1983) is related to perception that an individual has on the importance of a task for the accomplishment of future goal. Behavioural beliefs of pre-service teacher on IT use for teaching have been a subject of study in the recent time, Teo (2009) in a study reported that behavioural belief of perceived usefulness and perceived ease of use as propounded by Davis (1989) have been found to be of significant reason for pre-service teacher behavioural intention toward technology use.

Earlier, Ajzen and Fishbein's (1980) postulated a theory of reason action (TRA), which stated that individual intention to perform a specific task, is determined by beliefs and attitudes which altogether predict the behavioural intention of an individual. Teo. (2009) defined belief as 'the individual estimated probability that performing a given behavior will result in a given behavior". In a study of Davis (1989) submitted that perceived usefulness and perceived ease of use are function of belief that enable one to form a favourable attitude and intention to accept to use a technology.

Successful use of information technology for classroom instruction depends on several factors which include behavioural belief and positive attitude of teacher (Yuen & Ma, 2002; Teo, Luan & Sing 2008). This study therefore, set to reconfirm this assertion in order to determine whether the finding could be similar or otherwise, most especially when literature revealed that there are conflicting results arising from studies on what inform users decision on IT use. For the purpose of this study, the conceptual framework in fig 1 is generated to guide the study.

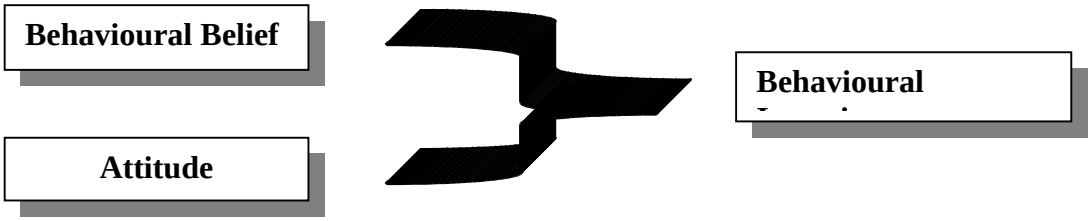


Figure 1: The conceptual framework of the study

Based on the framework in fig 1 above the following alternate hypotheses were generated to be tested through the data collected for the study.

Hypotheses of the Study

H_1: Attitude of Pre=service teachers will positively influence their behavioural intention toward Information technology use.

H_2: Belief of pre-service teacher will positively influence their behaviooural intention toward information technology use.

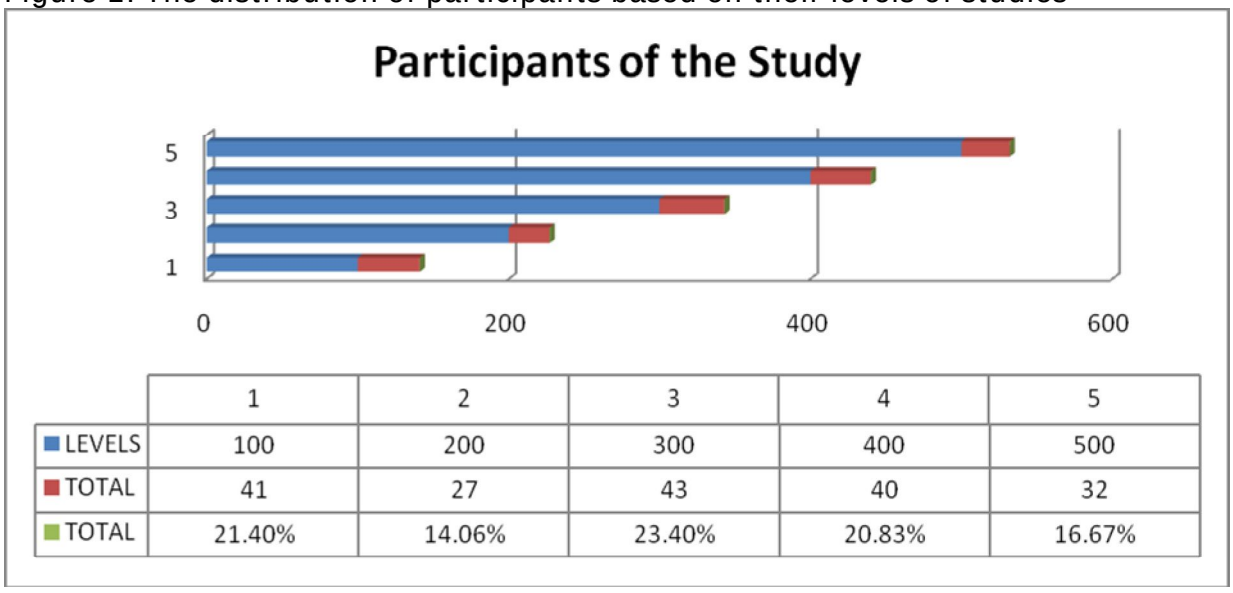
H_3: Pre-service teacher level of study will influence their behavioural intention toward Information technology use.

Research Methodology

The study was prosecuted with descriptive survey method. The major construct of the study involves pre-service science teachers' behavioural beliefs and attitudes towards IT as independent variable, while behavioural intention toward use is the dependent variable. The

study involves one hundred and ninety-two (192) pre-service students at various levels of studies. The participants were purposively selected for the study. Among the respondents, forty-one (21.40%) were in 100 level, twenty-seven (14.06%) in 200 level, forty-three (23.40%) in 300 level, forty (20.83%) in 400 level and thirty-two (16.67%) in 500 level respectively, as presented in figure 1 below. An adapted instrument was used for gathering the data of the study. The instrument was subjected to face and content validity check. Also, the instrument internal consistency (reliability) was computed, the cronbach alpha of .76, .82 and .80 were obtained for behavioural belief, attitude and behavioural intention. The hypotheses one and two of the study were subjected to regression analysis, while the third hypothesis was analyse with anova

Figure 1: The distribution of participants based on their levels of studies



	1	2	3	4	5
LEVELS	100	200	300	400	500
TOTAL	41	27	43	40	32
TOTAL	21.40%	14.06%	23.40%	20.83%	16.67%

Table 1: Summary of the model of the study

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.666[a]	.443	.436	5.25675

a. Predictors: (Constant), belief, attitude

Table 2: Multiple Regression analysis of factors influencing pre-service teachers' IT use

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistic	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	3.250	2.186		1.487	.139		
	attitude	.088	.062	.124	1.431	.155	522	1.92
	belief	.595	.089	.574	6.653	.000	522	1.92

P <0.001

a. Dependent Variable: intention

Table 3: Analysis of variance of pre-service teacher level of study and behaviouralintention to IT use

Years of study	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	90.951	27	3.369	1.743	.023
Within Groups	228.090	118	1.933		
Total	319.041	145			

Hypotheses Testing

Multiple regression analysis was used to analyse the hypotheses of the study. Before computing the analysis, assumption of multiple regression analysis was checked. In doing this, collinearity diagnostic were performed to check that the data was free from multicollinearity. The result shows that the assumption has not been violated. To ascertain this, we check at the VIF value in Table 2. The value shows that all VIF were greater than 0.10 which is above the cut-off point (Pallant, 2007). The data has satisfied all assumption of regression analysis

Results

Table 1 above shows that the multiple correlation coefficient (R), of the combination of predictors is .66 and the adjusted R^2 is .44, this finding suggest that (44%) of the variance in behavioural intention of pre-service science teacher toward IT use can be predicted from combination of their belief system and their attitude. By implication there are variables that are not capture which equally responsible for pre-service teacher behavioural intention aside belief and their disposition.

The result of hypotheses tested for the study is hereby presented: The first hypothesis which states that H1: Attitude of Pre=service teachers will positively influence their behavioural intention toward Information technology use showed effect size of (β=.124), $p< 0.05$, with this result, the hypothesis stand validated. The second hypothesis which states that H2: Belief of pre-service teacher will positively influence their behavioural intention toward information technology use showed effect size of (β=.574), $p< 0.05$, the hypothesis was equally stand validated. The third hypothesis H3 that Pre-service teacher levels of study (students in 200,300, 400, & 500level) will influence their behavioural intention toward Information technology use is rejected. The analysis of variance computed in table 3 revealed $F(27,118)=1.743$, $p<.05$. This finding suggest that there is no significant different in pre-service science students behavioural intention towards IT use in respective of their level of study.

Discussion

The finding of this study has provides empirical evidence to factors that influence pre-service science students behavioural intention toward information technology use for teaching function in the setting of this study. The finding revealed that behavioural belief stand to be the strongest determinant of pre-service teacher behavioural intention. This finding validates and supports Davis (1989), Teo (2008) study on factors that determine users' information system use which revealed that users' adoption of information system was predicted by student behavioural belief, that is, users' perceived ease of use and their perceived usefulness of the system. The finding also support Yuan and Ma (2009); Teo, Luan and Sing (2008) findings which posited that successful information system use for classroom instruction depend majorly on user behavioural belief as well as attitude develop toward information system.

Similarly, the study also confirm the finding of Ajzen and Fishbein (1980) that reported the reason for an individual behavioural intention as a function of their belief as well as attitude toward such situation. The study also revealed that attitude was an important factor when it comes to the use of IT for teaching. This finding was in agreement with Selwyn (1999); David (2013) finding which opined that integration of information technology in educational environment will largely depend on students and teacher attitude towards usage. The study also support Lee (1997) finding which reported that user attitude was a precondition for future use of computer. In furtherance to that, Yuen and Ma (2002); Teo, Luan and Sing (2009) study reported similar finding which support the present study on the influence of behavioural belief and attitude as a significant factor to integration of IT in teaching.

It is important to note that behavioural belief is a function of an individual conviction or opinion of usefulness and ease of use of a process or tool. In this study pre-service science teacher has express their opinion about usefulness and ease of use of information technology which is the product of their belief. This belief greatly influences their behavioural intention toward future deployment of IT for their professional practice. Of note is also that 44% of variance of pre-service science teacher behavioural intention toward IT can be explains by the collective influence of their belief and attitude. What this suggest is that there are other salient factor that also predict pre-service student behavioural intention towards IT for professional practice. The study therefore suggest further understanding of factors that may predict pre-service teacher behavioural intention toward use of IT for teaching

Recommendations

Based on the finding of this study, the following recommendations were made that:

(i) The government should increase provision of IT equipment and tools for the training of pre-service teachers so as to encourage and equip them for the task they will engage in after graduation. This becomes important because we are in the knowledge society where one of the skill requirements to survive is self-efficacy in the use of information technology.

(ii) The teacher educators should intensify their effort in the deployment of IT tools for the training of teachers so as to increase students' behavioural belief on ease of use and usefulness of IT for professional practice when they get to the field of practice.

References

Ajzen, I. & Fishbein, M. (1980). *Understanding attitude and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Anderson, S. E., Groulx, J. G., & Maninger, R. M. (2011). Relationships among pre-service teachers' technology related activities, belief and intention to use technology in their future classrooms. *Journal Educational Computing Research,* 45 (3), 321 – 338.

Becker, H. J. (2001). Finding from teaching, learning and computing survey. Is Larry right? *Education Policy Analysis Archives,* 8 (31).

Becta. (2004). Tablet PCs in schools: A review of literature and selected projects. Retrieved on September, 2015 from http://dera.ioe.ac.uk/1411/

Bozdogan, D., & Ozen, R. (2014). Use of ICT technologies and factors affecting pre-service ELT teachers perceived ICT self-efficacy. *International Journal of New Trends in Education and Their implications,* 5 (2), 63 - 76.

Cuhadar, C. (2014). Information technologies pre-service teacher acceptance of tablet PCs as an innovative learning tool. *Educational Sciences Theory and Practice,* 14 (2), 741 – 753.

David, O. O. (2013). Attitude of teachers and students towards use of information and communication technology in the implementation of Biology curriculum in selected secondary schools. *Research Journal in Organizational Psychology & Educational Studies,* 2 (3), 76 - 83.

Davis, F. D. (1989). Perceived ease of use, and user acceptance of information technology. *MIS Quarterly,* 13(3),319 – 340.

Keller, J. M. (1983). Motivational design of instructional. In C. M.Reigeluth (Ed), *Instructional deisgn theories and models an: An overview of their current status* (pp. 393-434). Hillsdale, NJ: Lawrence Erlbaum.

Lee, D. (1997). Factors influencing the success of Computer skills learning among in-service teachers*. British Journal of Educational Technology,* 28, 139 - 141.

Oigara, J. N., & Wallace, N. (2012). Modeling, training, and mentoring teacher candidate to use smart board technology. *Issue in Informing Science and Information Technology,* 9(1), 297 – 315.

Pajares, M. F. (2002). Overview of social cognitive theory and of self-efficacy. Retrieved on September 20, 2015 from http://www.emory.edu/EDUCATION,mfp/ett.html

Pallant, J. (2007). *SPSS survival manual: A step-by-step guide to data analysis using spss for window (version 20)*. Allen & UNWM, Australian.

Teo, T. (2008). Pre-service teacher attitude towards computer use. A Singapore survey. *Australian Journal of Education Technology,* 23(4), 413 - 424.

Teo, Y., SuLuan, W. & Sing, C. C. (2008). A cross-cultural examination of the intention to use technology between Singaporean and Malaysian Pre-service teachers': An application of the technology acceptance model TAM. *Educational Technology & Society,* 11 (4), 265 - 280.

Teo, T. (2009). Examining the relationship between student teachers self-efficacy belief and their inended uses of technology for teaching. *The Turkish Online Journal of Educational Technology. TOJET.*

Selwyn, N. (1997). Students' attitude toward computers: validation of a computer attitude scale for 16-19 education. *Computer & Education,* 28, 35 – 41.

Wong, K. T., Osman, R., Goh, P. S.C., & Rahmat, M. K. (2013). Understanding student teachers behavioural intention to use technology. Technology acceptance model (TAM) validate and testing. *International Journal of Instruction,* 6 (1), 89 – 104.

Yusuf, M. O., & Balogun, M. R. (2011). Student teachers competence and attitude towards information and communication technology. A case study in Nigerian university. *Contemporary Education Technology,* 2(1), 18 – 36.

Yuen, A., & Ma, W. (2002). Gender differences in teacher computer acceptance. *Journal of Technology and Teacher Education,* 10(3), 365 – 382.

PERCEPTION OF OBAFEMI AWOLOWO UNIVERSITY FINE AND APPLIED ARTS STUDENTS' ON EASE OF USE OF DRAWING MEDIA.

ODEWUMI, MICHAEL OLUBUNMI
Department of Educational Technology,
University of Ilorin, Ilorin, Nigeria.
E-mail: agbegilerebunmi@yahoo.com Phone No: +234-703-435-5363

Abstract

This study investigated the Perception of Obafemi Awolowo University, Ile Ife, Nigeria, Fine and applied arts students on ease of use of drawing media. The descriptive research type utilising survey method was used, purposive sampling was drawn for 125 students, total number of 47 female and 53 male. Research instrument was questionnaire Perception of Fine And Applied Arts Students on Ease of Use of Drawing Media (PFAASEUDM) for data collection. The validation of the instrument is subjected to content and face validation by the experts. Two hypotheses were postulated and tested at 0.05 level of significance using ANOVA and t- test. The analysis revealed that there is no significant difference between the students but gender was a factor because there is a significant difference between the male and female student on the ease of use of drawing media. Based on these findings the students should be encouraged to vary the drawing media and not to stick to one from the inception of their study in the university.

Keywords: *Perception, Drawing, Drawing Media, Gender*

Introduction

One of the most remarkable phenomena in drawing is the media and the ability of the illustrators to depict well object drawn depend on perception and the media used. Perception is receiving, collecting, and the action of taking possession, apprehension with the mind or senses and awareness or understanding of sensory information (Schacter 2011 & Falade, 2013). Perception can also be defined as the process by which organisms interpret and organise sensations to produce a meaningful experience of the world. It is a consciousness usually referred to the immediate, relatively unprocessed result of stimulation of sensory receptors in the eyes, ears, nose, tongue or skin (Olasedidun, 2014). Perceived ease of use, (PEOU) is defined as the degree to which a person believes that using that particular system would be free from effort (Abbitt, & Klett, 2007). Also, Sumak, Hericko, Pusnik, and Polancic, (2011) submitted that perceived ease of use was a factor that directly affected students' attitude, and it was the strongest and most significant determinant of students' attitude toward using technology, tool and equipment in learning. However, students' perception in the ease of use of drawing media would strongly influence the choice and manipulation of the drawing media for productions of arts.

Since earliest time man drew images on the wall of caves, the arts have been of recording our experience and of making sense of our world in different media. However, nature created man into the creative world of drawing to exploit different media for the designated purpose. It is obvious that people do draw but not all people that draw, can draw into proper resemblance of what they draw. Moreover, drawing cut across all discipline and it is the foundation stone in which all other subjects are built on the school curriculum. Hawkins, (2002) submitted that drawing is a powerful medium in which self-image is perceived; therefore drawing human being is a representation of the revelation of a sense of self-identity that involves the uses of media in a two dimensional form. Drawing is an innate urge, which is exhibited in different media such as pencil and paper. The pencil and paper serve as most known catalyst for drawing (Beal, 2001).

Drawing is an activity that is engaged in by a wide spectrum of individuals from artists to surgeons, psychologists to knitters and also serves as a mixed media of a medium in disciplines. Drawing has migrated from traditional practice of fine arts to that of an independent medium, offering distinctive graphic possibilities through exploring media (Kantrowitz, Brew, & Fava, 2011). Drawing is relevant to many disciplines, it is exhibited by radicalizing with media by the marks, forms and lines which gives the appearances on any surface. It is the representation, abstraction, description or self-expression and a process of deep inquiry into that which is possible to know yet impossible to say verbally. Drawing has been described as the vision of thinking and as well as the aesthetic transparent visual (Wheelock, Bebell, & Haney, 2000). It is a visual expression of the inner feelings. Drawing involved ways of creating models. It is also a means of interacting with a system via media. Freehand sketches are automatically marked with different lines, form and designs which provide timely feedback. Technology has also widened the concept of drawing horizon as learners create animations that help to understand in lively form what they visualised in complex environments (Zhang & Linn, 2010).

Drawing is more than scribbling with pencil on a paper. It cuts across other disciplines, and has a prominence as a link with other subjects. Moreover, it is imperative and widely used by scientists involved in basic research to document the reliability and validity of student's performances as a form of assessment (Heller, 2002). However, drawing is important in teaching and learning, it is a means of communication of new ideas, concepts and for learning expository text (Van & Garner, 2005). For illustrations (Zhang & Linn, 2008) and to enhance some forms of learning and comprehension (Ainsworth, 2006). Similarly drawing is both a poetic, expressive and scientific - discursive discipline, while technical drawing has been identified as an important science subject with its importance in scientific and technological development of any nation (Odu, 2006). The invention of technologies in term of computer software's especially on 3 dimensional has brought changes to drawing.

In another development, Koster, (2009) explained that drawing is the fundamental and cognitive activity of the human's mind in diverse subjects and disciplines. Drawing serves as artists' tool of thought and action. It is also a means of exploring, researching and investigating ideals and concepts through media. Drawing offered possibilities to learners into their world of experiences and imaginations via media. In essence, drawing is also the forms and lines marked on visible surfaces or objects. It is the way of constructing ideas and expressing the idea in two dimensional ways. Tania, (2006) submitted that drawing promotes close scrutiny of aesthetic, design qualities and enabled the sightseer to notice and look closely at details that might otherwise go unnoticed. Drawing helps them to think critically on what they are looking at and understand it more fully. In essence, observational drawing requires much focus and concentration from the person that produce them. Drawings are mostly instinctive which enabled ones to express feelings, tolerances, attractive environment and improved academic skills, in different artistic media (Olin, 2008). It is a known fact that drawing trains, teaches, and improve mental alertness of individuals.

General drawing, this encompasses sketches of architects, engineers, interior designers, artists and electricians. The technical drafters require knowledge in the field of engineering and geometry, as well as program like AUTOCAD (Elom, 2014). The importance of drawing was stressed as a means of communication, giving vivid meaning to visuals and as well as for developing the mental growth of individuals (Anning & Ring, 2004). The ability of male and female learners to draw depends on two important things; namely the teachers' methods of teaching and the teachers' interest (Bae, 2004).

Amina, (2001) submitted that each gender represented drawing in different unique colours, especially with their sex. The traits are exhibited in the way they communicate in their various drawing activities. The pictorial presentations and drawings from the learners, shows that they usually draw themselves as a form of identity or self – expression. These are manifested in the figure drawing of a man or a boy, a woman or a girl by gender representing in different primary colours. Ijima, Arisaka, Minamoto and Yasumasa, (2001) studied the drawings of boys and girls especially their usage of colours. The findings revealed that boys used significantly fewer and bright colours in their free hand drawings than girls, and that the most usual colours employed by girls were pink, gray and blue. Hall, (2009) researched into composition of female free hand drawing. The study observed that female students used certain structure such as hair, breast, phallus, pregnancy to depict differences in gender along with bright colours. However, the study concluded that females emphasised clothing such as shorts, skirts, hats, in their drawings for easy identification of boys and girls. Moreover, Hawkins, (2002) submitted that free hand portraits drawings of pencil on white cardboard for male and female are manifested in different characters. These characters are shown in the height, the colour of hair, the emotions and actions expressed in the facial expression gestures such as sadness, smiling, and talking are depicted well in male than in female.

Drawing media is an object used to create and explore lines, forms, shapes and colours in a process that have connection with intellectual domains and are mostly associated with fine arts. Scribbling with pencil on paper emphasised the process of growth, which trains and develops the muscles of the hand, hence scribbles are made in developmental stages. This stage hides the reflection of the gender's emotions and personality acquired through drawing media that later manifest in the future (Taylor, Branscombe, Burcham, & Land, 2011). Computer should not be left out on the medium of drawing. Moreover, drawing media can be explained as the materials, tools and equipments manipulated during the course of scribbling on a particular surface. In other words, it is the artist utilising medium or tool that brings out different features of forms and lines in an illustration or object. Drawing media can be of dry, wet and mixture of both dry and wet. The dry drawing media has no element of oil and water while the wet media are made up of oil pigment, water and tempera based. The mixed drawing media is putting together different media from different objects, along with pencil to form illustrations. It is a means of communication of idea and concept (Usman, Odewumi, Obotuke, Apolola, & Ogunyinka, 2014).

Striker, (2001) suggested that teacher's positive attitude towards children's drawings media promotes a healthy, confident, self-image and high self-esteem in gender. She identified some key strategies that teachers' should apply in developing creativity in gender such as, a role model, taking initiatives in the drawing activities and passing constructive criticisms on their drawing. Drawing interprets and revises thought, therefore, the teaching and learning environment must offer support, time, and opportunity for gender to achieve this aim through various good drawing media (Brooks, 2003), and these are guided and supported by educational models.

This study is based on the Technology Acceptance Model (TAM) which was developed by Davis (1989) to explain how individuals make a decision to accept and use a particular technology. Psychology defines learning as a relative permanent change in organisms' behaviour due to experience. Also, psychology and education believed that learning is a process that bring together cognitive, emotional, and environmental influence for acquiring, enhancing, or making changes in ones knowledge, skill, value and world views, (Wright, & Hinson, 2009).

Technology Adoption Model (TAM) is an adaptation of the Theory of Reasoned Action (TRA) to the field of Instructional System Design (Olasedidun, 2014). Instructional system design model (ISD) is the systematic approach to the development of instructional specifications, using learning and instructional theories to ensure the quality of instructions. TAM perceived usefulness, ease of use, attitude and intention are the determine factor influence individual's intention to use a system. The usefulness is also seen as being directly impacted by perceived ease of use. There has been an extensive amount of research on these variables that have evolved out of the theory of reasoned action, by Fishbeen. The TRA posited users accept or reject the use of information technology based on its perceived ease of use and usefulness (Malhotra, Heine, Grover, 2001).

However, Davis invented the TAM model, the model has been widely used to predict user acceptance and use based on perceived usefulness and ease of use. Ndubisi, Gupta, and Ndubisi (2005) added that "innovativeness, risk taking propensity, perseverance, and the flexibility between users' ease of use are important constructs", TAM has been acclaimed for predicting acceptance. Venkatesh and Morris (2000), suggested that the TAM does not help to understand and explain acceptance in ways that promote development from meaningful predictive analysis. Nevertheless, TAM's perceived usefulness will be influenced by perceived ease of use, because the easier a technology is to use, the more useful it can be.

TAM considers that an individual's intention to use a system will be verified by perceived usefulness and perceived ease of use of that system. TRA and TAM presume that when someone develops an objective to perform, that they will be free to execute without restraint. The model implies that when a new package is given to the users, perceived usefulness and perceived ease of use will impact their determinations about how and when they will use the package. Perceived ease of use has been established from previous research to be an important factor influencing user acceptance and usage behaviour of information technologies (Abbitt, & Klett, 2007). Perceived ease of use consists of the following determinants: Easy to use, easy to read, using understandable terms, able to link to search for related information and easy to return to previous page (Davis, Bagozzi, & Warshaw 1992). Furthermore, this study sought to find out whether perceived ease of use would influence the choice and use of drawing media among the students of Fine and applied arts department of Obafemi Awolowo University Ile Ife, Nigeria.

Statement of the Problem

The frequent use of media to execute drawing, design and writing is increasingly prevalent in higher education. Fine and applied arts students mostly manipulate diverse media to perform drawing task within the scope of their studies. Several studies have been conducted on drawing and drawing media because of it is imperative in all arts courses. The majority of fine and applied arts students have negated drawing as a course especially when it comes to utilising other media apart from pencil. Therefore the research stands to investigate the ease of use of the drawing media by the Fine and Applied Arts students of Obafemi Awolowo University, Ile Ife. Nigeria.

Research Questions

The study sought to answer the following two research questions:

(i) What is the difference in perception of Fine and Applied arts students of Obafemi Awolowo University Ile-Ife. Nigeria, on the ease of use of drawing media?

(ii) What is the difference in perception of male and female students of Fine and Applied arts department of Obafemi Awolowo University Ile-Ife. Nigeria on the ease of use of drawing media?

Research Hypotheses

The following null hypotheses were tested in the study:

Ho_1 There is no significant difference between the perception of Fine and Applied arts students of Obafemi Awolowo University Ile-Ife Nigeria on the ease of use of drawing media.

Ho_2 There is no significant difference between the perception of male and female students of Fine and Applied arts department of Obafemi Awolowo University Ile-Ife. Nigeria on the ease of use of drawing media.

Methodology

The study was a descriptive research type utilising survey method. A survey research is one in which a group of people or items are studied by collecting and analyzing data from only a few people or items considered to be representatives of the entire scheme. The study used a questionnaire to obtain necessary information from the respondent.

The targeted population of this study was the students of Department of Fine and Applied arts, Obafemi Awolowo University, Ile-Ife, Nigeria. The sample for the study was drawn from purposively sampling of students of part one, two, three, and four of the Department of Fine and Applied Arts. A total number of 100 students were sampled, 25 students in each level total number of 47 female and 53 male.

The instrument used in generating data for the study was the questionnaire named Perception of Fine and Applied Arts Students on Ease of Use of Drawing Media (PFAASEUDM). The questionnaire consists of three sections A, B, and C. Section A was used to elicit information on biographical data of the respondents such as gender, religion, and course of study. Section B seeks to find out the drawing media the students frequently used, while section C, deals with student's perception on the ease of use of drawing media. This section is further divided into 10 items numbered 1 - 10 and were patterned after the five point - likert type rating scale format of Strongly Agree (SA) - 5 points, Agree (A) - 4 points, Disagree (D) - 3 points Strongly Disagree (SD) - 2 points and Undecided (UD) -1 point.

The instrument was validated to obtained useful suggestion; modifications in term of language clarity, content coverage in terms of adequacies and inadequacies, comments on the relevance to the stated objectives and constructive criticisms on the instrument. Therefore, the research instrument was tested and found to satisfy face, content and construction validity by given to two lecturers, one from the Department of Educational Technology, University of Ilorin. Nigeria and another Lecturer from the Department of Fine and Applied arts Ladoke Akintola University of Technology, Ogbomoso, Nigeria. The instrument was further subjected to pilot testing and reliability before using the research instrument. The reliability of the instrument was administered on undergraduate students of department of Fine and Applied arts Ladoke Akintola University of Technology, Ogbomoso. Oyo State. Nigeria, with Cronbach's alpha. The value obtained for the reliability was 0.79 which was quite satisfactory for this study. The level of the significance adopted for the analysis was $P \leq 0.05$. This level of significance formed the basis for accepting or rejecting the hypothesis.

The researcher administered the instrument to the targeted sampled. Due to the type of the instrument, it was possible for the students to attempt the questionnaire within a period of five to ten (05-10) minutes. Therefore, the researchers waited to collect the completed questionnaire from the respondents immediately.

Result

Hypothesis 1: *There is no significant difference between the perception of Fine and Applied arts students of Obafemi Awolowo University Ile-Ife, Nigeria on the ease of use of drawing media*

This hypothesis was tested using t-test statistics to compare the students of Fine and Applied arts Department of Obafemi Awolowo University. Ile Ife on the perceived ease of use of drawing media.

Table 1: One way ANOVA result of students of Fine and Applied arts on the perceived ease of use of drawing media

Source of Variable	Sum of Square	df	Means square	F	P-value
Between Group	64.214	3	21.405	2.524	.070
Intercept	364.722	43	8.482		
Corrected total	428. 936	46			

Table 1 indicates that the calculated F value of 2.524 is significant because the significant value of .070 is greater than 0.05 alpha levels. The result implies that there is no significant difference in perception of students on the ease of use of drawing media. Therefore, the null hypothesis is accepted. What the result suggested was that students in all levels (100, 200, 300, and 400) do not differ in their perception on ease of use of drawing media.

Hypothesis 2: *There is no significant difference between the perception of male and female students of Fine and Applied arts department of Obafemi Awolowo University Ile-Ife, Nigeria on the ease of use of drawing media.*

This hypothesis was tested using t-test statistics to compare the students of Obafemi Awolowo University. Ile Ife Department of Fine and Applied arts on the perceived ease of the use of drawing media.

To test this hypothesis, t-test statics was used, to compare the male and female students, of Fine and Applied arts. The hypotheses was tested at 0.05 level of significance as shown in Table 2.

Table 2: t-test result of male and female students of Fine and Applied arts on the perceived ease of use of drawing media

Variable	No	Mean	SD	df	t-value	P-value
Male	53	39.62	2.10	100	52.8	.000
Female	47	39.26	3.05			
Corrected Total	100					

Table 2 indicates that the calculated t value of 52.8 is significant because the significant value of .000 is lesser than 0.05 alpha levels. The result implies that there is significant difference in mean scores of both male and female students on the ease of use of drawing media. Therefore, the null hypothesis is rejected. In other words the result suggested that male and female students of 100, 200, 300 and 400 levels of Fine and Applied arts Department differ in their perception on ease of use of drawing media.

Discussion and Conclusion

The result of the analysis implies that there is no significant difference in perception of students on the ease of use of drawing media. This finding agree with the conclusion of Tania (2014) and Olin, (2008) based on their review of studies of drawing media. Also the findings can be compare with Assisted Technology like video of Omiola, Enuwa, Awoyemi and Bada (2012) and computer assisted instructional packages of Fakomogbon, Adetayo, Oyebode, and Enuwa (2014) that proved the facilitative effect of media in enhance teaching and facilitate the acquisition of knowledge.

The result of t-test shows that there is significant gender difference in perception of ease of use of drawing media. These findings shows that gender had influence on perception on ease of use of drawing media, This finding agreed with the conclusion of Zhang and Linn, 2010 based on their reviewed of studies on drawing media and gender and Beal (2001).

Recommendations

Based on the findings of the study, the following recommendations were made; The students of fine and applied arts should be encourage to vary the drawing media from 100 level i.e. which is the genesis of drawing in the university. It will further fathom the fundamental principles of drawing and exposes them to divers drawing technique utilising different media. Others drawing media should be inculcated along the most known and generally accepted drawing medium (pencil), to enable it have positive impact on the drawing courses. The study shall be of high benefit to students in the field as a guide for making the right choice of drawing media for individual. The students will be able to derive joy and interests in becoming illustrators (specialist in drawings) and designers, and in having less fear of basic uses of other drawing media.

References

Abbitt, J. T. & Klett, M. D. (2007). Identifying influences on attitudes and self-efficacy beliefs towards technology integration among pre-service educators. *Electronic Journal for the Integration of Technology in Education*, (6), 28 - 42.

Ainsworth, S. E. (2006). A conceptual framework for considering learning with multiple representations. *Learning and Instruction*, 16, (3), 183 - 198.

Amina, J. (2001). *Research on the teaching of instructional materials*. Kano. Beijiny Publishing Limited.

Anning, A. (2002). A conversation around young children's drawing: The impact of the beliefs of significant others at home and at school. *International Journal of Art and Design Education.* 21, (3), 197 – 208.

Anning, A. & Ring, K. (2004). *Making sense of children's drawings.* Maidenhead: Open University Press.

Bae, J. (2004). Learning to teach visual arts in an early childhood classroom: The teacher's role as a guide. *Early Childhood Education Journal,* (31), 247 - 254.

Beal, N. (2001). *The art of teaching art to children in school and at home.* New York: Farrar, Straus and Giroux.

Brooks, M. (2003). *Drawing to learn.* Retrieved April 6th, 2012 from http://www.naeyc.org

Davis, F. D. (1989). Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly,* 13(3), 319 - 340.

Davis, F. D., Bagozzi, R. P. & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology,* 22(14), 1111 - 1132.

Elom, N. E. (2014). Effective teaching and learning in technical colleges: Challenges of technical drawing. *Journal of Educational Policy and Entrepreneurial Research* (JEPER), 1(1), 76 - 86.

Falade, A. A. (2013). *Stakeholders' perception of integration of information technology and communication technology (ICT) in open and distance learning in Nigeria.* (Unpublished Ph.D. thesis) Department of Educational Technology, University of Ilorin. Nigeria.

Fakomogbon, M. A., Adetayo, A. O., Oyebode, M. S. & Enuwa, M. R. (2014). Effect of computer assisted instructional package on the performance of students in mathematics in Ilorin metropolis. *European Scientific Journal,* 10(25).

George, T. K. (2012). *University management in Nigeria*. Ibadan: Spectrum Books Limited.

Hall, E. (2009). Mixed messages: The role and value of drawing in early education. *International Journal of Early Years Education,* 17 (3), 179 - 190.

Hawkins, B. (2002). Children's drawing, self-expression, identity and imagination. *Journal of Art & Design Education,* 21(3), 209 - 219.

Heller, S. (2002). *Smoke, grief and dinosaurs*. (Review of the book, The day our world changed: Children's art of 9/11/2002). New York Times Book.

Iijima, M., Arisaka, O., Minamoto, F. & Yasumasa, A. (2001). Sex differences in children's free drawings: a study on girls with congenital adrenal hyperplasia. *Hormones and Behaviour*, *40*, 99 - 104.

Kantrowitz, A., Brew, A. & Fava. M. (October 2011). *Thinking through drawing: Practice into knowledge. Proceedings of an interdisciplinary symposium on drawing, cognition and education.* Teachers College, Columbia University, New York Symposium.

Koster, J. B. (2009). *Growing artists: Teaching art to young children.* Albany. NY: Delmar.

Malhotra, M. Heine, M. & Grover, V. (2001). An evaluation of the relationship between management practices and computer aided design technology. *Journal of Operations Management,* 19(3), 307 - 333.

Matthews, J. (2003). *Drawing and painting: children and visual representation.* (2nd Ed.). London: Paul Chapman Publishing.

Ndubisi, N. Gupta, O. & Ndubisi, G. (2005). The mogul's model of computing: Integrating the moderating impact of users' persona into the technology acceptance model. *Journal of Global Information Technology Management*, 8 (1), 27-47.

Odu, K. O. (2006). Improving the quality of technology education in Nigerian Secondary Schools, *African Journal of Education and development Studies* (AJEDS), 8(2), 19.

Olasedidun, O. K. (2014). *Relationship among lecturers perceived usefulness, ease of use, attitude and intention towards social media in South West Nigeria.* (Unpublished Ph.D. thesis) Department of Educational Technology, University of Ilorin. Nigeria.

Olin, L. (2008). More than wriggling your wrist (or your mouse): Thinking, seeing and drawing, *Treib,* 82 - 100.

Omiola. M. A., Enuwa, M. R., Awoyemi, S. O. & Bada, A. A. (2012). Effect of developed video instructional package on the performance of senior secondary school physics students in Ilorin Metropolis. *British Journal of Science*, 6(1).

Sumak, B., Hericko, M., Pusnik, M. & Polancic, G. (2011). Factors affecting acceptance and use of moodle: An empirical study based on TAM. *Informatica*, 35, 91 - 100.

Striker, S. (2001). *Young at art: teaching toddlers self-expression, problem-solving skills, and an appreciation for art*. (1st ed). New York. H. Holt.

Tania, K. (2006). *The Drawing Book: A survey of drawing, the primary means of expression*. London: Black Dog Publishing Limited.

Taylor, J. B., Branscombe, A. N., Burcham, G. J. & Land, L. (2011). *Beyond early literacy.* New York and London: Routledge.

Usman, A., Odewumi, O., Obotuke, E., Apolola, O. & Ogunyinka, C. O. (2014). *Cultural and creative arts book one for junior secondary schools*. Ibadan. Spectrum Books Limited.

Van Meter, P. & Garner, J. (2005). *Educ. Psychol. Rev.* (17), 285

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research,* (11), 342 – 365.

Wright, D. K. & Hinson, M. (2009). An updated look at the impact of social media on public relations practices. *Public Relations Journal*, 3(2), 2.

Zhang, Z. & Linn, M. (2008) Using drawings to support learning from dynamic visualizations, *Proceeding. of the 8th International conference on the learning sciences, Chicago* (3), 161 - 162.

Zhang, H. Z. & Linn, M. (2010). *Proceedings of the 9th International Conference of the Learning Sciences*, *Chicago,* (2),165 – 166.

APPENDIX I
QUESTIONNAIRE ON PERCEPTION OF FINE AND APPLIED ARTS STUDENTS ON EASE OF USE OF DRAWING MEDIA.

Section A

Instruction: Kindly tick ( ) in the appropriate column as applicable to you. Which of the following drawing media are you using? Tick as many as may be applicable to you.

Chalk ( )	Charcoal ( )	Computer ( )	Crayon ( )	Erasers ( )
Pencil ( )	Coloured pencil ( )	Pastel ( )	Markers ( )	Fixatives ( )
Crayon ( )	Ink pen ( )	Water colour ( )	Tempo ( )	Pen ( )
Specify others				

SECTION B

Instruction: Kindly respond to all the items in this section by putting a tick ( ) in the column that best represents your view on each of the item using the format below as guide. SA (Strongly Agreed). A (Agree), UD (Undecided), D (Disagree), SD (Strongly Disagree).

STUDENTS' PERCEIVED EASE OF USE OF DRAWING MEDIA IN DRAWING.						
S/N	STATEMENT	SA	A	D	SD	UD
1	Vary drawing media will reduce my stress.					
2.	Using many media to draw will be frustrating.					
3.	Drawing media will make my drawing more difficult.					
4.	Scarcity of drawing media will hinder my drawing.					
5.	It is easy to become skillful at using drawing media.					
6.	Drawing media are easy to manipulate.					
7.	I will use drawing media without instruction.					
8.	Drawing media are always cumbersome.					
9.	Drawing media utilization will be too complex.					
10	Drawing media are effortless.					

IMPACT OF 2 DIMENSIONAL SHAPES ON PRIMARY SCHOOL PUPILS' ACADEMIC PERFORMANCE IN MATHEMATICS IN ZARIA METROPOLIS, KADUNA STATE

ZUBAIRU SULEIMAN ABUBAKAR[1] & ISYAKU ABDULRAHEEM[2]
[1]Department of Educational Foundations and Curriculum, Faculty of Education,
Ahmadu Bello University, Zaria
[2]Dept. of primary Education Studies,
Kaduna State College of Education Gidan Waya, Kafanchan, Nigeria
E-mail: sazubairu@gmail.com Phone No: +234-806-545-1770

Abstract
This study sought to determine the impact of 2 dimensional shapes in the teaching of mathematics among primary school pupils. The study adopted the quasi-experimental research design using 2 dimensional shapes instruction and conventional strategy. A purposive sampling technique was employed to select 400 Primary three Class pupils made up of 240 boys and 160 girls from 17601 Local Education Authority primary Schools in Zaria Metropolis in Kaduna State. A validated Mathematics Performance Pre and Post tests instruments with reliability coefficient of 0.80 was administered. The data collected in this study were subjected to t-test analysis at = 0.05 level of significance. The findings revealed that pupils taught with 2 dimensional shapes instruction using student's centered approach performed better than those taught with the conventional method. The results of the statistical analysis revealed that gender was a significant factor on pupils' performance in mathematics when 2 dimensional shapes are used. The mean performance scores of both male and female pupils were greatly improved on the use of 2 dimensional shapes instruction establishing that the use of 2 dimensional shapes will enhance pupil's performance if judiciously, skillfully and effectively used in teaching / learning of Mathematics.

Keywords: 2 dimensional shapes, Mathematics, Performance, Learning strategy

Introduction
Two dimensional shapes are objects with a recognizable boundary. They are shapes that only have width and height and no thickness. Square, circle, triangle and rectangle are good examples of two dimensional shapes. In mathematics they are called geometric shapes. Teachers use many pieces of information about an object in order for pupils to recognize it. The size, shape, colour and position of an object are obviously important. Pupils easily recognize objects from gray-scale picture with limited views, and often recognize or at least guess at objects from their shapes (Salma, 2009). Salma, (2004) also confirmed that students taught mathematics with graphics materials perform better than those students taught without graphics materials. She also opines that gender has influence on student's performance.

Recently, Mathematics education is currently undergoing a paradigm shift. In the past, teachers stressed mastery of basic facts and mathematical algorithm. Today, educators advocate meaningful understanding of the underlying concepts rather than mastery. This understanding would be the building blocks towards constructing lifelong learning and the capability to use that learning to build new knowledge and apply them to "situations which are of significance to their private, social and professional lives" (Ernest, 1991). For pupils to become mathematically competent, they should be opened to mathematical experiences that promote critical thinking. The problem is that a great number of pupils either fear or dislike mathematics. Their fear is rooted on failure in mathematics. Accordingly, mathematics failure can be attributed to a shallow understanding of mathematical concepts

(Salma, 2009). Understanding of mathematical concepts is shallow when the teacher is the sole source of information and the learner is the passive receiver. McCombs (1997) contends that learning is most meaningful when topics are relevant to the pupils' lives, needs, interests, and when the pupils themselves are actively engaged in creating, understanding and connecting to knowledge. This is the true essence of student-centered approaches – pupils are put into the center of the learning process. Pupils become active participants of the learning process. The concepts to be learned are taken into the world in which they operate. The pupils are involved in deciding what they will learn and how they are going to learn it. In a student-centered classroom, pupils can be provided with opportunities to develop mathematical thinking and explore their own power to utilize mathematics in varied situations. Cockcrift (1982), Nuffied (1967) and Oyeneye (1996) have identified the support of teaching and learning of Mathematics with relevant concrete materials and learners' participation through interaction with the concrete materials as being effective in promoting a meaningful understanding of Mathematics contents.

Teachers' knowledge of subject matter continues to draw an increasing attention from policy makers in recent years all over the world, since more emphasis is given to highly qualified teachers (Crespo & Nicol, 2006; Hill, Rowan, & Ball, 2005). The National Council of Teachers of Mathematics (2000) reported that teachers who have strong subject matter knowledge give details in their lesson, link the topic to other topics, ask students many questions, and stray from the textbook. Subject matter knowledge of teachers has been an interest for educators, but more recently there has been a shift to pedagogical content knowledge (Johnston & Ahtee, 2006). PCK concerns how teachers relate their subject matter knowledge to their pedagogical knowledge and how subject matter knowledge is related to the process of pedagogical reasoning. In the teaching and learning of mathematics in secondary schools for proper understanding, in-depth pedagogical content knowledge of the mathematics teachers should include, knowing those topics that are typically difficult for students and why, knowing different representations that are useful for teaching a specific idea and knowing ways to develop students' understanding of mathematics.

Ball (2003), said that a teacher with good mathematical pedagogical content knowledge can break down mathematical knowledge into less polished and abstract forms, thus making it accessible to students who are at different cognitive levels. A teacher with good pedagogical content knowledge can unpack the mathematics into its discrete elements and can explain a concept or procedure at a level that includes the steps necessary for the students to make sense of the reasoning. He further indicated that teachers with good mathematical pedagogical content knowledge understand where students may have trouble learning the subject and should be able to represent mathematical concepts in a way that their students can comprehend its structure and avoid these difficulties.

Statement of the Problem

Educational system in Nigeria is dominated by talk- and chalk method of instruction, which involves only the teacher talking while the students are passive listeners. However, this practice could be boring after a while. On the other hand the use of visual materials specifically 2 dimensional shapes is sparsely used in Nigerian educational system. But researchers such as Gana (1997) and Patrick (2000) support the use of instructional materials as increasing retention, reinforce verbal and visual messages, fostering and developing higher level thinking skills. Salman (2005) confirmed from her research work that pupils dislike certain topics in Mathematics because of the belief that they are difficult, while the teachers also dislike teaching certain topics because of the belief that they are difficult to teach. Therefore this study investigated the effect of 2 dimensional shapes on performance of pupils in Mathematics and to what extent

does this learning strategy affect gender in learning outcomes.

Research Questions

The following questions were raised to guide the study:

(i) What is the difference between the mean scores performance of pupils taught with 2 dimensional learning strategy and those taught with conventional learning strategy in Mathematics?

(ii) What is the difference between the mean scores performance of girls and boys taught Mathematics with 2 dimensional learning strategies?

Research Hypotheses

The following hypotheses were generated and tested at 0.05 levels of significance:

(i) There is no significant difference between the mean academic performance of mathematics pupils taught with 2 dimensional learning strategy and those taught with conventional learning strategy.

(ii) There is no significant difference between the mean academic performance of boys and girls taught mathematics with 2 dimensional learning strategy.

Methodology

The research design adopted for this study is quasi experimental research. In other words the design is a one short experimental design. In order to eliminate bias and to have a fairly representative sample size for the study, two techniques of sampling were used: purposive and simple random sampling techniques. Four hundred pupils purposefully chosen from 144 schools in the six Educational Districts, five schools were randomly selected from each of the District. Twenty (20) pupils of which 12 were boys and 8 were girls, were chosen from the selected schools. On the whole there were 240 boys and 160 girls.

A purposive sampling technique was used to divide the sample into two groups (2 dimensional and conventional groups). Mathematics Performance Test (MPT) was administered to treatment groups as Pre-test in order to ascertain the homogeneity of the treatment groups, and later administered to the two treatment groups after teaching the groups for the period of four weeks using the same scheme of work. The treatment was done by the classroom teachers who also served as research assistant. They were given detailed instructions with lesson packages on how to teach each group on the topic under consideration, while the researchers moves round to supervise the conduct of the exercise. After treatment, the scores in Posttest were collated and subjected to appropriate statistical analysis. The Two hypotheses were analyzed by Analysis of t-test at = 0.05 level of significance.

The instruments used for this study was Mathematics Performance Test (MPT) developed by the researcher. Mathematics Performance Test was designed to test the homogeneity of the two groups (2 dimensional and conventional learning strategies groups) and it was administered to all the pupils before treatment. MPT was administered to the two groups after treatment. Any difference between the Pre Test and the Post – Test might have been due to treatment given to the 2 dimensional and conventional groups. The MPT contains four topics which include: circle, square, triangle and rectangle.

The instruments was validated by content and face validity methods. It was given to two primary three mathematics teachers. Also, to establish the reliability of the instrument, a pilot test was conducted in Sabon-Gari LGA of Kaduna State. Two schools were used as trial. The results of the test were subjected to split-half reliability method. The reliability coefficient through the PPMC yield an r = 0.8.

Results

Hypothesis 1: There is no significant difference in the academic performance of mathematics pupils taught with 2 dimensional learning strategy and those taught with conventional learning strategy.

Table 1: t-test analiysis of post test scores of pupils taught with 2 dimensional shapes

Source of Variation	N	Mean	SD	df	t-value	t-critical	Decision
Conventional group	200	50.2	10.87	398	11.97	1.96	Sign.
2 Dimensional group	200	62.6	9.05				

Table 1 shows the mean scores of 50.2 and Standard Deviation of 9.05 for students taught using 2-Dimensional learning strategy and mean scores of 62.6 and Standard Deviation of 10.87 for those taught with conventional method respectively. The t-value calculated of 11.97 is greater than the t-critical of 1.96 at 0.05 level of significance. The group taught with 2 dimensional learning strategy outperformed those taught with conventional method, therefore hypothesis one is thereby rejected.

Hypothesis 2: There is no significant difference between the mean academic performance of boys and girls taught mathematics with 2 dimensional learning strategy.

Table 2: t-test analysis of boys and girls performance in mathematics with 2 dimensional shapes

Source of Variation	N	Mean	S D	Df	t_ value	t-critical	Results
Boys	120	56.8	16.8	198	5.8	1.96	Sign.
Girls	80	42.8	18.3				

Table 2 shows the mean scores of 56.8 and Standard Deviation of 16.8 for boys while mean scores of 42.8 and Standard Deviation of 18.3 for girls taught using 2-Dimensional learning strategy. The t-value calculated of 5.8 is less than the t-critical of 1.96 at 0.05 level of significance. This indicates that there is no significant difference between boys and girls taught with 2-Dimensional learning strategy, therefore hypothesis two is thereby not rejected.

Discussion

The data analyzed in hypothesis 1 revealed that Mathematics pupils taught with 2 dimensional learning strategy performed better than those taught with conventional learning strategy. This result is line with Oyeneye (1996) Cockcriff (1982) and Nufield (1967) who have identified the support of teaching and learning of Mathematics with relevant concrete materials and learners' participation through interaction with the concrete materials as being effective in promoting a meaningful understanding of Mathematics contents. Hypothesis 2 revealed that boys performed significantly better than girls in 2 dimensional learning strategy. This result is in agreement with that of Salma (2004), that gender influences student's performance.

Conclusions

This study concludes that 2 dimensional learning strategies is more effective than conventional learning strategy in teaching of Mathematics at Primary School level. The male

pupils performed significantly better than their female counterparts in learning Mathematics with 2 dimensional learning strategy.

Recommendations

Based on the findings from this study the following recommendations are made:

(i) Mathematics teachers should adopt 2 dimensional learning strategy to improve pupils performance in mathematics.

(ii) Mathematics teachers should strategize and make more emphasis on the use of 2 dimensional learning that could benefit both male and female students.

References

Ball, D. L. (2003). Mathematical proficiency for all students. toward a strategic research and development program in mathematics education. *RAND mathematics study panel santa monica, CA: RAND.*

Ball, D. L., Lubienski, S. T. & Mewborn, D. S. (2001). Research on teaching mathematics: the unsolved problem of teacher's mathematical knowledge. I n V. Richardson (Ed.), *Handbook of research on teaching (4th ed.)* (pp. 433-456). New York, NY: Macmillian.

Cockcritf, W. H. (1982). *Mathematics count*. London: HMSO.

Crespo , S. & Nicol, C. (2006). Challenging persevere teachers' mathematical understanding: The case of division by zero. *School Science and Mathematics,* 106(2), 84 - 97.

Gana, E. S. (1997). *Effects of using designed visual teaching models on the learning of mathematics at JSS level.* Ph.D Thesis. University of Ibadan, Ibadan.

Johnston, J. & Ahtee, M. (2006). Comparing primary student teachers attitudes, subject knowledge and pedagogical content knowledge needs in a physics activity. *Teaching and Teacher Education*, 22, 503 - 512.

National Council of Teachers of Mathematics [NCTM]. (2000). *Principles and standards for school mathematics.*

Nuffield Mathematics Project (1967). *I do and I understand.* London: Edinburgh.

Oyeneye, F. H. (1996). Teaching primary mathematics. In V. W. Fomoung, O. P. A. Wotunde,
Patrick, S. (2000). *The effect of visual aids and tactile stimuli on the teaching of English language in selected secondary schools in Bosso Local Government Area of Niger State*. Unpublished M. Tech. Thesis Federal University of Technology, Minna.

Salma, M. F. (2004). Analysis of gender influence and performance of jss student's techniques in solving simultaneous liner equation by graphical methods. *Gender Discussion,* 1,(11), 87 - 99.

Salma, M. F. (2009). Active learning in a mathematics workshop: Nigerian primary school teacher's assessment. *International Electronic Journal of mathematics Education*, 4, 24 -35.

EFFECTS OF VIDEODISC MEDIATED AND COMPUTER ASSISTED INSTRUCTIONAL PACKAGES ON ACHIEVEMENT OF JUNIOR SECONDARY SCHOOL MATHEMATICS STUDENTS IN GEOMETRY IN MINNA, NIGERIA

ALABI. T. O. (Ph.D)[1], EMMANUEL OMEIZA[2] & FALODE, C. O. (Ph.D)[1]
[1]Science Education Department, Federal University of Technology, Minna, Nigeria
[2]Hill-Crest International School Minna, Nigeria
E-mail: dralabiomotayo2012@gmail.com Phone No: +234-806-453-1808

Abstract
The study was carried out to investigate the effects of Videodisc mediated and Computer assisted instructional packages on achievement of junior secondary school students' geometry in Minna metropolis, Niger State. A quasi – experimental, pretest – posttest experimental and control groups design was used in carrying out the research. The study strive to answer four research questions. One hundred and twenty students from three selected schools (male and Female) formed the sample for the study. Two treatment instruments were used which are Videodisc and computer instrument as they were assigned to the Experimental groups and the Convectional method was assigned to the control group. Geometry Achievement Test (GAT) containing twenty multiple choice tests was used for data collection. The reliability coefficient of the item instrument is (r = 0.85). Analysis of Covariance (ANCOVA) was used to test formulated four hypotheses and tested at 0.05 level of significance. The finding showed that videodisc mediated instructional package performed significantly better than the computer Assisted Instructional packages and the control group. There was statically no significant difference in the mean achievement of male and female students of Videodisc mediated and Computer Assisted instructional strategy. The study recommended that Mathematics teachers should endeavor to use VDMIS in presenting Mathematics lessons especially Geometry in schools to arouse the love for Mathematics by students.

Keywords: Achievement, Computer Assisted Instruction, Geometry, Mathematics, Video Disc

Introduction
Learning occurs right from the birth of the child and proceeds until he/she dies. Learning is acquired due to the prior experience one has gained. Learning is seen as a relatively permanent change in behavior, which includes both observable activity and internal processes such as thinking, attitudes and emotions (Jarvis, 2009). However, the essence of enrolling a child in the school is to acquire desirable/positive behavior under the tutelage of the teacher. To further ease the work of the teacher, facilities and other personnel are employed to provide an education designed for classroom learning, which is aim to prepare all the students to work and participate in the society which they live in. Also, the teacher further design a way to manipulate effectively the use of material or equipment meant for teaching and learning process in education.

Education is to assist individuals to maximize their potentials for optimal self and national development. Education is a prerequisite for meaningful and sustained national economy. Education cannot be of quality without effective teaching. The instructional method employed by teacher plays an important role in the acquisition of instructional contents for meaningful learning and development of necessary skills. Teacher-centered instructional methods make students passive with less interaction. Classrooms in Nigeria are predominantly dominated by such method of instruction which does not encourage

students-students interaction. This is why educational technology has strived over the years in integrating instructional media into teaching and learning (Nsofor, 2010).

Discovery has shown that learning is better when information is referentially processed through two channels than when the information is processed through only one channel. This brings about the dual coding of information as it appeals simultaneously to learner's auditory and visual modalities. This is seen in the use of computers which have become the basis of data processing technologies used in realizing information production, manipulating, and storing, sharing and distributing processes. Since they address to more senses compared to other technological tools and make abstract and complicated concepts concrete digitally because of their extensive multimedia properties, they are one of the most important technological tools which are made use of in educational and instructional process. At the same time they play an influential part in accomplishing many pedagogical functions such as measuring and evaluating knowledge and giving feedback, observing activities and performances of students, being independent from time and environment, providing students with motivation and participation to the lesson, considering individual differences regulating education level according to existing knowledge and progress of the students, and supporting instruction with such materials as graphics, pictures, animation and sound used in all science subjects including Mathematics (Al Sharaideh, 2011).

Right from on set, cultures and societies have identified the significance of mathematics. Mathematics is more than simple subject it is a language that help us understand the world around us. Mathematics is a tool of science and technology that enables people to explore concept with idealized models before trying them in the real world (Boaler, 2008). As mathematics is being offered as a subject by pupils and students from primary and secondary school levels, if well taught and the attention of learner is properly captured, this is capable of preparing the learner for an assured tomorrow and a meaningful development both mentally and morally. It is important to note that the impact played by Mathematics in individual life makes it unique in our day to day activities. Not only for scientific and technological development, but for all forms of development. Mathematics being a universal subject has an advantage of been offered worldwide and is also entails the social, cultural, utilitarian and disciplinary qualities. Due to its efficacy it can be apply in economic, social, cultural, and environmental development o f a nation since it is not restricted by sex, race, culture, and religion (Martin, 2007).

Teachers of mathematics are continually challenged to find the most effective methods of reaching students easily. Primary school and secondary school pupils and students today are the generation bombarded by little of media and more of social media networks. They watch DVDs, play video games, and listen to music constantly, visit internets and social networks like WhatsApp, Facebooks, twitters, wecharts and also watch more of television (Hunter, 2008). While these types of technology may seem more entertainment than tool, teacher today are finding ways to work with various forms of visual media to help gain and keep students' attention. The mathematics community nationwide is also seeing potential value in the variety of forms of technology now available. In 2000, the National Council of Teachers of Mathematics found technology to be of such import they included a Technology Principle in their Principles and Standards for School Mathematics. Specifically, they state that "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students learning" (National Council of Teachers of Mathematics, 2010:24)

Ezike (2011) stated that: "educational technology awakens learner's interest by its ability to arouse their curiosity to know more. Once more the use of audio – visual aids makes the

learners to be more alert and attentive. It captures their interest, and they would like to follow the explanation, procedure or the exercise sequentially and faithfully in order to get the precised meaning of the whole event. The use of educational technology processes and devices help to make learning more permanent. It creates impressions that are so vivid and powerful that the learner hardly forgets the experiences into which he was exposed.

Video is a medium of transmitting information in the form of sound and image to be displayed on the screen of television tube. It is usually grouped along with television and films (Bada, 2006). Video, an audio – visual media is always recorded in tapes and disks. Video combines many kinds of data (images, motion, sounds, text) in a complementary fashion, thereby ensuring that learning can be adjusted more easily in the use of video than any other tools to the diverse learning styles and individual learning pace of students (Bates, 2012). Videodisc mediated packages are instructional materials that employ the stimuli of sight and hearing.

Many years ago, worldwide communication of information immediately was not so common. Nowadays, there is no doubt that modern communication technology has vastly increased our exposure to information and experience. Most media have implications for education that are only beginning to be fully understood and appreciated. The importance of using video in learning as presented by Kali and Linn (2009) stated that by using video as a learning media, students are not only able learning to make a mental representation from the semantic understanding of a story in either audio or visual form but when presented together, each source gives an additional information and completion which helps students in remembering symbols or pictures naturally. Video can be used in a variety of instructional setting in classrooms, on distance learning sites where information is broadcast to learners who interact with the facilitators via video or computer and in self-study evaluated situation (Ezike, 2011). Also with video, the learner has more control over the information he receives and an additional opportunity for deeper learning by being able to stop, rewind, fast-forward, and replay content as many times as needed. Video presentation or movies, in the classroom are more effective for students in learning (Kopcha, 2010). Video are more interactive and engaging. This helps stimulate the brain for better achievement and retention. This further shows that Video is a rich and powerful medium in learning especially e- learning, because it can present information in an attractive manner.

Videotape is a step up from audiotape as Videodisc is a step from Audio disc, i.e. DVD or VCD from CD. Videodisc mediated films are the best instructional media that can hold the attention of learners because they add motion to the projected visual image. Videodisc mediated film can be used to achieve educational objectives in the areas of present information that involves motion, describe processes, and shows relationship in order to convey knowledge, teach skills or affect an attitude through individual study or group viewing.

The practical use of microcomputer in the Nigeria classroom for teaching and learning process is slowly gaining acceptance as a result of great significance and educational appropriateness it brings. Computers and learning increasing recognized in the developing countries, especially as these form an essential part of everyday activities that generated kind information and ease its fast delivery. Computer can be used to assist instruction, manage instruction and aid design. However, when computer is used to assist instruction, it is referred to as 'Computer Assisted Instruction'. According to Ezeliora (2010), the use of CAI provides the learner with different backgrounds and characteristics. Using teaching package such as CAI, concepts are presented to the students in such a well-organized manner that makes for greater clarity and easier understanding. Egunjobi (2002) and

Karper, Robinson, and Casado – Kehoe (2005) found CAI effective in teaching geography and counseling education respectively; they all confirmed that CAI is seen to be effective in enhancing students' performance in other subjects than the conventional classroom instruction. Opportunities in the classroom are in the areas of drill and practice, tutorial, simulation demonstration, designing, data and collection, analysis and games.

In the early 1960s educational technologists developed some set of programs of Computer Assisted Instructional (CAI) in order to drill, tutor and evaluate students and to manage such programs effectively (Busturk, 2005). A lot of speculations have been made by educational technologists who believe that CAI will not only reduce educational costs in the long run but will enhance educational effects.

Computer assisted instruction (CAI) delivered on a personal computer has been viewed optimistically by many researcher since its introduction, it has claimed that if Judged by a number of criteria that include achievement gains most CAI uses one or a combination of techniques, which are Tutorial, Drill and practice, Learning games, Simulation, Problem solving, Assessment, and Demonstration/ presentation (Jarvis, 2009).

CAI is a new teaching and learning strategy in which the topics are carefully planned, written, and programmed in a computer which can be run simultaneously in several computer units and it allows each students to one computer terminal. The instructions are equally programmed on a computer disc (CD), this could be played in either audio or video system for the student to learn the programmed at his /her convenient time without being hasting (Adegoke, 2011). CAI programs use tutorial, chill and practice, simulation and problem solving approaches to present topics and they test the student's understanding. One of the most challenging techniques used in CAI is problem solving. It helps students develop skills in logic, solving problems and following directions, and is generally used to augment higher order thinking skills. Assessment is a valid part of any learning experience. Computer – based assessment can be used to initially place and then monitor students, progress within a curriculum. Demonstration or penetration is best used to support the introduction of new information. It can also be used as a review tool (Jarvis, 2009).

Gender issues too have been linked with performance of students in academic tasks in several studies but without any definite conclusion. But there is a general conclusion that general imbalance exist in computer use, access, career and attitude. That is why Davies, Klawe, Ng, Nyhus, and Sullivan, (n.d.) based on their review suggested that current gender imbalance in technology and the role that technology will play in the future should be a concern for men and women, practitioners, policy makers and parents. Some studies revealed that male students perform better than the females in physics, chemistry, and biology (Afolabi & Yusuf, 2010; Gambari, Ezenwa & Anyanwu, 2014). This one of the reasons why this study is designed to find out the effect of Videodisc Mediated Instructional Package(VDMIP) and Computer Assisted Instructional Package (CAIP) on teaching geometric shapes in Junior Secondary schools to and if it can be used as a tools to enhance student learning.

Objectives of the Study

The general objective for this study was effects of videodisc mediated and computer assisted instructional packages on achievement of junior secondary school mathematics students in geometry in Minna, Nigeria. The specific objectives of the study are:

(i) To determine the achievement of junior secondary school students taught geometry with computer Assisted instruction strategy and those taught with conventional lecture method.

(ii) To determine the achievement of Junior secondary school students taught geometry with Videodisc Mediated Instructional strategy and those taught with conventional lecture method

(iii) To examine the achievement of male and female students taught geometry with computer Assisted Instructional Strategy.

(iv) To examine the achievement of male and female students taught geometry with Videodisc Mediated Instructional strategy.

Research Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance:

Ho_1: There is no significant difference in the mean achievement score of students taught geometry using computer Assisted Instructional Strategy, Videodisc Mediated Instructional Strategy and Conventional lecture method.

Ho_2: There is no significant difference between the mean achievements scores of male and female students taught geometry Using Computer Assisted Instructional Strategy.

Ho_3: There is no significant difference between the mean achievement scores of male and female students taught geometric shapes using Videodisc mediated Instructional Strategy.

Methodology

The research design for this study is a factorial design. The design consists of three groups (I, II, III), taught with videodisc mediated, computer assisted and chalk and talk method. The study was limited to all of the Junior Secondary School, class two (JSS II) students in Minna metropolis, Niger State. The target population was 1,200 junior secondary school two (JSS2) students. Three schools were randomly selected and assigned as experimental I, experimental II and Control group respectively. A total number of one hundred and twenty (120) JSS II students in Minna metropolis for the purpose of treatment, analysis and discussion. A total of forty (40), twenty (20) male and twenty (20) female students were selected from each school. The choice of three (3) schools was purposive and the selection of students was done randomly. The Experimental groups' one and two were taught VDMI and CAI respectively as the control group was taught with conventional method. The method of data collection used was based on the administering of the test instrument (GAT) on the experimental and control groups before and after teaching. The pretest was administered to the experimental and control groups. The scores obtained were used to determine the academic equivalence of the control group and experimental groups before the experiment started. The scope of the test was limited to geometry concept which was treated in Mathematics and was administered as pretest and post– test. The instrument was subjected to both the face and content validation by experts. The students were assigned to experimental and control groups, pretest, treated and posttest using test – retest method to ascertained the reliability of the Geometry Achievement Test (GAT) instrument. The instrument had reliability coefficient of 0.85 obtain using person's correlation.

Results

The summary of the data analysis and results are presented in Table 1.

Ho_1: There is no significant difference in the mean achievement scores of students taught mathematics using Videodisc Mediated Instructional Strategy, Computer Assisted Instructional Strategy and those taught with the conventional method.

Table 1: Mean and standard deviation of the posttest mean achievement scores of experimental group 1, 2, and the control group

Group	N	Mean($\bar{x}$)	SD
EXP 1(VDMI)	40	13.53	3.218
EXP 2 (CAI)	40	11.45	2.873
CONT.	40	9.70	4.767

Table 1: shows the mean scores and standard deviation of the experimental groups 1, 2, and the control group. From the results, Experimental Group 1 (M = 13.53, SD = 3.218); Experimental Group 2 (M = 11.45, SD = 2.873) and control Group (M = 9.70, SD = 4.767) respectively.

In order to find out if the mean difference between the groups is statistically significant, ANCOVA was carried out.

Table: 2: ANCOVA result of the posttest mean achievement scores of experimental 1, 2, and the control group

Source	Sum of Square	df	Mean Square	F – Value	P – value
Corrected Model	1867.928	3	622.643	1917.678	.000
Intercept	153.682	1	153.682	473.326	.000
Covariance(Pretest)	1574.611	1	1574.611	4849.647	.000
Treatment	15.548	2	7.774	23.943	.000
Error	37.664	116	.325		
Total	17937.000	120			
Corrected Total	1905.592	119			

S = Significant at 0.05 level

Table 2 shows ANCOVA results of the posttest mean achievement scores of Experimental Group 1, 2 and the Control Group. The results yielded an F – Value of 23.943 and a P- value of .000 ($F(2,119) = 23.943$, $P < 0.05$). The result was significant because $P< 0.05$ and hypothesis one (HO_1) was rejected. Therefore the Videodisc Mediated and Computer Assisted Instructional Packages used for the experimental groups produced a significant effect on the posttest achievement scores of students when Covariate effect (Pretest) was controlled. This implies that a statistically significant difference exist among the three groups (Videodisc Mediated and Computer Assisted Instructional packages and the Control Group).

Ho_2: There is no significant difference in the mean achievement score of male and female students taught geometric shapes using computer assisted Instructional Strategy (CAIS)

Table 3: Mean and standard deviation of the posttest mean achievement scores of male and female students taught with CAIS

Variable	N	Mean	SD
Male	20	11.05	2.964
Female	20	11.85	2.796
Total	40	11.45	2. 873

Table 3 shows the mean and standard deviation of male and female students taught with CAIS. The mean of the male is 11.05 with standard deviation 2.964 while that of the female mean is 11.85 with standard deviation of 2.796.

Table 4: ANCOVA result of the posttest mean achievement scores of male and female students taught geometric shapes using computer assisted instructional strategy

Source	Sum of Squares	df	Mean Square	F- value	P- Value
Corrected Model	9.832	2	4.916	.583	.563
Intercept	3.432	1	3.432	.407	.527
Covariance(Pretest)	361.495	1	361.495	42.860	.000
Treatment	3.771	1	3.771	.447^{NS}	.508
Error	312.068	37	8.434		
Total	5566.000	40			
Corrected Total	321.000	39			

S = Not Significant at 0.05 level

Table 4 shows ANCOVA results of the posttest mean achievement scores of male and female students. The result yielded an F – value of 0.447 and a P – Value of 0.508 (F (1, 39) = 0.447, P > 0.05). This shows that the result was not significant because P > 0.05. Hence, hypothesis two (HO_2) was not rejected. It indicate that there was statistically no significant difference in the mean achievement scores of male and female students taught geometric shapes using Computer Assisted Instructional strategy (CAIS).

Hypothesis Three

There is no significant difference between the mean achievement scores of male and female students taught geometric shapes using Videodisc Mediated Instructional Strategy.

Table 5: Mean and standard deviation of the posttest mean achievement scores of male and female students taught with VDMIS

Variable	N	Mean ($\bar{x}$)	SD
Male	20	14.70	2.736
Female	20	12.35	3.297
Total	40	13.53	3.218

Table 5 shows the mean and Standard deviation of male female students taught with VDMIS.

The mean of the male is 14.70 with standard deviation 2.736 while that of the female mean is 11.85 with the standard deviation 3.297 respectively.

Table 6: ANCOVA comparison of the posttest Mean Scores of Male and Female Students taught geometric shapes using Videodisc Mediated Instructional Strategy

Source	Sum of Squares	df	Mean Square	F- value	P- Value
Corrected Model	86.082	2	43.041	1.209	.310
Intercept	4.857	1	4.857	.136	.714
Covariance(Pretest)	468.586	1	468.586	13.166	.001
Treatment	65.615	1	65.515	.1.841^{NS}	.183
Error	1316.893	37	35.592		
Total	8137.000	40			
Corrected Total	1402.975	39			

NS = Not Significant at 0.05 level

Table 6 shows ANCOVA results of the Posttest Mean Achievement Scores of Male and Female students. The result yielded an F – value of 1.841 and a P – Value of 0.183 (F (1, 39) = 1.841, P < 0.183). This shows that the result was not significant because P > 0.05. Hence, hypothesis three (HO_3) was not rejected. It indicate that there was statistically no significant difference in the mean achievement score of male and female students taught geometric shapes using Videodisc Mediated Instructional Strategy (VDMIS).

Discussion

The result of the analysis of covariance on the performance of students taught geometric shapes using Computer Assisted instructional Packages and Videodisc Mediated Instructional Packages and those taught with the Conventional Classroom Instruction indicated a significant difference in favour of the students in the experimental groups.

Also in the case of the Computer Assisted Instructional Package the result shows that, there is no significant difference between the mean achievement scores of students taught using CAIS and Conventional method. The result is in agreement with the findings of Jarvis (2009), Adegoke (2011) and Yusuf and Afolabi (2010), which found and reported that there was significant differences in the mean achievement scores of male and female students taught suing CAIS. Similarly, the findings agree with the studies of Ajala and Eraywoke (2010) on Integrated Science, Hunter, (2008) in Mathematics confirmed that CAIS has been effective in enhancing students' performance in other subjects than the conventional classroom instruction. However, when similar comparison was made between VDMI and CAI, it is shown to be in favour of experimental 1 which is VDMI. This means that there is no significant differences in the achievement of students taught geometry using Videodisc Mediated Instructional Package could be attributed to the fact that they are more focused, conscious and committed when learning from this package than the Computer assisted Instructional Package or Conventional Method. Similarly, a video presentation embedded with graphics, pictures, sound effect and narration hold the Key to better assimilation and retention of knowledge especially when students are conversant with the control features such as play, pause, forward, repeat and next.

The above result is in agreement with previous findings of Al Sharaideh (2011), Kopcha (2010), Kali and Linn (2009) who reported that videodisc have the potentials of increasing the probability that students will learn more, retain better and even improve their performance of the skills they are expected to develop. The findings was also in agreement with the findings of Egunjobi (2002) who found that a combination of audio, video and print media mode of instruction is more effective than the audio or print mode alone.

Conclusion

The result of the study brought about the following;

(i) The effect of using the videodisc mediated instructional package and the computer assisted instructional package researcher has been positive and effective in teaching geometry than the conventional lecture method.

(ii) The use of the package has helped provided empirical basis for maximizing classroom teaching and learning of mathematics, especially geometry.

(iii) The videodisc mediated and computer assisted instructional package has given both the male and female students the ample opportunity to study at their own pace.

(iv) It was evident from the research work that the groups taught with videodisc mediated and computer assisted instructional packages performed significantly higher than those taught using conventional method.

(v) Gender was not a factor that could have annul the positive effect of the use of videodisc mediated and computer assisted instructional as it bridge the gap between male and female students.

Recommendations

Based on the outcome of this study, the following recommendations are made:-

(i) Mathematics teachers should endeavor to use VDMIS in presenting Mathematics lessons especially Geometry in schools to arouse the love for Mathematics by students.

(ii) Necessary attention should be accorded to the effective use of electronic media and computer literacy and the operation in the secondary schools. Also, videodisc instructional packages and computer assisted instructional packages should be developed for use within the Nigerian school systems.

(iii) Nigerian public schools should be equipped with necessary ICT facilities to leverage the potentials of ICT in Nigerian schools.

(iv) Attention should be drawn to the literacy of teachers in the operation and adequate maintenance of modern teaching facilities. As such, government should ensure the training of teachers through the organizing of seminars and workshops in the area of effective use of modern technological teaching equipment and materials.

(v) Adequate fund should be provided by the government, non-governmental organizations and international organizations in the provision of enabling environment, sufficient man-power and enough instructional media resources to schools.

(vi) Government should ensure the availability of steady power supply in order to keep the machines alive for adequate utilization in teaching with the videodisc mediated instructional packages and computer assisted instructional packages.

References

Abimbola, I. O. (1988). The role of computer in education in Nigeria. *National Journal of Technical Education,* 5(1 & 2), 26 – 33.

Achebe. A. E. (2005). *Effect of videotape instructional package on achievement and retention in food and nutrition at senior secondary school level in Minna, Niger State.* An M. Tech Thesis submitted to the department of science and science education, Federal university of technology, Minna, Nigeria.

Adegoke, B. A. (2011). Effect of multimedia instruction on senior secondary school students' achievement in Physics. *European Journal of Educational Studies,* 3(3), 537 – 541.

Yusuf, M. O. & Afolabi, A. O. (2010). Effects of computer assisted instruction on secondary student' achievement in Biology. TOJET: *The Turkish Online Journal of Educational. Technology, 9(*1), 1 - 8.

Aguisiobo, B. C. (2000).The level of use of resources utilization in integrated science master plan. *Journal of Science Teacher Association of Nigeria*, 27(2), 50 - 53.

Ajaja, O. P, & Eravwoke, O. U. (2010). Effects of cooperative learning strategy on junior secondary school student's achievement in integrated science. *Electronic Journal of Science Education*, 14(1). Retrieved from http://eise.southwestern.edu

Akour, M. A. A. (2006). The effects of computer assisted instruction on Jordanian college students' achievement in an introductory computer science course. *Electronic journal for the Integration of Technology in Education*, 5, 17 - 24. Retrieved July 20, 2008, from http//ejite.isu.edu/volume5/Akourpdf.

Al Sharaideh, S. T. S. (2011).The impact of using computer-assisted programs for teaching national education in Jordanian schools. *Institute of Interdisciplinary Business Research,* 8(3), 860 - 873.

Aluko, K. O. (2004). *Effects of cooperative learning and individualistic instructional strategies on student's problem solving abilities in secondary school chemistry in Ilesa.* Unpublished PhD Thesis, Department of Curriculum Studies and Education Technology, University of Ilorin

Awe, B. (1990). The role of Nigerian women in management. *Management in Nigeria*, 26(6), 8 - 11.

Ayogu, Z. U. (2000). Enriching science technology and mathematics education. The role of new media. *Journal of STAN*, 42(2), 18.

Bada, T. A. (2006). *The effects of locally produced interactive instructional package and demographic variables on the acquisition of textile design skills of junior secondary school students.* Unpublished Ph.D Thesis, ObafemiAwolowo University, Ile-Ife.

Bailozor, R. C., Fine, L. P. & McLaughlin, T. F. (1991). An analysis of computer assisted on scholastic aptitude test performance of rural high school students. *Education spring* 111, (3) 400 - 403.

Batchhelder, J. S. (2000). Efficacy of a computer assisted instruction program in a prison setting: An experimental study. *Adult Education Quarterly,* 50 (2),120 - 129.

Baynes, J. F. (1999). The development of a Van Hiele - based summer geometry program and its impact on student van Hiele levels in achievement in High School Geometry.

Berge, Z. (1995a). Facilitating computer conferencing: Recommendations from the field. *Educational Technology*, 35(1), 22 - 30.

Boaler, J. (2008). Promoting 'relational equity' and high mathematics achievement through an innovative mixed-ability approach. *British Educational Research Journal,* 34, 167 – 194.

Brown, M. D. (1999). The relationship between traditional instructional methods, contract activity packages and mathematics levels in achievement of fourth grade students.

Busturk, R. (2005). The effectiveness of computer assisted instruction in Introductory Statistic. *Educational Technology and Society*, 8 (2), 170 – 178.

Egunjobi, A. O. (2002). *The efficacy of two computer-assisted instructional modes on learners' practical geography achievement at the secondary school level in Ibadan metropolis, Nigeria*. Paper delivered at NAEMT conference, 20,23, 12-22.

Ezeliora, B. (2010). Motivating secondary school science teacher to face the challenge of the Third Millennium. *Journal of Science Teachers Association Niger*, 39(1&2), 14 - 18.

Gambari, A. I., Ezenwa V. I. & Anyanwu, R. C. (2014). Comparative effects of two modes of computer-assisted instructional package on solid geometry achievement. *Contemporary Educational Technology*, 5(2), 110 - 120.

Hunter, R. (2008). Facilitating communities of mathematical inquiry. In M. Goos, R. Brown, & R. Makar (Eds.), *Navigation currents and charting directions* (Proceedings of the 31st annual Mathematics Education Research Group of Australasia conference, Vol. 1, pp. 31-39). Brisbane Australia: MERGA.

Jarvis, p. (ed.) (2009), The Routledge International Handbook of Lifelong Learning. London: Routledge.

Kali, Y., & Linn, M. C. (2009). Designing effective visualizations for elementary school science. *Elementary School Journal*, 109(5), 181 – 198.

Karper, C., Robinson, E. H. & Casado-Kehoe, M. (2005). Computer assisted instruction and academic achievement in counselor education. *Journal of Technology in Counseling,* 4 (1), 12 - 15.

Kopcha, T. J. (2010). A systems-based approach to technology integration using mentoring and communities of practice. *Education Technology Research and Development*, 58, 175 - 190.

Martin, T. S. (Ed.) (2007). *Mathematics teaching today: Improving practice, improving student learning (2nd ed.).* Reston, VA: Author.

National Council of Teachers in Mathematics (2010).*Principles and standards for mathematics in secondary schools.* Abuja: Addis Publishing.

Nsofor, C.C. (2010). *Effects of developed instructional media on Niger State secondary school students achievement in biology.* Unpublished Ph.D Thesis Minna Federal University of Technology.

FACTORS INFLUENCING DIFFERENTIAL GENDER PARTICIPATION IN CURRICULUM IMPLEMENTATION FOR MILLENNIUM DEVELOPMENT

ALADE, IBIWUMI A. Ph.D[1] & AMODA, MORILI BISOLA Ph.D[2]
[1]Department of Educational Foundations and Instructional Technology,
[2]Department of Vocational and Technical Education,
Tai Solarin University of Education, Ijagun, Ijebu Ode, Ogun State, Nigeria
E-mail: ibiwumiabiodun@yahoo.com, curritech66@gmail.com, bisolamoda@yahoo.com
Phone No: +234-803-243-7263

Abstract
Since the beginning of the 21st century, the Federal Government's tasks have been pursing the actualization of Millennium Development Goals (MDGs) through various articulated policies and strategies. Be that as it may, the challenges confronting Nigeria in the task of achieving the MDGs bear seriously on both the recipients of Millennium Development programmes and the human participants involved in the building of skilled human capacities needed for sustainable environmental development. However, the paucity of gender disaggregated statistics still remains alarming. This prompted the authors to examine the factors influencing differential gender participation in curriculum implementation activities for millennium development. The descriptive survey was guided by one main research question and two research hypotheses. Two hundred academic and administrative staff as well as five hundred and ten undergraduate students of Tai Solarin University of Education, Ijebu-Ode, Ogun State, Nigeria were sampled for the study. They were seven hundred and ten participants altogether. Gender Differences Influencing Factors Scale (GDIFS) was the instrument used for data collection. The study discovered that virtually all the identified factors influence differential gender participation in curriculum implementation for millennium development. Also positive correlation exists between male and female students' mean scores on the influencing factors. It is recommended that sensitization, access to education and testimonies of female as role models among others be fortified to close the gender gap in human efforts towards millennium development beyond year 2015.

Keywords: Curriculum Implementation, Gender Differences, Millennium Development.

Introduction
In September 2000, Nigerian government through president, General Olusegun Obasanjo was among the one hundred and eighty-nine (189) World Leaders who signed the Millennium Development Goals (MDGs) with a view to achieving a number of human development outcomes. In the eight chapters of the United Nations Millennium Declaration, the eight MDGs identified and signed include (a) eradication of extreme poverty and hunger; (b) achievement of universal primary education (c) promotion of gender equality and empowerment of women; (d) reduction of child-mortality (e) improvement of maternal health; (f) combating HIV/AIDS, malaria and other diseases; (g) ensuring environmental sustainability; and (h) developing a global partnership for development (Okam & Gele, 2011).

At the world summit in September, 2005, governments reaffirmed their convictions on the progress to be made for women and for all. The Nigerian Government is committed to the implementation of the MDGs as great targets set by the World Nations in 2000 to reduce poverty by 2015 (Ihensekhien & Adedeji, 2013). Since human beings are the centre of development, men and women, boys and girls are expected to have equal opportunities to realize their individual potential to contribute to their country's economic and social development and to benefit equally from their participation in the society.

Prominent, among the eight Millennium Development Goals is the promotion of gender equality and empowerment of women (Goal 3) as well as ensuring environmental sustainability (Goal 7). It is envisaged that the pursuit of this goal along with others would be rounded off in 2015 when the world would transit to Sustainable Development Goals (SDGs) which are very likely to address the weaknesses of MDGs. The ideals in the MDGs are rooted in exploring and employing education as an instrument per excellence in our hauling Nigeria out of misery, promote human dignity and equality, achieve peace, democracy and environmental stability in due course.

As a result, it has therefore become vital that new courses or programmes be deliberately introduced into various schools' curriculum. This is necessitated by various articulated policies, strategies and plans at levels and quarters in diverse forms. Agbaje (2006) emphasized that the major strategy is to build and groom skilled human capacities who would display organizational and management practices needed for developing Nigeria's natural resources and manage the environment in a sustainable manner.

Thus, the curricular underpinnings of Nigeria's educational programmes at all levels fosters the education of the country's youngsters irrespective of gender for millennium development. For both the recipients of the education focused by MDGs and the participants involved in curriculum programmes implementation for millennium development, gender equality is central. Gender inequality restricts a country's economic growth; removing inequalities gives societies a better chance to develop. United Nations (2005) puts it that when women and men have relative equality, national economy grows faster, children's health improves and there is less corruption.

The challenges confronting Nigeria in the task of achieving the Millennium Development Goals stated earlier in this paper bear seriously on the problem of implementing nearly all MDGs programme in terms of gender access to education and female participation in curriculum implementation matters in Nigeria. The gap appears more pronounced at the tertiary level where there is gender streaming or sex segregation by field of study (Ojedele, Oluchukwu & Adegbesan, 2013). It is evident that in the early development of education in Nigeria, gender issues significantly influenced the establishment of schools, the enrolment of students and the curriculum control, although there was no clear-cut policy towards it. Yet gender differences and participation play important role in all classroom delivery of subject matter in the educational system, employment, empowerment, choice of career, environmental control and sustainability (Agbaje, 2008).

In the present-day Nigeria, the agitation has taken a new dimension, gender issue is now tilted towards gender equality, women empowerment and their opportunities in issues of development. If the educational curriculum as one of the avenues for achieving MDGs represents an accepted and dynamic structure which is designed to bring in useful innovations in a society and millennium development, then the needs of Nigerians are expected to be met by this curriculum. However, it has been observed that women participation in education in African countries has remained low and limited in nature (Alade, 2013). This observation no doubt, has implications on curriculum implementation activities for millennium development.

A summary of theoretical considerations, research findings and general observations still reported that gender gap in female participation in education continues widening as one goes up the education ladder. Ojedele, Oluchukwu and Adegebsan, (2013) reported that the dearth of role models, stereotyping, enrolment patterns, threat to female charity, control over women's productive and reproductive labour, and apprehension that educated females

will not make "controllable", "obedient" and "subservient" wives among many other factors often account for why the gender gap in female participation in education continues to widen. Olaleye (2001), Obaid (2005), Dosunmu and Olusanya (2008), Ayangunna (2012) and Kanu (2012) have also rightly pointed out that gender differential recognition, disparity in selection, law and custom, legal subordination of women, religion and traditional gender role are among many other factors causing gender disparity in various work places in Nigeria.

The foregoing factors are indeed predicaments which largely bear on the problem of achieving effective classroom delivery of instruction dictated by various school curricula. Meanwhile, the curriculum implementation activities which cover the administration and management of institutional programmes as well as academic responsibilities rest mostly on human personnel which are either male or female or both. The executive curriculum activities in a school system cover the provision of leadership, coordination and control of the activities of various people working in the system interdependently to achieve organizational goals, in this case, targeting the millennium development goals. The academic activities which are equally the function of human resources (male and female staff) cover: the keeping of learners engaged and motivated; employing a range of learning styles; encouraging the children to develop range of skills; and on the whole preparation of learners for sustainable living. Thus, the curriculum framework enshrined in Nigerian educational institutions endorses that instructions in it should be the responsibility of the trainers and the trainees.

By implication, gender access, equality and participation are essential. As trainers have the executive role, the organizational role and interactive role, curriculum activities are channeled to major purposes of meeting the Millennium Development Goals targets in the curriculum recipients. Obviously, gender issues pre-determine the extent of human participation in various sectors of the society, but in this context, education sector in particular. In several literature on gender, theoretical considerations abound on factors that are likely to be the causes of gender disparity in education matters. Even it is not uncommon to see youth imbibing the legacy of gender disparity and segregation as socio-cultural factors dictate the tune. It is in the light of this background that a deliberate attempt is made to explore the perceived factors that are likely to influence differential gender participation in curriculum delivery for the actualization of the millennium development goals with implications beyond 2015.

Statement of the Problem

The predicaments of the mismatch prevailing in gender participation in schooling in Nigeria and the paucity of gender disaggregated statistics among curriculum implementers at various levels of education in Nigeria have often been associated with some stereotypical assumptions which are very alarming. Meanwhile, male and female human personalities are working instruments in the realization of Millennium Development Goals (MDGs), but gender inequity is likely to have implication on any further development policy objectives beyond 2015. This study therefore, was designed to examine the factors influencing differential gender participation in curriculum implementation for millennium development.

Purpose of the Study

The main purpose of the study was to examine the various factors influencing differential gender participation in curriculum implementation activities for millennium development. The specific purposes are to:

(i) Find out the factors influencing differential gender participation in curriculum implementation for millennium development.

(ii) Examine the correlation between male and female mean responses on the factors influencing differential gender participation in curriculum implementation for millennium development.
(iii) Examine the correlation between staff and students mean responses on the factors influencing differential gender participation in curriculum implementation for millennium development.

Research Question

This study specifically attempted to answer the question below:
(i) What are the factors influencing differential gender participation in curriculum implementation for millennium development?

Research Hypotheses

The following hypotheses were formulated to guide the study:
Ho_1: There is no significant correlation between male and female mean responses on the factors influencing differential gender participation in curriculum implementation for millennium development.
Ho_2: There is no significant correlation between staff and students mean responses on the factors influencing differential gender participation in curriculum implementation for millennium development.

Methodology

Research Design: An ex-post-facto descriptive research design was employed in this study. The design is appropriate as it helped in investigating "in situ" the factors influencing differential gender participation in curriculum implementation activities for millennium development without the manipulation of any variables.

Target Population: The population of this study consists of all the academic and administrative staff of Tai Solarin University of Education, Ijebu-Ode, Ogun State as well as all undergraduate degree students.

Sample and Sampling Technique: A simple random sampling technique was used in selecting 200 academic and administrative staff and 510 undergraduate students for the study. In all, 710 participants were sampled for the study.

Research Instrument: A ten-item Gender Differencing Influencing Factors Scale (GDIFS) designed by the researchers was used for gathering required data for the research. The GDIFS was in two sections. Section A sought for personal data of the respondents while section B contained ten items on the perceived factors influencing differential gender participation in curriculum implementation activities for millennium development. The content of the GDIFS are directly relevant in providing solutions to the research question and the hypotheses formulated for the study. All the selected GDIFS items were allotted with the ratings of agreement/influence of the factors on gender participation in curriculum implementation activities for millennium development. They are: Strongly Influenced (SI); Moderately Influenced (MI); Not Influenced (NI). They were summated with weights – 3, 2, and 1 respectively.

The face and content validity of the research instrument were ensured through a critical appraisal by experts in social sciences and gender issues, curriculum experts and authorities in school administration and management. The relevance, phrasing and suitability of the items of GDIFS and how friendly the instrument is at the face level were all put together as

the criteria used for the instrument validation. Upon the administration of twenty of the instrument to some other university staff outside the scope of the study, Cronbach Alpha Coefficient of 0.65 obtained was considered suitable for the study.

The researchers with the help of some trained research assistants were involved in the data collection, and the data collection lasted for about two weeks in the university surveyed. The information collected was transferred into data coding sheet and presented in form of tables. Descriptive statistics of frequency count, mean and standard deviation was used to answer the research question while the decision point for mean acceptance is 3.0 out of a total score of 6 upon which interpretations were made. Pearson's Product Moment correlation was used to test each of the two research hypotheses at 0.05 level of significance.

Results

Research Question 1

What are the factors influencing differential gender participation in curriculum implementation activities for millennium development?

Table 1: Participants responses on the factors influencing differential gender participation in curriculum implementation activities

S/N	Factors Influencing Differential Gender Participation in Curriculum Implementation Activities	Strongly Influenced SI	Moderately Influenced MI	Not Influenced NI	Mean X	Decision
1.	Biological destiny as a factor influences differential gender participation in curriculum implementation activities	470	150	90	4.32	Accept
2.	Religious factor influences differential gender participation in curriculum implementation activities	510	165	35	4.20	Accept
3.	Family/Community factor influences differential gender participation in curriculum implementation activities	321	290	99	4.30	Accept
4.	Traditional/Custom factor influences differential gender participation in curriculum implementation activities	194	362	154	3.92	Accept
5.	Legal subordination of women as a factor influences gender participation in curriculum implementation activities	354	314	42	3.56	Accept
6.	Stereotyping factor influences differential gender participation in curriculum implementation activities	355	245	110	4.23	Accept
7.	Social experience factor influences differential gender participation in curriculum implementation activities	266	387	57	4.60	Accept
8.	Government policy factor influences differential gender participation in curriculum implementation activities	305	280	135	4.12	Accept
9.	Control over women as a factor influences differential gender participation in curriculum implementation activities	267	272	171	3.80	Accept

10.	Apprehension of female superiority as a factor influences differential gender participation in curriculum implementation activities	348	268	94	4.34	Accept
	Average (%)	44.5	34.6	20.9	4.21	Accept

Table 1 shows that all the factors identified in this study were accepted by the respondents as influencing differential gender participation in curriculum implementation for millennium development because each of the mean score is above 3.0 the cut-off score selected as decision point in this study. Social experience which is a condition of people interaction in various social group has the highest mean score of 4.60. It is followed by biological destiny (4.40) which implies that natural gender build up of individuals influences their selection in work places on curriculum matters. Legal subordination of women as a factor has the least mean score of 3.56. Notwithstanding, it is also applauded as another factor influencing gender differences in education sector where curriculum implementation comes into play.

Hypotheses Testing

Ho_1: There is no significant correlation between male and female mean responses on the factors influencing differential gender participation in curriculum implementation for millennium development.

Table 2: Pearson correlation between male and female participants' responses on the factors influencing differential gender participation in curriculum implementation for millennium development

Variables	N	Mean	Std. Dev.	df	R	Critical (r-table) value	Remark
Male	410	15.03	3.18	708	0.638	0.195	Significant
Female	300	24.30	8.24				

As presented in table 2, it shows that r-calculated is 0.638 while its corresponding table value at 0.05 level of significance is 0.195. Since r-cal.> r-tab, it implies that significant correlation exists between male and female mean responses on the factors influencing differential gender participation in curriculum implementation for millennium development. Null hypotheses 1 (HO_1) is thus rejected.

HO_2: There is no significant correlation between staff and students mean responses on the factors influencing differential gender participation in curriculum implementation for millennium development.

Table 3: Pearson correlation between university staff and students mean responses on the factors influencing differential gender participation in curriculum implementation activities for millennium development

Variables	N	Mean	Std. Dev.	df	R	Critical (r-table) value	Remark
University Staff	200	18.90	3.27	708	0.571	0.195	Significant
University Students	510	24.10	8.10				

Table 3 shows that the mean responses of the university staff and students on the influencing factors are 18.90 and 24.10 with standard deviations of 3.27 and 24.10 respectively while the r-calculated is 0.571 and its corresponding table value is 0.195 at 0.05 level of significance. By comparison, r-calculated is greater than the r-tabulated. Hence, the null hypothesis of no significant correlation between staff and students mean responses on

the factors influencing differential gender participation in curriculum implementation for millennium develop identified in this study is rejected.

Discussion

In the study, the factors influencing differential gender participation in curriculum implementation activities were investigated along with the correlation between male and female scores on the influence of the factors as well as the correlation between university staff and students mean scores correlation on the factors, all for millennium development.

The result in table 1 showed that the ten influencing factors identified in this study are indeed worthy of attention in curriculum implementation activities because the 710 respondents (university staff and students) confirmed that they influence gender participation in education sector. This confirms the report of Alade (2012) that gender disparities is obvious in various positions as a result of cultural believe, societal expectations, religious records, and discrimination among others.

The significant correlation between male and female students mean scores in table 2 is an indication that their perception about the identified factors in this study moderately (57.1%) related to gender position and participation in curriculum implementation activities in education sector. However, the female participants have a higher mean score of 24.30 compared to a mean of 15.03 of their male counterparts. By implication, the female participants considered those factors as the main factors suppressing them in participating maximally in curriculum implementation process. This is marginalization per se. To corroborate this observation Sadoh, Alenkhe and Agbontaen-Eghafona (2013) see it as underutilization of women, frustration for women, inferiority complex and recycling of males.

The result in table 3 with significant correlation between the university staff and students mean scores on the ten identified factors also implies that differential gender participation in curriculum implementation still persists till date. The influence of gender is therefore similar in strength to that of religion, race, social status, and wealth (Ayangunna, 2012). The environment has helped to create the current situation, and it is not that women are frail and mindless (Mill, 2006, cited in Kanu, 2012). The environment is seriously engulfed with the factors identified and applauded by the participants in this study.

Conclusion

This study has acknowledged that male and female individuals as parties are both responsible for curriculum implementation in education sector. Their access and parity are conditions for millennium development. With the findings in this study, the influence of biological factor, religious factor, family/community factor, tradition, legal subordination of women, stereotyping factor, social experiences, government policy, man control over women and apprehension of female superiority complex in Nigerian sector remain unabated. This continues to have a carryover influence, many a time, negatively on their much needed contributions towards development. This paper concludes that the female folk should not be judged in terms of sex stereotypes rather than their present or potential talents and contributions towards the development of the environment.

Recommendations

To close the gender gap and the obvious differences in gender participation in curriculum matters, both in administration, management and academic, as well as in education sector generally, the following recommendations are suggested for consideration and action:

(i) Governments and private agencies/organizations must continue to make efforts in addressing the systematic barriers to girls educational access and female participation in management positions in Nigeria.
(ii) Norms and attitudes in term of socio-cultural factors that perpetuate inequality in gender participation in curriculum matters should be discouraged through adequate sensitization of the citizenry to enhance gender participation and productivity.
(iii) Women testimonies of good leadership and as role models in their respective positions whenever they have opportunity to serve would close the gender gap in human efforts towards millennium development beyond year 2015.

References

Agbaje, G. I. (2008). *National geospatial data infrastructure (NEDI): An enable for socio-economic improvement in Nigeria.* Paper presented at the GSDI-10 conference, Trinidad. Held in February between 25 – 29, 2008.

Alade, I. A. (2012). Gender stereotyping and empowerment in Nigeria society: Implications for women repositioning in curriculum delivery. *An International Journal of Language, literature and Gender Studies,* 1(1), 30-43.

Alade I. A. (2013). Gender inequalities in developing nations: The Nigerian experience. *Benin Journal of Gender Studies.* 3(1&2), 94 - 112.

Ayangunna, J. A. (2012). Factors influencing differential gender participation in reproductive behaviour among females in Ibadan. *International Journal of Educational Leadership (IJEL).* 4(4), 139-146.

Dosunmu, A. G & Olusanya, O. (2008). Women participation in politics in Ogun State: Implications and way forward. *A Journal of Human Rights and Gender Education* 1(1), 231 - 243.

Ihensekhien, I. & Adedeji, C. (2013). Promoting gender equality through the millennium development goals (MDGs): Implication for sustainable development. *Benin Journal of Gender Studies,* 3(1&2), 126 - 136.

Kanu, I. A. (2012). The equality of sexes in J. S. Mill vis-à-vis the participation of women in the Nigerian labour and economy. *An International Journal of Language, Literature and Gender Studies,* 1(1), 18 - 29.

Obaid, T. A. (2005). Religion and reproductive health and rights. *Journal of the American Academy of Religion,* 73(3), 1155 - 1173.

Ojedele, P. K., Oluchukwu, E. E. & Adegbesan, S. O. (2013). Gender differences in teacher production in Nigeria. *Journal of Educational Development (JONED),* 5, 164 - 172.

Okan C. C. & Gele, S. M. (2011). Exploring the assets in entrepreneurship programme in promoting universal basic education for attaining the goals intrinsic in Nigeria's vision 2020. *Multidisciplinary Journal of Research Development,* 17(3), 1 - 11.

Olaleye, F. O. (2001). Sex differences of principals and their effectiveness in school-community relations as perceived by teachers. *African Journal of Educational Research,* 7(1&2),161 - 167.

Sadoh, L. I., Alenkhe, O. A. & Agbontaen-Eghafona, K. (2013). Women's participation in community meetings: Marginalization and its social consequences for development in Ikpoba Okha local government area, Edo State, Nigeria. *Benin Journal of Gender Studies,* 3(1&3), 157 - 169.

United Nations (2005). *Commission on the status of women. Report on the forty-nineth sessions of United Nations.* UN.DOC.E/2005/27/corr./-E/CN. February 11 & March 22.

A MULTIPREDICTOR EVALUATION OF SECONDARY SCHOOL STUDENTS' ACADEMIC PERFORMANCE: ISSUES AND IMPLICATIONS FOR EDUCATIONAL ACCOUNTABILITY

YUSUF, LATEEF ADEYEMI Ph.D
Department of Educational Management,
College of Education, Al-Hikmah University, Ilorin-Nigeria
E-mail: adedeyemi@yahoo.com Phone No: +234-806-064-5304

Abstract

This study investigated a combinational effect of four predictor variables (government, school, home and the child) on secondary school students' academic performance in Oyo State. The study adopted a descriptive survey research design. Two research questions guided the study. Simple stratified random sampling technique was used to select 576 respondents from the population 11,733 public secondary schools teachers. A well validated researcher designed instrument tagged 'Academic Performance Inventory' (API) with reliability index of 0.89 (test-retest of three weeks interval) was used for data collection. Multiple regression analysis statistics was used to test the research questions at P<0.05 level of significance. Results showed that the combination of four predictor variables significantly predicted academic performance. Government was the highest predictor, followed by the school, the home and the child, respectively Part of the recommendations stated that the Government should strictly adhere to United Nation recommendation of 26% annual budgetary allocation to education sector. It was concluded that all the stakeholders should be held accountable for poor academic performance, though the highest responsibility lies with the government.

Keywords: Secondary schools, Students' academic performance, Accountability.

Introduction

Education is considered as investment in most developing countries. This is due to the fact that education is now globally recognised as an instrument "par excellence" for development and eradication of poverty. In Nigeria, stakeholders are disturbed following the yearly performance of students in the Secondary School Certificate Examination (SSCE). Student outcomes do not match the public investment in education. Not only that Nigerians no longer believe in public schools due to decaying of infrastructure. What the public see are massive failure in public examination and indiscipline (Balogun, 2005; Ekwesili, 2006 & Ogunsaju, 2004).

A worthwhile investment in education will lay a true foundation for an enduring development. The idea behind the huge resource allocation to secondary school level of education in the nation was to revamp the glory of education sub-sector, as it was then plagued by poor academic performance. The broad aim of secondary education is to prepare students for higher education and useful living in the society (FGN, 2008). Results of May/June 2011 National Examination Council (NECO) revealed that only 26% of the candidates that sat for the examinations scored five credits and above including English Language and Mathematics, being the two subjects that are central to admission requirement of Nigerian higher institutions. In 2010 only 21% of the candidates passed with distinction or credit in five subjects and above including English language and Mathematics. The situation was worse in 2009 where only 10.53% of the candidates scored five credits and above including English language and Mathematics (Ayodele & Ige, 2012).

From time immemorial, learning outcomes (passes or failures) could largely be attributable to the quality of instructions received by the learners. An underlying assumption is that causes of poor academic performance could be varied and multi-dimensional. For example, Majoribank (1995) opined that aspirations of peers could affect an individual's effort and achievement in school. In the same vein parents are more influential than peers on plans for future schooling. However, there are more fundamental barriers to the success of learning outcomes, which neither policy makers nor planners adequately grasped. Prominent among them is the problem of accountability and control in our education system.

When President George Bush assumed office, he undertook some educational reforms based on his observations about the dwindling quality of public education in America and the need for America to rise up to the challenges of post modern world. Based on this, his administration educational reforms tackled four key issues, namely accountability, standard, test and choices (Reeves, 2001).

Accountability is here defined as a state of accepting and demonstrating responsibility for actions taken or not taken in connection with one's designated position. Control is a situation of demanding accountability from an employee or any person by holding him responsible for the consequences of his action or inaction (Unachukwu, 2001). According to Benjamin (2011), accountability is not a means of relieving teachers of their jobs, but it is a guarantee that all students, regardless of place of origin or social status will acquire the minimum skills necessary to take full advantage of the choices that are open to him upon the successful completion of his public school.

In the study of students' academic achievement in secondary schools, Aderonmu (1995) submitted that pupils' achievement is determined by many factors other than skills and efforts of teachers. Such factors are the learners' socio-economic status and home environment over which educations exercise no control and peer groups in the school, which the teacher only minimally influences. Nwagwu and Salami (2000) and Bakare (1999) have all reported that several factors including teaching methods, interpersonal relationships among school personnel, nature of curriculum and school topography could affect the academic performance of learners. Ehrenberg and Brewer (2005) and Ferguson (2001) asserted that students learn more from teachers with strong academic skills.

Odedele (2000) opined that anxiety could affect students' academic performance and stressed the importance of home in cognitive stimulation on academic performance. Also, Aremu (2001) discussed the importance of home psychological climate on child emotional states and academic performance. Further on this, Bakare (1997) identifies six basic cognitive skills that a child must acquire for him to do well. This, they explained could be better formed and enhanced through positive child-parent interaction. Still on determinants of student academic success, Aduwa (2004) reported that a student's home environment and their cognitive abilities affects their academic success.

Akinade (2009) in his study identified lack of quality students as ill militating against the success of public schools. In a similar view Adetayo (2009) reported laziness on the part of Nigerian pupils. According to Odedele (2009), the way and manner the child perceives himself could affect his academic performance. Not only that, the students' behavioural patterns have strong links to academic performance. In the same way, funding could be described as a critical determinant of student academic performance.

Quality education according to Tawari (2002) and Okroma (2006) is a function of adequate funding. It has become obvious that Nigeria's neglect of the UNESCO funding formular of

26% annual budgetary allocation to education is detrimental to the nation's developmental aspiration. This neglect has already precipitated crises in the entire educational system. The chronic underfunding crises results in poor teaching and learning process. Perhaps the most severe of the problem is poor funding which directly or indirectly leads to other perennial setbacks such as shortage of qualified teachers, death of infrastructure and shortage of books. Based on this background, it will be necessary to unfold some predictor variables of student academic performance with a review to discussing some thorny issues and implications for educational accountability and control.

Research Questions

In order to have necessary guide for this study, the following research questions are raised and answered accordingly;

(i) What is the joint effect of predictor variables (home, child, school and government) on the academic performance of secondary school students?

(ii) What is the relative contribution of each of the predictor variables (home, child, school and government) to academic performance of secondary school students?

Methodology

This study adopted a descriptive survey research design involving the use of questionnaire and checklist. The study populations include 324 public secondary schools in the 33 Local Government Areas (LGAs) in Oyo State. There are 11,732 teachers in the public secondary schools in Oyo state. Stratified random sampling technique was used to sample 24 out of the 33 LGAs (76%). Stratification was based on the dimension of the three senatorial districts in Oyo state. Simple random sampling technique was used to select two public secondary schools in each of the sampled LGAs to give a total of 48 sampled schools. The teachers (n = 576) within these schools were the survey respondents.

The instrument used for this study was a questionnaire tagged "Academic Performance Inventory" (API). The instrument covers four predictor variables (Government, School, Child and Home). The items were structured on a four-point modified likert-type rating format. Experts (in the test construction, Educational Management and English language) from University of Ilorin and Ibadan were used to moderate the face, content and construct validity of the instrument. A reliability index of 0.89 was established, using test-retest method of three weeks interval. This attests to the adequacy of the psychometric properties of the instrument. Check list was used to obtain students' academic performance. NECO results from 2009 to 2013 were collected from the respective schools.

Results

The results and interpretation of the findings of the study are as follows:

Research Question 1: What is the joint effect of predictor variables (home, child, school and government) on the academic performance of senior secondary school students?

Table 1: Composite contribution of the predictor variables to academic performance

Multiple R	R square	Adjusted R Square	Standard Error
0.920	.846	.846	5.9022

Analysis of Variance

Source of Variation	Sum of Square	df	Mean Square	F-ratio	P
Regression	771224.31	4	187224.705	5215.530	0.00
Residual	31213.22	584	36.123		
Total	802437.53	588			

P<0.05

In Table 1, the regression analysis yield a coefficient of multiple regression (R) of 0.920 and a multiple R-square (R^2) of .846. The R^2 values translated into 85% of the observed variance. This means 85% of the variance in the academic performance is accounted for by all the four predictor variables when taken together. The significance of composite contribution or the prediction was tested at P<0.05, producing the F-ratio of 5215.530 at the degrees of freedom (df=4/584). This implies that the joint contribution of the independent variables to dependent variables was significant and that other variables not included in this model may have accounted for the remaining variance.

Research Question 2: What is the relative contribution of each of the predicator variables (home, child, school and government) to academic performance of secondary school students?

Table 2: Relative contribution of the predictor variables to academic performance

Variables	B	SEB	b	T	P
Child	87.413	1.714	.259	41.042	<.05
Home	101.502	2.024	.281	44.013	<.05
Government	127.204	2.301	.272	49.120	<.05
School	121.651	2.123	.285	51.161	<.05
Consumer	-697	6.012		-102.216	<.05

Table 2, reveals the contributions of each of the four predictor variables to student academic performance as expressed Beta weights. Using the standardized regression coefficient of the predictor variables, Government (Beta = 127.204, T = 49.120, P<0.05) was the highest contributor to student academic performance; followed by school (Beta = 121.651, T = 51.161, P < 0.05) followed by home (Beta = 101.502, T = 44.013, P<0.05) followed by child (Beta = 87.413, T = 41.042, P<0.05), respectively

Discussions

The study established some predictor variables, such as home, child, school and government as factors that affect students' performance at secondary school level. In this study 85% of the observed variance were accounted for by the four variables investigated. The F-ratio value (5215.530) of the analysis was found to be significant at the 0.05 alpha level. This implies that predictor variables in the prediction of academic performance were not due to chance factor. Factor residing in government was the highest, this is in line with the view of Ogunsanya (1999) that underfunding of education, instability of educational policy are major factors affecting academic achievement. Findings revealed school as a factor in student academic performance. This corroborates the view of Aremu(2001). The success of the

students in any examination depends largely on teachers and that the school environment is a critical factor in students' academic performance.

The study equally showed that the home has a great influence on the pupils academic performance. This is in line with the view of Ajila and Olutola (2000), Eweniyi (2005) that the states of home affect the individual since the parents are the first socializing agents in an individual's life. The findings equally revealed child as a predicator variable of academic performance. This is because examination anxiety manifested by the learner could affect his performance in academic and that students behaviour patterns have strong link to academic performance.

Issues and Implications for Educational Accountability

In this study, four variables were identified in predicting students' academic performance. The government, school, home and social composition of the student were critical determinants of educational motivation and achievement. From the finding, the government is ranked first, this is occasioned by poor budgetary allocation to education system (less than 26% UNESCO recommendation) that has resulted in dilapidated classroom buildings, laboratories and equipment and irregular payment of teachers salaries that do warrant frequent strikes or how do we explain a situation whereby funds meant for recurrent expenditures, precisely salary, were diverted to capital projects or for political campaign activities. All these among others pave way for declining student academic performance in Nigerian secondary schools. This logically implies that government/ politicians should be the first to be held accountable for poor student academic performance in Nigerian secondary schools.

In a similar vein, this finding equally revealed the school, home and the child as factors affecting academic performance. Thus, to some extent accountability lies in them. It is the school administrators that are ultimately held accountable for the pupils' progress. They must therefore work with teachers in creating an environment where both teachers and pupils will perform at their best. As noted by Lunenburg (2008) teachers have the responsibility for what might be called achievement accountability. In other words, the classroom teacher has the responsibility to find out what skills his pupils needs to ensure continuous progress.

There is need for learner friendly school environment which are virtually not available. Also factors like teaching methods and school topography affects students' academic performance. The child also becomes accountable because students behavioural patterns have strong links to academic performance. The locus of control and examination anxiety manifested by the child affects his academic performance.

Many persons feel threatened by the idea of accountability, and even more disturbed by the way in which the concept is being translated into action. Teachers have the fear that the required level of performance will be unrealistic and unattainable, and this may result in punitive actions against them, especially when the school system does not meet the demand of the parents and the ministry of education.

Teachers could be of the view that while they are likely to be the ones to be held accountable, they often do not have the resources or the power to alter policies or practices which must be changed to pave way for improvement. They cannot on their own buy materials, and initiate new curriculum that necessitate improvement.

Another issue is that schools are not the only factor of change in pupil education. Much of what a pupil learn depends on experiences provided in other setting such as the home or

the child himself. A teacher who is accountable for raising the level of educational performance of a 'culturally deprived' pupil has a much tougher job than one who has to move youngsters from an advantaged background to the same level of achievement

Recommendations

(i) The government at all levels (Federal, State, and Local) should allocate a reasonable percentage of their budget to education sector. However, this is not expected to be less than 26% of annual budget as recommended by the United Nations.

(ii) The importance of home psychological climate on a child's academic performance cannot be ruled out. Based on this, the school is expected to work closely with the home especially on matters concerning 'special' students' such as students with learning difficulties, and those who are emotionally disturbed. Therefore the Parent Teachers Association as an organ of school administration needs to be strengthened.

(iii) The school administrator should perform both supervisory and administrative functions. The latter is however meant to complement the first. The school principal has to be a practical internal supervisor not sitting administrator, working closely with teachers to ensure effective teaching and learning.

(iv) Classroom teachers must be made to view accountability as something designed towards providing them an opportunity for objective performance, with a view to improving the quality of their instruction.

(v) In service training will play an important role in the implementation of a successful system of accountability. Both teachers and administrators will have to develop a sophisticated set of skills for the purpose of setting goals, defining behavioural objective, providing for the involvement of parents and pupils in the decision making process, and prescribing guidelines for instruction and evaluation

Conclusion

The bane of educational development in Nigeria is lack of accountability. The rhetoric question is "who should be held accountable for the poor academic performance? This study has been able to establish some predictor variables of academic performance in secondary schools. Improved academic performance is achievable with the cooperative efforts of all the stakeholders, the government, school, home and the child himself inclusive. This is based on the fact that education for all is the responsibility of all.

References

Aderounmu, W. A. (1995). *An introduction to the administration of schools in Nigeria.* Lagos: Evans Brothers (Nigeria publishers) Limited.

Aduwa, S. E. (2004). Dynamising the instructional system: An inquiry for effective childhood education in Nigeria. *Nigerian Journal of Curriculum Studies, 11,* 239 - 245.

Aremu, A. O. (2001). *Predicting effect of some causal variables on normal primary school pupils academic performance.* A recurring decimal in the educational mandate. Paper presented at the first Faculty of Education annual conference, August 1-3.

Ayodele, J. B. & Ige, M. A. (2012). Teaches utilization as correlate of students academic performance in secondary schools in Ondo state, Nigeria. *European Journal of Educational Studies,* 4, 281 - 256.

Bakare, C. G. M. (1997). Mass failure in public examinations, some psychological perspectives. *Monograph,* Department of Guidance and Counseling, University of Ibadan, Ibadan.

Balogun, A. (2005). *Beyond the post-JAMB test debate.* The punch, October 28, P.15.

Benjamin, B. L. (2001). Accountability for educational result. *Leadership Journal 33*, 559 – 598.

Ehrenberg, R. G. & Brewer, D. J. (2015). Teachers' verbal ability and race matters. *Economics of Education Review, 14*, 1 – 21.

Ekwesili, O. (2006). *Our educational system.* Paper presented at the presidential forum on education Abuja: October 16.

Eweniyi, G. D. (2005). The impact of family structure on university students' academic performance. *Ozean Journal of Applied Sciences 3*, 258 – 265.

Ferguson, R. F. (2001). Paying for public education: New evidence on how and why money matters. *Havard Journal on Legislation,* 28, 465 - 499.

Federal Government of Nigeria (2006). *National policy on education* Lagos: NERDC Press.

Lunenburg, F. C. (2008). *Educational administration: Concept and practices.* USA: Wadsworth Publishers.

Majoribanks, K. (1996) Factors affecting the social status of Australian young adults. *Journal of Social Psychology,* 36,133 – 138.

Nwagwu, H. O. & Salami, S. O. (2000). Self-esteem, locus control, self- efficacy and neuroticism as correlates of job satisfaction among secondary school teachers in Nigeria. *African Journal for the Psychological Study of Social Issues, 4*, 48 - 61.

Odedele, A. R. (2000). *Test anxiety and self- efficacy as correlates of academic performance among secondary school students.* An unpublished M.Ed Dissertation, University of Ibadan, Ibadan.

Ogunsaju, S. (2004). *A guide to school effectiveness in Nigeria*. Ibadan: Laville Publications.

Ogunsanya, M. (2000). Social and political content of education in Nigeria. In M. Ogunsanya (Ed.). *Basic process in education.* Pg.30-42. Ibadan: Adesesan Graphic Press.

Okroma, N. S. (2006). A model for funding and ensuring quality assurance in Nigerian universities. *Nigeria Journal of Educational Administration and Planning, 6*, 1 – 16.

Reeves, D. B. (2001). *Crusade in the classroom.* New York: Simons & Schuster Publishing Limited.

Tawari, O. C. (2002). *Developing a total quality management system for tertiary education in Nigeria*. An inaugural lecture, series No 10. River state University of Science and Technology.

Unachukwu, G. O. (2007). Educational accountability, network and school effectiveness. *Nigeria Journal of Educational Administration and Planning, 7*, 19 - 21.

SKILLS REQUIRED BY STUDENTS FOR VIRTUAL LEARNING IN TERTIARY INSTTUTIONS OF NIGER STATE

JIBRIL AHMED WUSHISHI[1], ABDULRAHMAN MUSA EWUGI[2] & BASHARU MUSA USMAN[3]
[1]Technical Drawing Department
[2]Automobile Technology Department
Niger State College of Education, Minna
[3]Education Technical Department, Kaduna Polytechnic, Kaduna
E-mail: jibrilahmed66@yahoo.co Phone No: +234-805-118-2083

Abstract
The study focused on student's personal skills required for virtual learning in Niger State Tertiary Institution, personal skills are essential to enable students succeeds in virtual learning. Three research questions guided the study and a total number of 54 copies of structured questionnaire with five point likert scale were distributed and used to elicit information from the respondents and all the copies were retrieved given a return rate of 100%. Mean and standard deviation were employed to answer the research questions. A descriptive survey research design was adopted for the study; it was found that computer literacy skills, effective communication skills and independent learning skills were needed for virtual learning. It was also recommended that the college should organize information communication technology training programme for the Students with emphasis on communication skills. This will increase their level of communication and will make them reach out to the world beyond the classroom and communicate ideas in powerful ways, use technology effectively to access, evaluate, process and synthesize information from various variety of sources.

Keywords: Personal skills, Virtual learning and Tertiary institution

Introduction
In the present days Nigeria, there is a general demand for functional education, the important role of technology to the present and future human existence cannot be over emphasized. The socio-economic and technological development of any community or nation hinge on the level of qualitative educational attainment of the citizens, therefore, Niger State as a developing state can only achieve this by exposing her students at the tertiary institutions to Virtual learning which depend on the students' personal skills. These skills are so essential for every 21st century child as a knowledge explorer.

Okorie (2001) defined skills as ease, rapidity and precision usually of muscular action.
Skill refers to the ability to perform an act expertly or that expertness, practiced ability or proficiency displayed in the performance of a task. It is also a well-established habit of doing something, Osinem&Nwoji (2005). Garrison (1997) also sees skills as the ability to do something well arising from talents, training or practice. Skills are of different types, they include academic skills, occupational/technical skills and employability skills. An efficient skill developed raises hope for better utilization of resources for the nation's industrial growth and development.

Personal skills are those skills that an individual should posses to enable him/her succeed in a Virtual learning environment; these skills are the computer literacy skills, self-motivational skills, effective personal communication skills, independent learning skills and personal commitment skills (Crowley, 2002). To progress towards career goals tertiary education students must be successful not only in occupationally related skills, but also in personal,

social and civic skills which are necessary to rewarding participation in the larger society. The acquisition of requisite personal skill is a means of increasing the productive power of a person or nation; those who are trained for jobs become wage earners. They turn out to be useful contributors rather than consumers of goods. Personal skill required for virtual learning is important for the development of intrinsic potentials in an individual, to enable people enhance their intellectual physical, social, emotional, moral, spiritual, biological, political and economic capacities, there is need to make provision for them to learn and acquire appropriate skills and express same. With this, individual's student can become aware of the challenges that are associated with a worthwhile life that will boost their career, stability and fulfillment in a world of competitive industry (Okorie, 2000).

Twenty years ago, cell phones, laptops, pagers, fax machines and internet were in the realms of scientists and science fiction; today those technologies and the Internet have gained widespread public acceptance and use. It is clear that in today's digital age, students must be technologically literate to live, learn and work successfully, Hoffman & Blake (2003). Most schools acknowledge the importance of technology to their students' futures, but to date few have successfully incorporated technology into the mainstream of academic learning, Hoffman & Blake (2003). Technological literacy is an essential component of job readiness, citizenry and life skills, students must not only become competent in the use of technology and associated applications, they must also be able to apply their skills to practical situation. Most experts agree that students should develop and improve their virtual learning skills in the context of learning and solving problems related to academic content.

Virtual learning has a key role to play as an enabler to help better manage complex information flow and to integrate them towards the maximization of human capacity and potentials. Virtual learning is the delivery of educational lessons through electronic medium anytime, anywhere. It can also be defined as employing information and communication technology to deliver instruction (Brooke, 2002). Virtual learning is a term frequently used interchangeably with Distance learning, Online learning, e-learning or web-based learning (Holstron, 2002). Virtual learning is seen as one of the modern instructional techniques that adopt the principle of artificial intelligence, that combine the power of massive data processing and computational power associated with modern computers (Webstar & Hackley, 1997).

In educational delivery system, Virtual learning can be achieved through the Internet, CD ROMs and computer base programme instruction either in the form of asynchronous instructor led instruction, synchronous instruction and blended instruction to compliment in-person teacher's instruction (Frick, 1991). Virtual learning is being developed to address individual learning styles and need, to provide opportunities for students at risk for dropping out of school because of pregnancy, high mobility and disciplinary problems to offer wider course offerings, particularly advanced courses and to accommodate the needs of accelerated learners who drop out of tertiary institutions. One of the main goal of tertiary education as stipulated by the national policy of education (FRN, 2004) is to acquire social and intellectual skills which will enable an individual to be self-reliant and useful member of the society. These includes Virtual learning skills, and these skills holds great potential in supporting and augmenting existing educational as well as National development efforts and therefore, the need for the study in students' personal skills for virtual learning in Niger State Tertiary Institutions.

Statement of the Problem

Many exciting applications of information communication technology in schools validate that new technology based models of teaching and learning have the power to dramatically improve educational outcomes, yet the cost of technology, the rapid evolutions and the special knowledge, skills and aptitude required of its users pose substantial barriers to effective utilization (Hoffman & Blake 2003).

Information in Niger State College of Education are received in lecture format over the internet or virtual learning environment, this may hinder the students ability to adequately explore for knowledge over the internet using the computers. This may be due to inadequate training programmes and infrastructures put in place by government in the educational sector for students to acquire personal skills before the introduction of virtual learning facilities in Niger State College of Education.

Virtual learning holds great potential in supporting and augmenting existing educational as well as National development efforts. Virtual learning instructional technique is still face with several problems Hoffman & Blake (2003), if these problems are not addressed, the effectiveness of any Virtual learning programme will be reduced considerably and will not be adequately replicated both at the state and national levels and it is against this backdrop that this study is undertaken to fill this identified gap.

Research Questions

This study was guided by the following research questions

(i) What are the basic computer literacy skills required by students in Niger State College of Education for Virtual learning?
(ii) What are the personal effective personal communication skills required by students in Niger State College of Education for Virtual learning?
(iii) What are the independent learning skills required by students in Niger State College of Education for Virtual learning?

Methodology

The study was a descriptive survey research design, the design was considered most suitable for the study since information from the population posses the characteristics of the whole population under investigation. Niger State College of Education, Minna was the area of the study which is one the state own tertiary institutions. This area suits this study because it is believed that the acquisition of social and intellectual skills which will enable an individual to be self reliant and useful member of the society is best achieved at the tertiary institutions. The population for the study was 687 which comprise all the students of School of Technical Education, Niger State College of Education. A total number of 54 students were randomly selected as sample for the study from all the levels of the students of School of Technical Education.

Face validation was carried out on the structured questionnaire used for data collection by two experts from the Department of Computer Science, Niger State College of Education, Minna. The structured questionnaire was made up of two parts “I” and “II”. Part “I” is personal data, which indicated the category each respondent belongs. Part “II” is the questionnaire items which are made up of three sections A, B and C with specific observation skills used to elicit the opinion of respondents. All the instruments administered were retrieved given a total of 100% return leaving a mortality rate of 0.0%. It was made up of 21 items from five likert – type scale to identify to which extent a skill is required for virtual learning.

The data collected from the questionnaire were analyzed using mean and standard deviation to answer each of the three research questions. In taking decision for the research questions, any item with a mean of 3.50 and above was considered as required, while any item with the mean less than 3.50 was considered as not required. Before the administration, the instrument was administered on 10 students of 300 level in the school of science, Niger State College of Education, Minna. Their responses were used in the computation of the reliability coefficient of the instrument using Pearson product moment.

Results

Research Question 1: What is the basic computer literacy skill required by student in Niger State College of Education for virtual learning?

Table 1: Mean responses of students on computer literacy skills required for virtual learning in Niger State College of Education

S/No	Basic computer literacy skills required	X	SD	Remark
1	Ability to start, reboot and shut down a computer	3.76	1.22	Required
2	Ability to Log on to the Internet	3.60	1.23	Required
3	Ability to print a word processing document	3.58	1.39	Required
4	Ability to add a table to a document and edits rows and columns	3.55	1.33	Required
5	Ability to add a table to a document and edits rows and columns	3.67	1.23	Required
6	Ability to understand animation of movement	3.64	1.26	Required
7	Ability to vary font, size and style	3.53	1.33	Required

Key: N = no of respondents (54); X = mean; SD = standard deviation

Table 1 above shows the mean responses of students on computer literacy skills required by students in Niger State College of Education for virtual learning, from the above table, the students perceived that all the items are the most essential basic computer literacy skills required for virtual learning with a mean (X) and standard deviation (SD) ranging between 3.53 to 3.76 and 1.22 to 1.39 respectively

Research Question 2: What is the personal effective communication skill required by student in Niger State College of Education for virtual learning?

Table 2: Mean responses of student's effective communication skills required for virtual learning in Niger State College of Education

S/No	Effective communication skills	X	SD	Remark
8	Ability to type, spell and grammar check on the computer	3.50	1.36	Required
9	Ability to create, send, forward reply and save e-mail messages	3.55	1.23	Required
10	Ability to use talk or chat features for real-time communication	3.41	1.36	Fairly required
11	Ability to read and understand text messages clearly	3.50	0.85	Requires
12	Ability to use electronic mailing lists for communication	3.50	1.33	Required
13	Ability to use and understand the purpose of a Browser	3.79	1.2	Required
14	Ability to use keyboard for simple search	3.66	1.27	Required

Key: N = no of respondents (54); SD = standard deviation

Table 2 above shows the mean responses of students on the personal effective communication skills required by students in Niger State College of Education for virtual learning. The result from the table shows that students perceived that all the items with the exception of item number 10 are the personal effective communication skills required for virtual learning with a mean (X) and standard deviation (SD) rating ranging from 3.50 to 3.79 and 0.83 to 1.34. However, item number 10 is been perceived as a skill which is fairly required for virtual learning with a mean (X) and standard deviation (SD) of 3.41 and 1.36 respectively.

Research Question 3: What is the independent learning skill required by student in Niger State College of Education for virtual learning?

Table3: Mean responses of students independent learning skills required for virtual learning in Niger State College of Education

S/No	Independent learners skills required	X	SD	Remark
15	Ability to always work within schedule time when learning	3.52	1.33	Required
16	Ability to set and realize goals and objectives when learning	3.61	1.32	Required
17	Ability to work in collaboration with other students virtually through e-mail correspondence	3.57	1.34	Required
18	Ability to look forward to growing and developing one's full potentials when learning	3.78	1.25	Required
`19	Ability to transfer knowledge from virtual learning situation to real life situations	3.72	1.27	Required
20	Ability to access the information needed for problem solving virtually	3.68	1.24	Required
21	Ability to use self management strategies such as self discipline to allocate time and resources	3.57	1.09	Required

Key
N = no of respondents (54)
X = mean
SD = standard deviation

Table 3 above shows the mean responses of students on the independent learning skills required by students in Niger state College of Education for virtual learning. The result from the table shows that the students agreed that all the items are the independent learning skills mostly required for virtual learning with a mean (X) and standard deviation (SD) rating ranging from 3.52 to 3.78 and 1.09 to 1.33 respectively.

Discussion

The findings on the basic computer literacy skills as shown in Table 1 revealed that the ability to start, reboot and shut down a computer, ability to Log on to the Internet, ability to print a word processing document, ability to add a table to a document and edits rows and columns, ability to understand animation of movement and the ability to vary font, size and style are all in agreement with Owen (2003), Hoffman & Bankole (2003), Osinem & Nwoji (2005) that technological literacy is knowledge about what technology is, how it works, what purpose it can serve and how it can be used efficiently and effectively to achieve specific goals, that technologically literate students demonstrate a sound conceptual understanding of the nature of information communication technology garget and view themselves as

proficient users of these systems and use a variety of technology tools in effective ways to increase creative productivity.

The findings on the personal effective communication skills as shown in Table 2 revealed that the ability to type, spell and grammar check on the computer, ability to create, send, forward reply and save e-mail messages, ability to use talk or chat features for real-time communication, ability to read and understand text messages clearly, ability to use electronic mailing lists for communication, ability to use and understand the purpose of a browser and the ability to use keyboard for simple search are all in agreement with Okorie (2000), Crowley (2002)and Roskoff (1999) that in today's wired networked society, students should be able to use communication tools to reach out to the world beyond the classroom and communicate ideas in powerful ways, use technology effectively to access, evaluate, process and synthesize information from various variety of sources and that students should learn to communicate effectively using a range of media, technology and environment. This includes both synchronous and asynchronous communications, such as person to person to e-mail correspondence, phone or audio communication and interactions through simulations and models.

The findings on independent learning skills as shown in Table 3 revealed that the ability to always work within schedule time when learning, ability to set and realize goals and objectives when learning, ability to work in collaboration with other students virtually through e-mail correspondence, ability to look forward to growing and developing one's full potentials when learning, ability to transfer knowledge from virtual learning situation to real life situations, ability to access the information needed for problem solving virtually and the ability to use self management strategies such as self discipline to allocate time and resources are all in agreement with Abdullah (2001) and Hon Kock and Betts (2002) that an independent learners are responsible owners and managers of their own learning process, such individuals have the skills to access and process the information they need for a specific purpose. Independent learning integrates self management (management of the context including social setting, resources and actions) with self monitoring (the process whereby learners monitor, evaluates and regulate their cognitive learning strategies).

Conclusion

Based on the analysis and findings of this study, the following conclusions were drawn: students in Niger State College of Education require basic computer literacy skills, personal effective personal communication skills and independent learning skills in order to become proficient user of the computer for virtual learning at their disposals to enable them cope with this modern instructional techniques. Finally, all the skills are required in order to tackle extremely challenging problems and make a head way in virtual learning.

Recommendations

The following are recommended:

(i) Establishment of training centers for students in tertiary institutions to acquire basic computer skills. This will make the students to perfect their computer skills and become proficient users of information communication technology gargets.

(ii) The college should organize information communication technology training programme for the Students with emphasis on communication skills. This will increase their level of communication and will make them reach out to the world beyond the classroom and communicate ideas in powerful ways, use technology effectively to access, evaluate, process and synthesize information from various variety of sources.

(iii) The federal and state ministries of education should make more funds available for the provision of virtual learning equipment at various colleges for the students to learn on their own. This will make them responsible owners and managers of their own learning process, such students will have the skills to access and process the information they need for a specific purpose.

References

Abdullahi, M. H. (2001). *Self directed learning.* [ERIC digest No. 169] Bloomington, IN ERIC clearing house on Reading English, and communication (ERIC Document Reproduction service No. ED 459458).

Cowley, D. J. (2002). The www of distance learning. *Who does what and where? Training and development, 52(9), 29 – 30.*

Dede, S. (1998). Preparing students for lifelong learning. A review of instructional features and teaching methodologies performances improvement. *Quarterly*, 16(2).

Federal Republic of Nigeria (2004). *National policy on education*, Lagos: NERDC Press.

Frick, E. L. (1991). *Technological fluency: Needed skills for the future.* In H. F. Oncil, *Technology applications in education: A learning view.* Mahwah, N.J: Erlbum.

Garrison, D.R. (1997). Self directed learning; towards a comprehensive model. *An Adult Education Quarterly,* 97(48).

Hankok, V. & Betts, F. (2002). Back to the future preparing learners for academic success in 2004 *Learning with Technology*, 29 (7), 10 - 14.

Hoffman, M. & Blake, J. (2003). Computer literacy: Today and tomorrow. *Journal of Computer Sciences in Colleges,* 18(5), 221 - 233.

Holstron, A. O. (2002). Computer literacy topics: A comparison of views within a business school. *Journal of Information Systems Education,* 6(2), 55 - 59.

Okorie, J. U. (2001). *Developing Nigeria's workforce*. Calabar: Page Environs Publishers.

Osinem, E. C. & Nwoji, C. U. (2005). *Students industrial work experience in Nigeria: Concepts principle and practice.* Enugu: Cheston Agency Ltd.

Owens, B. (2003). Ethics and the internet: A novel approach to technical literacy*. Journal of Computing in Small Colleges,* 18(4), 4 - 10.

Rushkoff, D. (1999). *Playing the future*. New York: Retrieved Books

Webstar, L. & Hackley, F. (1997). *From computer to community*: *Unlocking the potentials of the wired classroom.* New York: Centrinity Publishers.

EFFECT OF CLASS-WIDE PEER-TUTORING TECHNIQUE ON THE PERFORMANCE OF SLOW LEARNERS IN ECONOMICS IN ILORIN-SOUTH, KWARA STATE NIGERIA

YUSUF, H. T. (Ph.D) & YUSUF, A. (Ph.D)
Dept of Arts and Social Sciences Education,
University of Ilorin, Ilorin, Nigeria
E-mail: hamdallatyusuf@yahoo.com; yuabra25@yahoo.com; gambari@futminna.edu.ng
Phone: +234-803-395-3944

Abstract
The study examined the effects of Class-Wide Peer Tutoring (CWPT) technique on the performance of slow learners in Economics in Ilorin-South Local Government of Kwara State Nigeria. 12 slow learners (8 male and 4 female) were randomly selected from a purposefully sampled secondary school. The pretest, posttest experimental group design was adopted. A 20-item multiple-choice objective test termed Economics Achievement Test (EAT) was used for collecting data. The validated EAT was tested for reliability. Paired sampled T-test and independent sample t-test were used in determining the significant differences among the two groups. The results showed that there was statistically significant difference between pre-test and posttest mean scores of students taught economics using class-wide peer tutoring. In addition, there was no significant difference between male and female slow learners taught economics using CWPT.

Keyword: *Class Wide Peer Tutoring, Slow Learners, Gender, Economics*

Introduction
In Nigeria, classroom teachers are facing large enrolment of students which makes heterogeneity and group management becoming increasingly more challenging. This could be one of the factors responsible for the adoption of teacher-centred teaching strategy. Teacher-centered approach is a one-way process in which the teacher directly presents information while students generally remain passive throughout a lesson. This approach could make schooling look tedious, suffused with anxiety and boredom, destructive of curiosity and imagination, and produce cramming machines (Nworgu, 2009; Gupta & Pasrija, 2012). In this strategy, teachers could only provide immediate feedback to group of students rather than individual. Peer tutoring is one of the strategies that can solve these problems (Enserqueix & Lafont, 2010).

Peer tutoring makes students active participants, giving them more responsibility and promoting their level of engagement in the task. Peer tutoring is an instructional strategy that encourages students' partnership, linking high achieving students with lower achieving ones for structured reading, discussion and information exchange among students during the class lesson (Ezeugwu, 2009; Rohrbeck, Ginsburg block, Fontuzzo & Miller; 2003). In a Peer tutoring program, one student teaches another in a school setting (Allen, 2011). Students are paired together with the goal of providing instruction and feedback to one another (Rink, 2006; Ward & Lee, 2005). Such arrangements can be both uni-directional, typically when a more knowledgeable student assists another less knowledgeable student. Or, the arrangements can be bi-directional involving the whole class, often called class-wide peer tutoring (CWPT).

CWPT is one of the most widely studied and most highly recommended strategies for promoting achievement among diverse groups of learners (Ayvazo & Ward 2009; Butler & Hodge 2001; Iserbyt, Elen & Behets 2010, Weidner & Popp, 2007). CWPT has been shown to greatly increase the level of active student responding while providing students with opportunities to

receive more time on task, immediate and specific feedback, more practices in short periods of time, and positive social and academic supports (Maheady & Gard, 2010). CWPT provides a way for students to get one-on-one help while practicing and learning, and more importantly, students have guided opportunities to apply learning strategies to improve their performance. The benefits of CWPT have been found to last even when a student moves into a classroom where similar methods are not being utilized (Gordon, 2003, Golding, Lisa & Tennant, 2006).

CWPT is characterized by highly engaged, high-paced, and partner-regulated instructional interactions (Greenwood, Maheady, & Delquadri, 2002). Teachers often report that students improve academic skills, on-task behaviors, and social skills as a result of utilizing the CWPT method (Elbaum et al., 2000). Research indicates that students enjoy both the role of tutor and tutee, giving them a positive attitude toward learning. This outlook increases positive social interactions while reducing disruptive behaviors. Given the critical importance of behavior to children's school and later life success, the social and academic benefits of school interventions such as CWPT deserve close scrutiny.

The CWPT method can effectively assist the teacher by providing two important learning variables: many opportunities for students to respond to academic tasks, and frequent and immediate feedback (Golding, Lisa & Tennant, 2006). Research indicates that peer tutoring is an economically and educationally effective intervention for slow learners and high achievers that can benefit both the tutor and tutee, socially and educationally by motivating them to learn. It means that when peer tutoring is carefully guided by a teacher, the interaction among individuals and groups in the classroom will deepen the understanding of the concepts among the students.

Slow learning is not a learning disability that can be classified as a diagnostic category. It is simply a term used to describe a student with the ability to acquire all necessary academic skills, but at a rate and depth below that of the average student. Slow learners lack concentration, have poor memory, imagination, and foresight; an inability to express ideas clearly through the medium of language (Bhatt, 2009). In order to grasp new concepts, a slow learner needs more time, more repetition, and often, more resources, external stimulation and encouragement from teachers to be successful. Reasoning skills are typically delayed, which makes new concepts difficult to grasp (Lowenstein, 2003; Muppudathi, 2014; Sugapriya & Ramachandran, 2011).

Research indicates that academically slow learners pose significant educational and behavioral difficulties in the schools because of their deficiencies in intellect and psychosocial skills (Anastasia, Elein, & Effi, 2006; Shaw, 2008). This is also well documented that slow learners do work at their ability level but below their grade level, which in turn leads to their adjustment problems in mainstream class rooms (Krishnakumar, Geeta, & Palat, 2006). Their deficit in skills (e.g. inadequate coping mechanisms, poor self-image, immature interpersonal relationships, troubled communications, and inappropriate social role ideology) make them vulnerable or at risk of several psychosocial problems (Khan, 2008). These problems could only be addressed by incorporating interventional teaching strategies in the inclusive classrooms for their accommodation and to enhance the rate of their adequate psychosocial development i.e., better adult and peer interactions, enhanced receptive and expressive communication, and modesty of self-concept, and social role by expressing logical reasoning and understanding of environmental demands (Anastasia, Elein, & Effi, 2006). For instance, Lata and Gaonka (2008) conducted a study on instructional strategies to accelerate science learning among slow learners in Dharwad city. The results indicated that the teaching through models for slow learners was found to be the most effective instructional strategy followed by charts, picture book, individual instruction and peer tutoring. Similarly,

Malik, Rehman and Hanif (2012) carried out single-group pre-test and post-test design to see the effectiveness of academic interventions on developmental skills (adaptive, personal-social, communication, motor, and cognitive) of slow learners having borderline intelligence. Quantitative analyses revealed that academic interventions were highly effective in enhancing the developmental skills of slow learners' adaptive, communication, and cognitive developmental skills.

Ayvazo and Ward (2009) examined the effects of Class-wide Peer tutoring (CWPT), a variation of peer tutoring on the volleyball skills of four 6th grade middle school students from an intact class of 21 students. The findings provide further validation of CWPT as an effective strategy in physical education settings. There was increased engagement in the lesson and correct performances of girls during CWPT. In another study, Ward and Ayvazo (2006) assessed the effects of CWPT on the engagement and success level of kindergarten and first grade students with autism in an inclusion setting, throughout a 26-day catching unit. Ward and Ayvazo (2006) demonstrated that both engagement and success levels increased during CWPT.

Anthony (2007) examining the effect of a required school year long Character Education and Class-Wide Peer Tutoring program (CE+CWPT) for students who scored at or below proficiency in one, two, or three of their reading fluency, reading comprehension, or writing assessments at the beginning of their 5th-grade school year. On posttest-posttest comparisons, there were no significant differences between the groups on reading fluency, reading comprehension, and writing scores.

The CWPT experience improves self-concept and positive attitudes toward school as students take ownership of learning and become more responsible for completing assignments and controlling their behavior (Greenwood & Delquadri, 1995). Educators and students alike have been enthusiastic about the use of CWPT (Greenwood, Arreaga-Mayer, Utley, Gavin, & Terry, 2001).

Ezenwosu and Nworgu (2013) investigate the efficacy of peer tutoring and gender on students' achievement in biology in Aguata Education zone of Anambra state, Nigeria. The results among others showed that students taught biology using peer tutoring performed significantly higher than those taught biology using the conventional lecture method. In a review of Peer Tutoring, Ward and Lee (2005) found that students can be taught to observe and assess their peers with 70-96% accuracy completing simple measures to more complex game performance instruments.

The debate over gender differences has gained renewed attention in recent years as researchers attempt to understand the discrepancies that still exist in academia and the work force. Gender is the societal meaning assigned to male and female with a particular role that each should play. This is verifiable because, there is a general belief among Nigerians that males are superior to females in terms of physical physique, cognition, logical reasoning and even in academic achievement (Anigbogu, 2002). Many argue that females are more likely to have better verbal abilities than males and conversely, males are more likely to have better mathematical skills than females (Skaalvik & Skaalvik, 2004). In support of this, Ezenwosu & Nworgu (2013) revealed that male students slightly performed better than female students when taught biology using peer tutoring strategy. On the contrary, Ozofor, (2001) found that females achieve better than males in mathematics. While, Scafidi and Khanh (2010), Else-Quest, Hyde, & Linn (2010) challenged the hypothesis that males, on average, demonstrate higher mathematical abilities than females. Consequently, gender differentiations that exist in some science related subjects, which lead to variation in academic achievement

of male and female students remain an issue of concern to researchers.

The slow learners in economics education should be identified and necessary remedial measures have to be taken for improvement in their performance. Hence, an alternative strategy for improving learning among slow learners seems to be most appropriate and the present study confirmed its effectiveness in improving the rate of learning science among slow learners.

Previous studies shown that CWPT had afforded the tutee more time to practice, to ask questions, and to learn the subject matter. These results, however, were obtained in regular and special education settings. Little is known about whether these effects are similar for instruction in economics education settings. It is on this premise that this study explored the effects of class-wide peer tutoring technique on the performance of slow learners in economics in Ilorin-South, Kwara State, Nigeria.

Research Questions

The following research questions were raised to guide the study:

(i) Is there any improvement in the performance of students exposed to class-wide peer tutoring method in pre-test as compared to post- test?

(ii) Is there any difference between male and female students' performance taught using the class-wide peer tutoring method?

Research Hypotheses

Ho_1: There is no significant difference in the pre-test and posttest scores of students taught economics with CWPT.

Ho_2: There is no significant difference in the performance of male and female students in the use of class-wide peer tutoring method.

Methodology

The study was a quasi-experimental design employed pre-test and post-test design. The population of this study is made up of all secondary schools in Ilorin metropolis. The accessible population was made up of one selected secondary school out of senior secondary schools in the area. One secondary school was purposively sampled. 12 slow learners (8 male and 4 female students) were purposely sampled from senior secondary school class two (SSSII). The selection was made based on the previous examination results in economics. The students in this category had comparable background with age ranges between 16 – 18.

The instrument used for data collection was Economics Achievement Tests (EAT). It consists of 20-item multiple-choice objectives questions that covered two areas in Economics syllabus (banking in Nigerian sector, and industrialization). The EAT was divided into two sections: 10 questions for each of the topic. Each question has options A-D. Students responded to EAT by ticking the right option from A-D.

A letter of introduction was collected from the Department by the researcher to seek for the approval of the principal, the class teacher, the Economics teacher and all the staffs and students of the selected secondary school in gathering the data needed. Economic Achievement Test (EAT) was administered as a pre-test by class teacher.

The class is divided into two competing teams, and pairs of students are formed within each team. The tutor presents the content stimulus (e.g. a word to be spelled, a maths' problem)

to the tutee. The tutee responds both orally and in writing. The tutor evaluates the tutee's performance; provide corrective feedback, and awards points for the performance. Tutor and tutee roles are exchanged within each session points for procreature requires 30 minutes per session, each student in the class receives 10 minutes of tutoring and 5 to 10 minutes are used to add and post individual points. Content to be learned, teams and tutoring pairs are normally changed on a weekly basis. Teachers organize the academic content to be tutored into daily and weekly units and prepare materials to be used within the class-wide peer tutoring format. Teachers develop tests and administer them in a pre-test post-test sequence based on the unit of study. The result serves as feedback for the students and for monitoring learning. Post-test was administered after four-weeks of exposing students to Class Wide Peer Tutoring Method.

Results

The data generated from the administration of Economics Achievement Test (EAT) were analyzed using paired sample and independent t-test for hypotheses one and two respectively.

Hypothesis One: There is no significant difference in the pre-test and posttest scores of students taught economics with CWPT.

To test this hypothesis, a paired sampled t-test was used to test if there is a significant difference in the performance of students exposed to CWPT at pre-test and posttest. The result of the analysis is shown in Table 1.

Table 1: Paired sample t-test of students taught economics using CWPT

		Paired Difference						
Source of variable	df	Mean	SD	Standard Error Mean	95% Interval Difference		t-value	Sig (2 tailed
					Lower	Upper		
Pre-test Post-test	11	-15.333	1.826	.527	-14.173	-16.493	-29.093	.000

Table 1 shows the paired sample t-test of slow learners taught economics using CWPT technique. From the table, it was found that the slow learners pre-test and posttest had mean scores of 15.333 and Standard Deviation of 1.826 with Standard Error Mean of 0.527. It can be deduced that significant difference was established between slow learners at pre-test and posttest; (t_{cal} = 29.093, df = 11, $p < 0.05$) in favour of posttest with an upper bound of 16.493. Hypothesis 1 was therefore, rejected. Therefore, there is significant difference between the pre-test score and posttest score of slow learners in favour of posttest of slow learners. This implies that slow learners performance better after exposing them to CWPT.

Hypothesis Two: There is no significant difference in the performance of male and female students in the use of class-wide peer tutoring method.

To test this hypothesis, independent sampled t-test was used to test if there is a significant difference in the performance of students exposed to CWPT at pre-test and posttest. The result of the analysis is shown in Table 2.

Table 2: t-test results of male and female students taught economics using CWPT

Gender	N	df	Mean	SD	t-value	Sig, 2tailed
Male	8		18.88	1.126		
Female	4	10	19.25	.957	.488^{ns}	.636

ns: Not Significant at 0.05.

Table 2 shows the independent sampled t-test results of male and female slow learners taught economics using CWPT. From the table, it was found that the male slow learners had mean score of 18.88, Standard Deviation of 1.126, while female slow learners had mean score of mean 19.25, Standard Deviation of 0.957. There is no significant difference between male and female slow learners taught using CWPT {$t(12) = 0.488$, $p > 0.05$}. On this basis, Hypothesis 2 was not rejected. This implies that CWPT strategy enhanced male and female slow learners' performance.

Discussion

The results from hypothesis one showed that there is a significant difference in the pre-test and post-test scores of students taught economics with CWPT. This result agreed with Ayvazo and Ward (2009) found that CWPT enhanced the performance of physical education students. Ward and Ayvazo (2006) reported that both engagement and success levels increased during CWPT. It also agreed with the findings of Greenwood, Arreaga-Mayer, Utley, Gavin and Terry (2001) who reported that educators and students alike have been enthusiastic about the use of CWPT. Similarly, the findings agree with the findings of Ezenwosu and Nworgu (2013) who reported that students taught biology using peer tutoring performed significantly higher than those taught biology using the conventional lecture method. It also agreed with the report of Ward and Lee (2005) who found that students can be taught to observe and assess their peers with 70-96% accuracy completing simple measures to more complex game performance instruments. However, Anthony (2007) reported that, there were no significant differences between the groups on reading fluency, reading comprehension, and writing scores on posttest-posttest comparisons of students exposed to Character Education and Class-Wide Peer Tutoring program (CE+CWPT).

The results from hypothesis two revealed no significant difference among students taught economics using CWPT and those taught without it. This study does not corroborate with the common belief that female students are more likely to have better verbal abilities than male students and conversely, male students are more likely to have better mathematical skills than female students (Skaalvik & Skaalvik, 2004). Similarly, it contradicts the findings of Ezenwosu and Nworgu (2013) who revealed that male students slightly performed better than female students when taught biology using peer tutoring strategy. On the contrary, Ozofor (2001) found that female students achieved better than male students in mathematics. While, Scafidi and Khanh (2010), Else-Quest, Hyde, and Linn (2010) found no significant difference between male female students in higher mathematical abilities.

Conclusion

The findings of the study confirmed that the Class-Wide Peer Tutoring (CWPT) was effective in enhancing the academic performance of slow learners. It was also found that male and female slow learners got maximum benefit of CWPT. The improvement in students' academic performance, on-task behaviors, and social skills was a result of utilizing the CWPT method. Students enjoy both the role of tutor and tutee, giving them immediate feedback which increased their positive social interactions while reducing disruptive behaviors.

Recommendations

The following recommendations were made based on the findings:

(i) The use of class-wide peer tutoring should encouraged for teaching economics at senior secondary school level.
(ii) The interaction and feedback should be given more emphasis during the process of teaching economics with CWPT in secondary schools.
(iii) Periodic training and seminars should be organized for economics teachers in other to update their knowledge and to improve on the use of peer tutoring in their work.
(iv) Government through the ministry of education should provide enabling learning environments for the teacher and slow learners.

Limitations

This study was limited to the students of a purposively selected secondary school in Iloein metropolis, Nigeria. Slow learners were purposively selected based on their previous examination results in economic. However, samples of male and female students were not proportionate. These aspects did not affect the results from this study but may limit the generalizability of the findings. This study therefore, provides basis for further exploration in the field of peer tutoring which requires a thorough research.

References

Allen, R. (2011). Increase student engagement and achievement with peer tutors. *Education Update,* 53(4).

Anigbogu, M.A. (2002). Educating the girl child. *Psychology News,* 1(3), 17 - 18.

Anastasia, V., Elein, D., & Effi, A. (2006). Preferences of students with general learning difficulties for different service delivery modes. *European Journal of Special Needs, 21*(2), 201 - 216.

Anthony P. D. (2007). The effect of a required character education and class-wide peer tutoring program on 5th-grade students' reading and writing performance. Unpublished Dissertation Presented to the Faculty of The Graduate College of the University of Nebraska.

Ayvazo, S. & Ward, P. (2009). Effects of classwide peer tutoring on the performance of sixth grade students during a volleyball unit. *Physical Educator Late Winter,* 66(1), 12 – 24.

Bhatt, M. (2009). *Are the teaching practices in mainstream classrooms having children with special needs inclusive? Reflections in Indian context*. Annual Report of 2008-09. Setu Developmental Intervention Centre, Ahmadabad, India.

Bowman-Perrott, L., Greenwood, C. & Tapia, Y. (2007). The efficacy of CWPT used in secondary alternative school classrooms with small teacher/pupil ratios and students with emotional and behavioral disorders. *Education and Treatment of Children*, 30, 65 - 87.

Butler, S. & Hodge, S. (2001). Enhancing student trust through peer assessment in physical education. *Physical Educator* 58 (1), 30 – 39.

Dame, N. F. (2012). The role of frequency and cross-ability peer tutoring on student performance in a collegiate, developmental mathematics classroom. Unpublished Ph.D, Colorado State University Fort Collins, Colorado.

Else-Quest, N. M., Hyde, J. S., & Linn, M. C. (2010). Cross-national patterns of gender differences in mathematics: A meta-analysis. *Psychological Bulletin, 136* (1), 103 – 127.

Elbaum, B., Vaughn, S., Hughes, M. T., & Moody, S. M. (2000). How effective are one-to-one tutoring programs in reading for elementary students at risk for reading failure? A meta-analysis of the intervention research. *Journal of Educational Psychology,* 92(4), 605 - 619.

Ensergueix, P. J. & Lafont, L. (2010). Reciprocal peer tutoring in a physical education setting: influence of peer tutor training and gender on motor performance and self-efficacy outcomes. *European Journal of Psychological Education,* 25 (2), 222 – 242.

Ezenwosu, S. U. & Nworgu, L. N. (2013). Efficacy of peer tutoring and gender on students' achievement in biology. *International Journal of Scientific & Engineering Research,* 4(12), 944 - 950.

Ezeugwu, E. N. (2009). *Effect of peer-mediated and self-regulated instructional model on students' achievement and retention in biology.* An Unpublished thesis, Enugu State University of Science and Technology, Enugu.

Federal Republic of Nigeria (2004). *National policy on education*. Abuja: NERDC

Greenwood, C. R., Maheady, L., & Delquadri, J. (2002). Classwide peer tutoring programs. In M. R. Shinn, H. M. Walker, & G. Stoner (Eds.), *Interventions for achievement and behavior problems* (pp. 611-641), Washington, DC: National Association for Psychologists.

Golding, S. & Lisa, F. T. (2006). *Effect of peer tutoring attitude and personality on academic performance of first year introductory programming students*. Jamaica: Taylor and Francis Ltd.

Gordon, E. E. (2003). Looking beyond the stereotypes: Ensuring the true potential of tutoring. *Phi Delta Kappan,* 84 (6).

Greenwood, C. R., & Delquadri, J. (1995). Classwide peer tutoring and the prevention of school failure. *Preventing School Failure,* 39(4), 21-25.

Greenwood, C. R., Arreaga-Mayer, Utley, C. A., Gavin, K. M., & Terry, B. J. (2001). Classwide peer tutoring learning management system. *Remedial and Special Education,* 22, 34 - 47.

Gupta, M., & Pasrija, P. (2012). Effect of cooperative learning on high school students' mathematical achievement and retention using TAI and STAD methods. *Indian Journal of Psychology and Education,* 2(1), 75 - 86.

Iserbyt, P., Elen, J. & Behets, D. (2010). Instructional guidance in reciprocal peer tutoring with task cards. *Journal of Teaching in Physical Education,* 29 (1), 38 – 53.

Khan, S. (January 31, 2005). Slow learners need lots of support. *The HINDU.* Retrieved from http://www.thehindu.com/thehindu/edu/2005/01/31/stories/2005013100100200.htm

Krishnakumar, P., Geeta, M. G., & Palat, R. (2006). Effectiveness of individualized educational program for slow learners. *Indian Journal of Pediatrics,* 73, 135 - 137.

Lata, L. P. & Gaonka, V. (2008). Instructional Strategies to Accelerate Science Learning among Slow Learners. *Karnataka J. Agric. Sci.,* 21(4), 553 – 556.

Lowenstein, D. (2003). *Understanding and helping the slow learner*. Retrieved from http://www.clubtheo.com/momdad/html/dlslow.html

Maheady, L., & Gard, J. (2010). Classwide peer tutoring: Practice, theory, research, and personal narrative. *Intervention in School and Clinic,* 46(2), 71 - 78.

Malik, N. I, Rehman, G. & Hanif, R. (2012). Effect of academic interventions on the developmental skills of slow learners. *Pakistan Journal of Psychological Research,* 27(1), 135 - 151.

Muppudathi, G. (2014). Role of teachers on helping slow learners to bring out their hidden skills. *Research Paper,* 3(3), 1 - 12.

Ozofor M. N. (2001). *Effect of two models of computer aided instruction on students' achievement and interest in statistics and probability.* Unpublished Ph.D Thesis University of Nigeria Nsukka.

Scafidi, T., & Khanh, B. (2010). Gender similarities in math performance from middle school through high school. *Journal of Instructional Psychology,* 37(3), 252 - 255.

Sing, V. P. (2004). *Education of the slow learners.* New Delhi, India: Sarup. Stenhouse, G. (May 05, 2005). *Slow learners fall victims to dogma*. The New Zealand Herald.

Skaalvik, S., & Skaalvik, E. M. (2004). Gender differences in math and verbal self concept, performance expectations and motivation. *Sex Roles,* 50(3-4), 241 - 252.

Ward, P. & Ayvazo, S. (2006). Classwide peer tutoring in physical education: Assessing its effects with kindergartners with autism. *Adapted Physical Activity Quarterly, 23,* 233-244.

Ward, P., & Lee, A. M. (2005). Peer assisted learning in physical education: A review of theory and research. *Journal of Teaching in Physical Education, 24,* 205 - 226.

Weidner, T. G. & Popp, J. K. (2007). Peer-assisted learning and orthopaedic evaluation psychomotor skills. *Journal of Athletic Training,* 42 (1), 113 – 119.

AN INVESTIGATION INTO CONFLICT RESOLUTION STRATEGIES AND ADMINISTRATIVE EFFECTIVENESS IN KWARA STATE-OWNED COLLEGES OF EDUCATION

AKINNUBI, O. P. Ph.D[1] & YUSUF, H. A.[2]
[1]Department of Educational Management, Al-Hikmah University, Ilorin, Nigeria
[2]Department of Educational Management, University of Ilorin, Ilorin, Nigeria
E-mail: akinnubipaul@yahoo.com, princesshabby@yahoo.com
Phone No: +234-805-221-4006, +234-803-482-5291

Abstract
This study investigated conflict resolution strategies and administrative effectiveness in Kwara State-owned Colleges of Education. The research design used was a descriptive survey. Using proportional stratified random sampling technique, 100 Deans and HODs were selected as participants. Research instruments titled: "Conflict Resolution Strategies Questionnaire" (CRSQ) and "Administrative Effectiveness Questionnaire" (AEQ) were designed and used to obtain relevant data. Descriptive statistics of frequency counts, percentage and rank ordering where used to answer the research questions raised while Pearson product-moment correlation statistics was used to test the hypothesis formulated at .05 level of significance. The findings of the study showed that inadequate facilities was ranked the most cause of conflict with 87 points. Negotiation was ranked the most conflict resolution strategy put in place by the institutions' management with 91 points. There was a significant relationship between conflict resolution strategies and administrative effectiveness (Cal. p-value =.001 < set p-value =.05). It was recommended that the government should provide more facilities in Kwara State-Owned Colleges of Education in order to reduce conflicts on campuses.

Keywords: Conflict resolution strategies, Administrative effectiveness, College of Education, Kwara State

Introduction
The quality of education depends substantially on the effectiveness of the school system, and the efficiency of the personnel in the school is a determining factor in the overall school effectiveness. Hence, practicing tolerance and living together in peace with one another as good neighbour should be a genuine concern of all, especially at Kwara State-Owned Colleges of Education. Conflict is a natural part of life which often arises in school settings due to the varying ideas school administrators have about issues, differences in their backgrounds and experiences. These differences can cause damage to the school if not well managed. Conflict is a consequence of struggle for power, position, properties and opportunities among individual workers in an organization. It is, therefore, a basic ingredient of human relations within an institution.

There is occurrence of disagreement in Kwara State-Owned Colleges of Education between the management and the staff. This often leads to disruption of the institutions' academic programme. Student-Student, lecturer-student and lecturer-lecturer conflicts, among others, are observed conflicts in these institutions. Causes of conflict in Kwara State-Owned Colleges of Education are delay in payment of salary, inadequate provision of students' welfare services, inadequate provision of learning resources and ineffective communication among management, staff and students.

Violence emerges out of intolerance for differences in beliefs, views, cultures and social traditions, in which peace can be cultivated through training of the mind to control the

deserving and desiring, developing tolerance and respect for differences, concern and love for others and moving from competition to cooperation (UNESCO, 2005). Conflict according to Zabadi (2009) is a disagreement over values between human beings which are inevitable and even sometimes desirable in the society. Since human beings seek after the same things which are not abundantly available to everyone at the same time, they tend to have conflicts with each other as they attempt meeting these needs. Such disagreements are expressed verbally, and in the extreme, violently to the extent that human life itself is endangered. It may be caused by competition for inadequate resources, contradicting value system, psychological needs of group and individual manipulation of information and perception (Albert, 2001).

Conflict is a dynamic phenomenon which consists of five stages: Initiation, escalation, controlled maintenance, abatement and termination/resolution. In this process, peace is the ultimate target or result of conflict or even violence. Francis (2007) described peace as the absence of war, fear, conflict, anxiety, suffering and violence, and about peaceful co-existence. This portrayed peace as absence of war (direct violent), peace as justice and development (absence of structural violence), peace as respect and tolerance between people, inner peace (spiritual peace) and peace as a "wholeness". The major cause of conflicts in Kwara State-Owned Colleges of Education include poor communication flow within the campus. Ineffective administrative control, poor job performance and inadequate facilities for both staff and students, among others, are traceable to causes of conflicts in the institutions.

Administration is an act of getting things done through and with people. Administration focuses more on implementation of plans in order to achieve institutional goals and objectives. Hornby (2002) defined administration as activity done in order to plan, organise and successfully run a business, school or other institution and a process or act of organising the way that something is done. Administration, according to Eden (2006), revolves round planning activities which aim at the fulfilment of the goals of a particular organisation or institution. It calls for the ability of the administrators to make the right decisions to fulfil the required goals. In institutional setting, therefore, administration has been extended as a service activity or tool through which the fundamental objectives of the institutional process may be more optimise efficiently when allocating human and material resources as well as to make the best use of existing resources (Liverpool & Jacinta,2013 & Akinnubi, 2014).

Adeyemi (2009) conducted a study on principals' management of conflicts in public secondary schools in Ondo State, Nigeria. The findings showed that conflicts have not been effectively managed by principals of schools because of their inability to effectively utilize the strategies for resolving conflicts, that is, communication, negotiation, conciliation and mediation. Salleh and Adulpakdee (2012) conducted a study on the perceptions of teachers and school principals toward the causes of conflict and effective methods to conflict management at selected Islamic private secondary schools in Yala Province, Thailand. The results showed that the principals perceived that the main cause of conflicts occurred in school was "ambiguously defined responsibilities" and the teachers agreed that different perception was the major cause of conflict in school.

The aim of an individual/group in a conflict may not necessarily be achieved but may be subdued by the conflict through negotiable settlement. Conflict resolution performs a healing function in the societies. It provides opportunity for the examination of the alternative means in situation of positioned disagreements, and restores normalcy in the society by facilitating discussions and placing parties in conflicts in situation in which they

can choose alternative positive decisions to resolve differences (Otite, 2007). According to Otokun (2008), conflicts are not discrete situations with a clear beginning and end. It obviously emerges out of a preexisting situation and it doesn't usually end with settlement, even though the intensity of the conflict may shift as one would expect in a dynamic situation. Conflicts resolution connotes a sense of finality, where the parties to a conflict are mutually satisfied with the outcome of a settlement and the conflict is resolved in a true sense. This could be done through communication - exchange and sharing of information can help remove doubt, suspicion and contribute to the process of confidence building; negotiation - direct bargaining by parties involved in the conflict; conciliation - bring parties to agreement through face-to-face negotiation; and mediation - third party involvement and fact finding (Best, 2007).

Mediation is a conflict resolution strategy where a neutral and impartial third party, the mediator, facilitates dialogue in a structured multi-stage process to help parties reach a conclusive and mutually satisfactory agreement. A mediator assists the parties in identifying and articulating their own interests, priorities, needs and wishes to each other. Conciliation is another conflict resolution process that involves building a positive relationship between the parties of dispute. Conciliation tries to individualize the optimal solution and direct parties towards a satisfactory common agreement. Negotiation is the process of finding an agreement that is satisfactory to all of the groups/individuals involved. It is used to ensure a "win-win" situation. Negotiation is best when it includes the members in conflict and peers who are stakeholders in the process Or, a third party may be called when ongoing conflict resolution/negotiation does not work among the team members. Communication is a method of resolving conflict in colleges of education where the management ensures that both staff and students are carried along about the activities of the institution (Osland, Kolb & Rubin, 2001).

Conflict is a tension between two or more social entities (individuals, groups or large organizations) that arise from incompatibility of actual and desired responses. Conflicts have become part and parcel of human organizations world over. This indeed is a paradox because of the amount of energy and resources expensed by institutions to prevent and resolve conflicts. There is no gain saying the fact that a total absence of conflict would be unbelievable, boring, and a strong indication that conflicts are being suppressed (Flippo, 1999). Thus, conflict is part of change and, therefore, inevitable. The nature and type of conflicts that happen in an institution vary from one institution to the others. The common types of conflicts that arise in College of Education include the one between the students on one hand and the institution management on the other. Other forms of noticeable conflict include interpersonal conflicts among staff and as well as the students on campus.

Problem Statement

Kwara State Colleges of Education in the recent past have been experiencing conflict on campuses. A state of disagreement has been occurring between management and academic staff, management and students, academic staff and students and students and students. The environment has not been conducive for both staff and students. This is inimical to the attainment of institutions' stated goals and objectives. Conflict is seen as an inherent feature of tertiary institutions, College of Education inclusive. Conflict in tertiary institution has been a major concern to stakeholders in education. It is on this note that this study examined the influence of conflict resolution strategies on administrative effectives in Kwara State-Owned Colleges of Education.

Objectives of the Study

The specific objectives of the study are to:

(i) examine the causes of conflict in Kwara State-Owned Colleges of Education;
(ii) examine conflict resolution strategies that are put in place by the management in Kwara State-Owned Colleges of Education.
(iii) determine the level of administrative effectiveness in Kwara State-Owned Colleges of Education.
(iv) Determine the significant relationship that exists between conflict resolution strategies and administrative effectiveness in Kwara State-Owned Colleges of Education.

Research Questions

(i) What are the causes of conflict in Kwara State-Owned Colleges of Education?
(ii) What conflict resolution strategies are put in place by the management in Kwara State-Owned Colleges of Education?
(iii) What is the level of administrative effectiveness in Kwara State-Owned Colleges of Education?

Research Hypothesis

There is no significant relationship between conflict resolution strategies and administrative effectiveness in Kwara State-Owned Colleges of Education.

Methodology

A descriptive survey method was used to collect data on conflict resolution strategies and administrative effectiveness in Kwara State-Owned Colleges of Education. The design was appropriate for data collection on both the independent (conflict resolution strategies) and dependent (administrative effectiveness) variables. The target population was all Deans and HODs in Kwara State-Owned Colleges of Education which include: Ilorin, Oro and Lafiagi. Using proportional stratified random sampling technique, 100 Deans and HODs were selected as participants in the sampled Colleges of Education because they could provide required information in pursuance of the study.

The major instruments used for data collection were “Conflict Resolution Strategies Questionnaire” (CRSQ) and “Administrative Effectiveness Questionnaire” (AEQ) designed to collect data on lecturers’ opinion about the influence of conflict resolution strategies on administrative effectiveness. The instruments were validated by experts in Educational Management and Test and Measurement. Test re-test method was used for the reliability test, which was analyzed using Pearson product-moment correlation statistic yielding coefficients of .94 and .83 for CRSQ and AEQ respectively.

Data for the study were collected from 100 Deans and HODs at Kwara State Colleges of Education- Ilorin, Oro and Lafiagi. Three trained research assistants who were lecturers in the Colleges of Education complemented the efforts of the researchers. The data collected from the participants were analysed using descriptive statistics of frequency counts, percentage and rank ordering to answer the research questions, while Pearson product-moment correlation statistics was used to test the formulated hypothesis at .05 significance level.

Results

Research Question 1: What are the causes of conflict in Kwara State-Owned Colleges of Education?

Table 1: Causes of conflict in Kwara state-owned colleges of education

Causes	Frequency	Rank
Poor communication flow	69	2
Ineffective administrative control	54	3
Poor job performance	11	4
Inadequate facilities	87	1

Table 1 shows that inadequate facilities was ranked number one with 87 points as the cause of conflict in Kwara State-Owned Colleges of Education, while poor job performance was ranked the least with 11 points. Poor communication flow and ineffective administrative control were not too popular among the respondents as causes of conflicts in Kwara State-Owned Colleges of Education with 69 and 54 points respectively.

Research Question 2: What conflict resolution strategies are put in place by the Management in Kwara State-Owned Colleges of Education?

Table 2: Conflict resolution strategies put in place by the management in Kwara state-owned colleges of education

Strategies	Frequency	Rank
Communication	71	3
Negotiation	91	1
Conciliation	88	2
Mediation	44	4

From Table 2, negotiation with 91 points was ranked the most conflict resolution strategy put in place by the management of Kwara State-Owned Colleges of Education, while mediation was ranked the least with 44 points. Conciliation and communication with 88 and 71 points respectively were not too popular among the respondents.

Research Question 3: What is the level of administrative effectiveness in Kwara State-Owned Colleges of Education?

Table 3: Level of administrative effectiveness in Kwara state-owned colleges of education

Level	Frequency	Percentage
High	5	5
Moderate	67	67
Low	28	28
Total	100	100

Table 3 shows level of administrative effectiveness in Kwara State-Owned Colleges of Education with high 5 (5%), moderate (67) and low (28%).

Research Hypothesis

There is no significant relationship between conflict resolution strategies and administrative effectiveness in Kwara State-Owned Colleges of Education.

Table 4: Conflict resolution strategies and administrative effectiveness in Kwara state-owned colleges of education

Variable	N	Mean	SD	df	Calculated r-value	p-value	Decision
Conflict resolution strategies	100	2.012	1.043				
				98	.679	.001	Significant
Administrative effectiveness	100	3.356	2.786				

Set-p-value= .05

Table 4 indicates that the calculated p-value (.001) is less than the set p-value (.05) for 98 degrees of freedom. Thus, the null hypothesis is rejected. This depicts that a significant relationship existed between conflict resolution strategies and administrative effectiveness in Kwara State-Owned Colleges of Education.

Discussion

Table 1 indicates that inadequate facilities were the main source of conflict in Kwara State Colleges of Education. Other causes of conflict in the institutions include poor communication flow, ineffective administrative control and poor job performance. Adebayo's (2001) findings which indicated that conflicts occur as a result of a communication gap between management and students. The findings indicated the cause of conflicts as the disagreement between students and school authority.

The finding from Table 2 depicts communication, negotiation, conciliation and mediation as factors that could be used to curb disagreement among management, staff and students in Kwara State Colleges of Education. Rahim's (2002) submitted that effective communication in higher institutions' administration would reduce conflict that might occur in the institutions.

From Table 3, majority of the participants indicated that administrative effectiveness was moderate with the highest points, that is, 67 (67%). Administrative effectiveness in institution management depends on collaboration and teamwork among lecturers, students, administrators and other stakeholders. Rahim (2002) submitted that conflict resolution involves designing effective macro level strategies to minimize the dysfunction of conflict in order to enhance leaning and administrative effectiveness in an organization. The success of any institution depends upon the quality and efficiency of its staff who perform the functions necessary for the fulfilment of stated goals and objectives, this assumption is also applicable to College of Education as it involves human efforts (Nakpodia, 2010).

Based on the results in Table 4, conflict resolution strategies, such as communication, negotiation, conciliation and mediation have direct impact on administrative effectiveness in Kwara State-Owned Colleges of Education. College of Education administrators are managers and they should be able to manage conflicts effectively rather than suppress or avoid them. Oduwaiye's (2004) found out that problems of role ambiguity and role incompatibility arise from inappropriate role definition which may be a major source of conflict.

Conclusion

It can be inferred from the results of this investigation that a significant relationship existed between conflict resolution strategies and administrative effectiveness in Kwara State-

Owned Colleges of Education. Conflict is seen as a dysfunction outcome, characterized by poor communications and personality clashes. Inadequate facilities was the major cause of conflict resolution in Kwara State-Owned Colleges of Education, while level of administrative effectiveness was moderate.

Recommendations

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

(i) The government should provide more facilities in Kwara State-Owned Colleges of Education in order to reduce conflicts on campuses.

(ii) Kwara State-Owned Colleges of Education management should lay more emphasis on negotiation strategy so that conflict can be suppressed to the barest minimum in the institutions.

(iii) There should be improvement on communication flow in the institutions in order to reduce conflict. This would make both staff and students to be well abreast of what is going on campus.

References

Adebayo, F. A. (2001). *School climate and students' academic performance in secondary schools*. Unpublished Ph.D. Thesis. University of Ado Ekiti, Ado Ekiti.

Adeyemi T. O. (2009). Principals' management of conflicts in public secondary schools in Ondo State, Nigeria: A critical survey. *Educational Research Review*, 4, (9), 418-426.

Akinnubi, O. P. (2014). Perception of the role of security personnel in effective administration of tertiary education institutions in Kwara State. *Journal of Science, Technology, Mathematics and Education (JOSTMED),* 10(3), 197-202

Albert, I. O. (2001). *Introduction to third party intervention in community conflicts*. Ibadan: PETRAF/John Archers Publishers.

Best, S. G. (2007). *The methods of conflict resolution and transformation in introduction to peace and conflict studies in West Africa*. Ibadan: Spectrum Books Limited.

Eden, D. A. (2006). *Introduction to educational administration in Nigeria*. Ibadan: A.

Flippo, A. (1999). *Conflict management in schools*. London: McGraw-Hill.

Francis, D. J. (2007). *Peace and peer mediation in introduction to peace and conflict studies in West Africa*. Ibadan: Spectrum Books Limited

Hornby, A. S. (2002). *Oxford Advance Learner's Dictionary*: Oxford University press.

Liverpool, E. O. & Jacinta, A. O. (2013). Information and Communication Technologies (ICT): A Panacea to Achieving Effective Goals in Institutional Administration. *Middle-East Journal of Scientific research*, 18(9): 1380-1384. http://www.idosi.org/mejsr/mejsr18 (9)13/22.pdf

Nakpodia, E. D. (2010). Relationship between principals and teachers perception of principals performance of staff development and students personnel in secondary school. *Academic Leadership*, 8, (4), 34-68.

Oduwaiye, R. O. (2004). Influence of role conflict on administrative effectiveness of academic staff in Nigerian Universities. *International Journal of Educational Management*, 3, 190-199.

Osland, J. S., Kolb, D. A., & Rubin, I. M. (2001). *The organizational behavior reader* (7th ed.). Englewood Cliffs, NJ: Prentice Hall.

Otite, O. (2007). *Community conflicts in Nigeria: Management, resolution and transformation*. Ibadan: Spectrum Publishers.

Otokun, O. S. (2008). Theoretical perspective on conflict resolution as applied to Nigerian organisations in Readings in conflict management and peace building in Africa. *Journal of Faculty of Social Sciences*, 2, (4), 67-72.

Rahim, M. A. (2002). Toward a theory of managing organizational conflict. *The International Journal of Conflict Management*, 13, (13), 206 - 235.

Salleh, M. J. & Adulpakdee, A. (2012). Causes of conflict and effective methods to conflict management at Islamic secondary schools in Yala, Thailand. *International Interdisciplinary Journal of Education*, 1, (1), 15 - 22.

.

UNESCO (2005). *Peace education*. Retrieved on 15th August, 2014. From www.conflict.htm

Zabadi I. S. (2009). *Conflict resolution in the new global environment. The Nigerian perspective*. Abuja: NDC.

EFFECTS OF POWER POINT INSTRUCTIONAL MEDIUM ON BIOLOGY STUDENTS' ACADEMIC ACHIEVEMENT AND RETENTION IN UYO AKWA-IBOM STATE

OFILI, GLORY OSARETIN (Ph.D)
Department of Educational Technology and Library Science,
University of Uyo, Akwa Ibom State, Nigeria
E-mail: gloryofili@yahoo.com Phone No: +234-805-173-7808

Abstract

Information Communication Technology (ICT) has been recognized as a tool for improving the quality of science education for national development. This paper therefore investigated the effect of the use of Power Pointpresentations in improving the quality of Biology education. The study adopted a pretest posttest quasi experimental non- equivalent control groupdesign. Two public secondary schools from Uyo Local Government Area of Akwa Ibom state were purposively selected from the schools that have computers and the students are computer literate. An intact biology class was selected from each of the schools respectively using purposive random technique. Each of the selected intact class made up of 44 students in each classwhichwas assigned to control and experimental group by balloting. Three research questions and two hypotheses were postulated for the study. The test instrument Biology Achievement Test (BAT) and the Power Point presentations were validated by experts from University of Uyo. The reliability coefficient of BAT yielded 0.76 using Pearson's moment correlation. The research questions were answered using Mean and Standard Deviation while the hypotheses were analysed with t-test method. The result revealed that students taught with Power Point presentation performed and retained the concept taught better than the students taught using the conventional method. Recommendations were made among others that computer and projectors be made available in schools for instructional purpose.

Keywords: PowerPoint, Biology, Achievement, Retention.

Introduction

Education is the major key for national development, this is the reason nations all over the world are striving towards the improvement of their educational system. In Nigeria,the Federal Government has placed more emphasis on the study of science. Science facilitates and enhances industrial and technological progress of a nation (Achor, 2002). There is need for the citizen in the developing countries like Nigeria to be scientifically and technologically literate if they wish to be placed in the 21st century global village. One of the subjects that make up the sciences is Biology which is the study of living things and their environment. According to FRN (2004)the aims of Biology educationlike other science subjects should be to encourage further the spirit of inquiry and inculcate creativity amongstudents. It also stated that the Biology educationshould help the individual acquire appropriate skills, abilities and competencies to live in and contribute to the development of the society. The policy is geared towards the achievement of a functional and relevant education for the children. These aims and objectives are in line with the educational policy (Etim, 2010) with the opinion that properly conceived Biology education enables the children to understand the nature of science and develop skills to solve problems in their living environment. Biology curriculum is geared towards equipping the students to live effectively in the modern age of science and technology. It trains manpower in skills, knowledge to be competent individual about life and environment(Mohan, 2012). The national policy on education emphasizes on the importance of the development of skills amongthe learners who are centrally placed in the educational system.

Biology should be taught usingall types of instructional materials needed to carry out qualitycontextual teaching and learning.There is the need to also carry out practical activities which are pivotal to the study of science. However this seems not to be the case in most secondary schools considering the meagre amount of budget allocated by the Federal Government of Nigeria on educationas compared to the large number of students in aclass. In most secondary schools in Nigeria, science facilities for practical are not available and instructional materials for teaching are lacking (Etim, 2010). Most of the schools do not have laboratory and the available few are not well equipped. This has led toscience being taught theoretically in most of the secondary schools (Umar, 2011). Adequate science education calls for innovation in instructional delivery such as use of cutting edge technology. Considering the factor of large class size which has contributed most to poor learning environment and consequently students' inability to participate actively in learning, the author felt that there is a need for adequate use of information communication technology(ICT) in instructional process.

In order to achieve quality science education for national development, there is a need for a paradigm shift from teacher centred learning to student centredlearning by embracing ICT into the study of science. This may facilitate students to learn at their own pace and master what is learnt. It means there should be a change of approach from teaching pupils about science to educating them about science through student-centred learning (Merrill, 2001).

ICT is a computer based tool used in creating, storing developing receiving and displaying information. It is an electronic device that deals with computer and computer software that can be used for teaching and learning purposes. It has been identified as an indispensable instrument for the development ofquality teaching and learning in the education system (Nyenwe & Ishiakaku, 2013). ICT is fundamental for the preparation of students inmeeting the innovations in the global world (Ogunlade & Olafera, 2012). The growth of information and communicationtechnologies has dramatically reshaped teaching and learning processes.It promotes active learning by making it possible for the students to become more engaged with their own learning,thereby enhancing students' achievement (Egbule, 2008). Learning with ICT enriches learning content and enhance wider access to information resources, improves the quality of education and reduces cost. The focus on ICTin education has created paradigm shifts of educators from merely depend on text books in teaching to the use of computers and Internet. The use of ICT when employed in science teaching can remove traditional barriers to learning such as fixed time, place of instruction and may allow the many aspects of the learning processes to be made under the control of the learners (Fagbemi, 2013). Well-equipped ICT class would perhaps, establish and enhanceconducive environment for learner to be further involved in interaction and promote better understanding of concepts. The use of computer to manage instruction adds value to the educational process.

Power Point presentation is one of the ICT devices that can be used for classroom instructional delivery. Power Point could be used for quality lecture presentation to stimulatescience visualization and animation. These can make good complementary resource as compared to the conventional lecture presentation. PowerPoint allows resource materials to be created forpresentationusing a projector. According to Egbule (2008) PowerPoint can be used to create screens that effectively incorporate colourful text, photographs, illustrations, drawings, tables and graphs. It can be used to make movies and transition from one to another like a slide show. The teacher can animate text and illustrations on the screen using the animation feature as well as add sound effects and narration. Moreover, one can print out materials to be distributed when making a presentation. Microsoft PowerPoint is used for creating presentations both for small and large crowd.

Howevercompetencies are required in the preparation of power point presentation. These include the ability to use different types of designs, slides and animation. Other skills include creating and importing pictures, clipart and inserting sound effects. The pages in PowerPoint could contain pictures, large texts, graphs, sounds, and other things that could make presentation more entertaining and easier to understand. This could stimulate the ability of students to retain what they have learnt.

For example, retention is the ability to response to a new stimulus using the previously leant responses (Ezekoka & Okoli, 2012). It involves recall, recognition and relearning. The best way to remember is to give attention to what is learnt. The ability to pull up information later and act on it is vital to science learning (Kamoru & Sussan, 2010). Learnersshould be able to retain (remember) what they have paid attention toas ICT gives them the control over the information received and an opportunity for them to contribute. This technique may be superior and more effective than the one that encourages memorization and regurgitation. This is because integrating ICT in educationis learner – centredwhich is a departure from the traditional learning which is teacher-centred. Also gender disparities in academic achievement in sciences have been reported by scholars. Nworgu (2004) revealed that females performed better in Biology compared to their male counterparts while males perform better than females when they were taught with ICT facilities (Etim, 2010). Other studies revealed contrary (Gana, 2013). Therefore studies on the effect of ICT on gender are still controversial.

Statement of the Problem

Research have shown that Power Point enhance teaching and learning because it contains pictures, large texts, graphs, sounds, and other feature that can make presentation more entertaining and easier to understand.It can be integrated into teaching and learning for use to support interactive learning and improve quality education (Egbule, 2008). Despite the obvious and enormous advantages as revealed from literature on using ICT in teaching and learning,thereis still practically not much ICT use in the classroom of Nigeria. The conventional method used in teaching and learning may be the one of the factors contributing tolow academic achievement in science subject such as Biology. The use of ICT when employed in Biology teaching can remove traditional barriers and may allow learning processes to be made under the control of the learners. This study therefore investigates the effect of using ICT tool such as Power Point on students' Biology achievement.

Research Questions

The following research questions were postulated to guide the study:

(i) What is the difference in the mean achievement scores of students taught with Power Point presentation and those taught with conventional method?
(ii) What is the difference in the mean achievement scores of male and female students taught with Power Point presentation?
(iii) What is the effect of Power Point presentation on students' retentionscores in Biology?

Hypotheses

(i) There is no significant difference in the mean achievement scores of the students taught with Power Point presentation and those taught without it
(ii) There is no significance difference in the mean achievement scores of male and female students taught with Power Point presentation

Methodology

The study adopted pretest - posttest "Quasi-experimental non-equivalent control-group" design. (Ali, 2006).Two public secondary schools were purposively selected for this study on the basis of availability and student proficiency in computer. A sample of 87 students made up of 44 males and 43 females were involved in the study selected using 'purposive sampling (Creswell, 2009) technique. An intact SS II Biology class was randomly selected from each of the schools being classified under categories of school. The research samples were from diverse socio-cultural backgrounds that were representatives of the population. Any bias in the population will be equally distributed among the people chosen (Creswell, 2009). The intact classes were assigned to the experimental and control group by balloting. The Power Point was developed by the researcher and the slides were made up of topics on the circulatory system. The slides were validated by three experts in educational technology from the University of Uyo and two Biology teachers. A Biology Achievement Test (BAT) was developed by the researcher and validated by experts in Biology education as well as an expert in Measurement and Evaluation for content validity. The reliability of the instrument using test-re-test method yielded 0.79. The selected topics were taught for four weeks after the administration of a pretest. The experimental group was taught using the power point presentation on computer while the control group was taught using the conventional method. After two weeks the items in the post test were rearranged and administered as retention test. At the expiration of the four weeks'treatment period a posttest was administered. Mean and Standard Deviation were used to answer the research questions and t-test was used in hypotheses testing at $P \geq 0.05$ levels of significance.

Results

Research Question 1: What is the effect of Power Point presentation on the academic achievement of Biology students?

Table 1: Mean and standard deviation of students' scores from pre-test and post-test

Group	N	Mean Pretest	Mean Posttest	SD	Mean Difference
Control	43	22.21	47.14	13.79	15.14
Experimental	44	26.28	68.28	15.05	42.00

Table 1 above revealed the pretest mean scores of the control and the experimental group showing that the groupsare equivalent with regards to academic achievement. The result also showed that the posttest mean score of the experimental group (68.28) was greater than that of the control group (47.14). The total mean difference was 15.14.This implies that students taught with power point presentation performed better than their counterparts who were not exposed to the treatment

ResearchQuestion2: What is the effect of Power Point presentation on academic achievement of male and female Biology students?

Table 2: Mean and standard deviation of male and female students' scores from post-test

Group	N	Mean	SD
Male	42	62.53	14.78
Female	45	65.95	15.00

Table 2 showed that the mean score of the male students (62.53) and female Biology students is (65.95). This shows that female students performed better than male students in Biology when taught with Power Point presentation.

Research Question 3: How does Power Point presentation affects the retention of Biology concepts?

Table 3: Mean and standard deviation of post-test and retention mean scores of student

		Post-test		Retention	
Group	N	Mean	SD	Mean	SD
Control	43	47.14	13.79	54.54	6.78
Experimental	44	68.28	15.06	74.02	10.89

Table 3 revealed that the control group had a mean retention score of 54.54 while the experimental group had a mean retention score of 74.2. Indicating that the experimental group retained what was taught better than the control group.

Hypothesis 1: There is no significant difference in the mean achievement score of the students taught with power point presentation and those taught without it.

Table 3: t-test analysis of the achievement score of students in control and experimental group

Group	N	df	Mean	SD	t-value	P-value
Control	43	85	47.14	13.79	8.230	.043
Experimental	44		62.28	15.06		

Table 3 shows that there is a significance difference between the post test of the experimental and control group at 0.05 level of significance ($t = 8.23$ $df = 85$ $P < 0.05$) was therefore rejected. This means there is a significance difference in the achievement of students in the control and experimental group. The hypothesis was not accepted. The students in the experimental group performed better than those in the control group.

Hypothesis 2: There is no significance difference in the mean achievement of male and female students taught with power point presentation.

Table 4: t-test analysis of the Post-test Achievement Scores of males and females

Group	N	df	Mean	SD	t-value	P-value
Male	42	85	62.53	14.78	8.270	0.034
Female	45		65.95	15.03		

Table 4 showed the achievement of male and female Biology students in the experimental group at 0.05 level of significance ($t = 8.27$, $df = 85$; $P<0.05$). Indicating that there is a significant difference in the mean achievement scores of male and female Biology taught using Power Point presentation the significant difference is in favour of females.The hypothesis was therefore rejected.

Discussions

The study, as indicated in Table 1 revealed that Biology students taught withPower Point presentationperformedbetter when compared with their counterparts who were taught using the conventional method of'chalk and talk'. Power Point presentation is a multimedia tool which is capable of stimulating students' interest and motivation to learn. This is in

agreement with the study by Egbule (2008) who revealed that power point as a medium for classroom interaction enhances student's performance.

The finding from research question two revealed that female students performed better than their when taught with Power Point presentation. The finding is in agreement with the research findings by Ezekoka (2010) who discovered that female students performed better when exposed to ICT. However, it is in disagreement with Umar (2011) and Fagbemi (2013) who asserted that gender have effecton the performance of students when taught with computer.

The result also revealed that the experimental group had higher retention than the students in the control group. This could be due to the fact that PowerPoint is acaptivating media and is able to hold the attention of students.This is in consonance with the study byGana (2013) who revealed that students in experimental group performed better than those in control group when taught Physics with CAI package

Recommendations

Based on the findings of the study the following recommendations are made

(i) Teachers should be trained on how to use computer so as to integrate the use of Power Point into their instructional process in order to achieve better students' performance.
(ii) Computers and projectors should be installed in secondary schools for instructional purpose.
(iii) Power supply should be made available in schools so that the computers can be well utilized
(iv) Teacher should be trained on how to use the Power point for teaching purposes.

References

Achor, E.E. (2002). Cognitive correlates of physics achievement of some Nigeria secondary students. *Journal of Science Teachers Association of Nigeria,* 38 (1&2), 10 - 15.

Ali, A. (2006). *Conducting research in education and the social sciences.* Enugu: Tanshiwa Network

Cook, T. D. & Campbell, D. T. (1979). *Quasi-experimentation: Design and analysis for field settings.* RandMcNally, Chicago, Illinois. Retrieved from http://www.socialresearchmethods.net/kb/desdes.php

Creswell, J. W. (2009). *Research design: Qualitative, quantitative and mixed methods approaches.* London: Sage publications, Inc.

Egbule, J. (2008). *Comparative effectiveness of power point and chalk presentations*. Unpublished Ph.D dissertation, Imo state University, Owerri.

Etim, P. J. (2010).*Mediated instruction and redundancy mediation in ICTs in Nigerian secondary schools:* Shifting from Theory to Practice. Association for Educational Media and Technology, 31 Proceedings, 115 - 118.

Ezekoka, G. K. & Okoli, A. M. (2012). The use of computer in teaching and learning in secondary schools in Imo State.*Journal of educational media & technology,* 16(1).

Fagbemi, P. O. (2013). *Effects of two strategies of tutorial mode of computer assisted instruction and verbal ability of junior secondary students' achievement in social studies in Abuja.* Unpublished Ph.D thesis University of Nigeria Nsukka.

FRN (2004). Federal Republic of Nigeria. *National policy on education.* Abuja: NERDC Press.

Gana, S. C. (2013). *Effect of computer assisted instruction and quantitative ability on achievement and retention of students' of colleges of education in quantum physics* Unpublished PhD thesis University of Nigeria Nsukka.

Kamoru, O. U. & Sussan, I. E. (2010). Effect of using computer as tutor and tool on students' achievement and retention in quadratic equation.*Journal of Mathematical science Education*, 1(1), 133 – 141.

Merrill, M. D. (2001). Constructivism and instructional design. *Educational Technology,* 3(3), 45 - 53.

Mohan, D. K. (2012). *Biology education.* Atahualpa: Word Press.

Nworgu, L. N. (2004) *Effects of gender sensitization of science teachers on gender gap in science achievement and interest among students*. Unpublished Ph.D thesis University of Nigeria, Nsukka.

Nyenwe, J. & Ishakaku, E. C. (2013). Planning for information and communication technology integration in Nigeria.*Journal of educational media and technology,* 17(1), 10 – 17.

Ogunlade, O. O. &Olafera, F. O. (2012). *Developing and assessing instructional package for teaching creative Art.* Proceedings of the 32rd international conference of Nigeria Association for Educational Media and Technology, 60 - 63.

Umar, M. (2011).*The effect of computer assisted instructional on secondary school Biology achievement in Yobe state.* Unpublished Master's thesis.University of Nigeria, Nsukka

MOTIVATIONAL EFFECTS ON SENIOR SECONDARY STUDENTS' ACADEMIC PERFORMANCE IN MATHEMATICS IN ABUJA, NIGERIA

SULE, SAMUEL SARDAUNA
Department of Mathematics and Statistics,
Yobe State University, Damaturu, Nigeria
E-mail: profsam8@gmail.com Phone: +234-706-189-3719

Abstract
The motivational effects on senior secondary school students' academic performance in mathematics was the focus of this study. An ex-post facto design was employed for the study. Sample of the study was 450 students selected from 10 secondary schools using the simple random sampling technique for data collection. Motivation for academic performance questionnaire (MAPQ) was the instrument used in this study. Two hypotheses were tested for significance at 0.05 alpha level using t-test and analysis of variance (ANOVA). The result showed that gender difference was significant when motivational effect on academic performance was compared in male and female students. Also other result indicated significant difference when extend of motivation was taken as a variable of interest on academic performance in mathematics based on the degree of their motivation. The study recommended that mathematics teachers should motivate their students during the course of instructions by making the mathematics learning interesting.

Keywords: Motivational effect, Academicperformance, Mathematics, Secondary school students

Introduction
In the Contemporary Nigeria, greater emphasis is being placed on industrial and technological development. As a result, students are being encouraged to take up science related subject. One subject that cut across all the science is mathematics. Today, mathematics methods pervade literally every field of human endeavour and play a fundamental role in economic development of a country. For Nigeria vision, toward scientific and technological advancement in 2020 to be achieved,there is for better performance in mathematics at all level of schooling. Unfortunately performance of students in mathematics at the end of secondary education has not improved in the past decade (Umoinyang, 1999).

Various factors have been adduced for poor performance of students in mathematics. The interest of students in mathematics have been related to the volume of work completed, students task orientation and skill acquisition, students personality and self-concept (More, 1973), feeling of inadequacy (Callahan, 1971), motivation and self-confidence (Aiken, 1976), shortage of qualified mathematics teachers Ohuche(1978), Ale(1989), poor facilities, equipment and instructional materials for effective teaching (Oshibodu,1984; Akpan,1987; Odogwu,1994), use of traditional chalk and talk methods, (Shibodu,1988, Edwards and Knight, 1994), large pupils to Teacher ratio (Alele - Williams, 1988) mathematics phobia (Georgewill,1990) and so on. Wentzel (1998) stated that interest in activities tends to increase the likelihood that individuals formulate goals relating to the activity and invest time and effort to achieve them.

Moreover, individual characteristics such as intelligence cognitive styles and personality play an important role in learning. Findings have shown that individual students' characteristics variable such as motivational orientations, self esteem and learning approaches are important factors influencing academic achievements.

In the effort to improve students cognition and affective outcome in mathematics and/orschool learning, education psychologist and mathematics educators, have continued to search for variable (personal and environment) that could be manipulated in favour of academic gains. Out of all the personal and psychological variables that have attracted researchers in this area of educational achievement, motivation seems to be gaining more popularity and leading other variables (Tella, 2003).

A lot of new and modified old methodologist have been proposed to improve performance in the subject (e.g. Ande,1990; Akinsola,1994; Broussard & Garrison, 2004) e.t.c. Instructional material have also been designed and developed to aid mathematics teaching and learning (Skem,1989). This helps to break the cycle of poor performance by motivating pupils to learn mathematics. The issue as relating to mathematics education would then be, is it possible to motivate pupils to learn mathematics? And how could it be done? One needs to therefore look at the effect of motivation on learning mathematics.

The issues of motivation of students in education and its effects on academic performance are considered as an important aspect of effective learning. However, a learner's reaction to education determines the extent to which learner will go in education. The motivational effect of a child on mathematics learning cannot be undermined. Hall (1989) believed that there is a need to motivate pupils so as to arouse and sustain their interest in learning mathematics "Motivation raises question on why people behave in the way they do it". An individual could therefore, from psychologists' point of view, be seen as politically, socially and academically motivated depending on the motive behind his or her activities.

Gesinde (2000) posited that the urge to achieve varies from one individual to the other, while for some individual's need for performance is very high where as for other it may be very low. Gesinde (2000) asserted further that, those who have high achievers as their models in their early life experience would develop the high need to achieve while those who have low achievers as their models hardly develop the need to achieve.

Okoye (1983) stated that motivation holds the key to the understanding of human behavior. According to him, motivation explains why some people run away from work; others put their best, yet other resort to illegal and unconventional method of achieving social/ academic, economic and political recognition. Okoye added that motivation should be carefully manipulated whether in the work situation or study situation, so that students are neither under motivated or over motivated but appropriately motivated so as to be useful to themselves in the society and world at large.

Bank and Finlayson (1980) found that successful students were found to have significantly higher motivation for achievement than unsuccessful students. Moreover, Johns (1996); Skaalvik (2004); Skaalvik and Sandra(2002) revealed significant relationship between academic performance and motivation.

Based on the foregoing, research on mathematics academic achievement should be considered a continuous process until there is evidence of improvement in interest and performances of the learners in the subject particularly the secondary school students.Therefore, this study examines the motivational effects on senior secondary school student's academic performance in mathematics.

Research Questions

The following research questions were formulated to direct this study:

(i) Is there difference in the motivational effect on academic performance of male and

female students in mathematics?

(ii) Is there difference in the academic performance of highly motivated and lowly motivated students in mathematics?

Research Hypotheses

From the research questions formulated for this study, the following null hypotheses were tested at 0.05 level of significance:

(i) There is no significant difference in the motivational effect on academic performance of male and female students in mathematics.

(ii) There is no significant difference in the academic performance of highly motivated and lowly motivated students in mathematics.

Methodology

The research design adopted for this study is an ex-post facto design. This is because the research does not have direct control over independent variables, and their manifestations have already occurred or because they are inherently not manipulable. The researcher therefore examined the motivational effect (independent variable) on secondary schools students' performance in mathematics.

The target population for the study comprised of all senior secondary school (SS3) students in Abuja Federal Capital Territory of Nigeria. The samples of the study were 450 secondary school students drawn from 10 schools in two Area councils which include Bwari and KujeinFCT-Abuja. The samples were randomly drawn from the selected secondary schools.

A modified instrument tagged Motivation for Academic Performance Questionnaire (MAPQ) was used to collect data for the study. Items in the instrument were adapted from Motivation for occupational preference scale (MOPS) by Bakare (1997) and motivation for academic study scale by Osiki (2001). The instrument was divided into two sections; the first part requires the respondents demographic information like sex, age, class, name of school etc; while the second part contain the items it was a thirty items with five scales of likert type format with response ranged from strongly agrees 5, to strongly disagree 1.

To ascertain the reliability of the instrument after modification, it was administered on 50 respondents secondary school students selected from another two secondary schools which were not part of the study sample. The reliability coefficient yielded an r= 0.85 through Cronbach alpha. All the items in the instrument were relevant to the content of the study. Data on academic performance were gathered through performance test in mathematics constructed by the researcher in the subject content area. The reliability coefficient of the instrument was found to be 0.82 using test re-test reliability method of two weeks interval.

Four hundred and eighty (480) copies of the questionnaire were administered or distributed to the respondents and four hundred and fifty (450) copies were properly filled and returned, which were valid for the data analysis, while only thirty (30) copies were not retrieved. Data collected on the study were analyzed using t-test inferential statistics.

Results

The sequence of the presentation of the result of data analysis is in accordance with the research hypotheses formulated:

Hypothesis One: There is no significant difference in the motivational effect on academic performance between male and female students in mathematics.

Table 1: t-test results of motivational effect of male and female students in mathematics

Gender	N	Mean	S.D	df	t.cal	t-critical	Decision
Male	260	48.3	18.2				
Female	190	33.4	13.6	448	9.4	1.96	s*

S*=Significant at 0.05 level

Table 1 shows the results of the motivational effect on academic performance of students in mathematics based on gender. From the table the mean academic performance of male is 48.3, while the mean of female is 33.4 with standard deviation of 18.2 and 13.6 respectively. The calculated t-value obtained is 9.4 which is higher than the t-critical of 1.96 at df = 448; at 0.05 level of significance. Therefore the null hypothesis one is hereby rejected. Hence there is a significant difference in the motivational effect on academic performance between male and female students in mathematics.

Hypothesis Two: there is no significant difference in the academic performance of highly motivated and lowly motivated students in mathematics.

Table 2: t-test results of academic performance of highly motivated and lowly motivated students in mathematics

Variables	N	Mean	Sd	df	t-cal.	t-critical	Decision
Highly motivated students	150	39.3	25.5				
Lowly motivated students	300	10.3	7.8	448	8.05	1.96	s*

S* = significant at 0.05 level

Table 2 shows the academic performance measured alongside the extent of motivation. The result reveals that there is significant difference in the academic performance of highly motivated and lowly motivated students in mathematics with their means score of 39.3 and 10.3 respectively. The calculated t-value is 8.05 and t-critical of 1.96 with df of 448 at 0.05 level of significance. Thus the null hypothesis was rejected.

Discussion

The result of the hypothesis, which compares the motivational effect on academic performance of secondary school students in mathematics using gender as a variable of interest is found to be significant. The findings showed that motivation has effect on academic performance of secondary school students in mathematics with respect to gender. Meanwhile, it is very clear that success in school subject or academic generally depend on many motivation factors. The issue of gender is part of it likewise parental involvement/support and or peer influence. All these should not be underrated because they are factors that can make or mar student performance in school.

The result of the second hypothesis shows that secondary school students differ significantly in their academic performance based on the extent to which they are motivated. The results reveal that highly motivated students perform better academically than the low motivated students. This finding corroborates with that of Bank and Finlayson's (1980) finding who stressed that successful students have significant higher motivation for performance than unsuccessful students. Similarly, the report by John (1996) that academic achievement is highly correlated with student's motivations lends a good support to the present findings. With reference to the position of Ayotola (1998), that when pupils express lack of interest in the subject, it affects the way they react or listen to the teacher. It can be said therefore that interest and attitude of learner towards a particular subject matters a lot. This is because these two constructs according to the author are high motivating factor which can

lead to better achievement on the part of the learner. Good attitude and better interest learners display particularly in Mathematics serve as an encouragement even to the teacher. This can help the teacher to disseminate his teaching to the best of his ability and knowledge making use of all available resources rather than resorting to the use of chalk and talk when learners show no interest or negative attitude. Moreover, when the students display good attitude and better interest in mathematics, the teacher is motivated and this may cause him to forget whatever hindrances to the teaching of the subject from his own part. Good impartation of mathematics knowledge on the part of the teacher, couple with student's interest in the subject and the display of positive attitude as earlier pointed out, are good motivating factors which when combine together is assumed will result to better performance in mathematics.

Conclusion and Recommendations

This study investigated the motivational effect on senior secondary84es school students' academic performance in mathematics. It was discovered that there is a significant difference in the academic performance of male and female students in mathematics. Similarly, there is a significant difference in the academic performance of highly motivated and lowly motivated students in mathematics.

Based on the results emanating from the study, this study justified the importance of motivation to academic performance or achievement. The study therefore recommends that mathematics teachers should motivate their students during the course of instructions by making the mathematics learning interesting.

References

Aiken, L. A. (1976). Update on attitudes and other affective variables in learning mathematics. *Review of Educational Research,* 61, 880 - 815.

Aire, J. E. & Tella, Y. (2003). The impact of motivation on student's school academic performance in Nigeria. *Journal of Personality Study and Group Behaviour,* 23(1), 107 - 114.

Ale, S. O. (1989). School mathematics in 1990's some major problems for developing countries. *International Journal of Mathematical Education in Science and Technology*, 20(5).

Allele, W. G. (1988). Keynote address delivered at the silver Jubilee meeting of mathematics association of Nigeria (MAN). *Abacus,* 18(1).

Aremu, A. (1988). Motivating learners for more effective achievement in mathematics. *Nigerian Journal of Applied Psychology*, 4(1), 27 - 34.

Bakare, C. G. M. (1977). Motivation for occupational preference scale*. Psycho-Educational Research Publications,* 5(2), 31 - 43.

Bank, C. & Finlapson, W. (1980). *Successful motivation of students in academic activities.* McClelland, D.C; Appleton Century - Crafts.

Baya'a, N. F. (1990). Mathematics anxiety, mathematics achievement, gender and socio-economic status among Arab secondary students in Israel. *International Journal of Mathematical Education in Science and Technology,* 21(2), 319 - 324.

Broussard, S. C. & Garrison, M. F. (2004). The relationship between classroom motivation and academic achievement in elementary school-aged children. *Family Consumer Science Research Journal,* 33(2), 106 – 120.

Collaham, W. L. (1971). Adolescent Attitude towards Mathematics. *Mathematics Teachers,* 64, 7, 51 – 753.

Edwards, A. & Knight, P. (1994). *Effective early year's education: Teaching young children*. Buckingham: Open University Press.

Georgewill, J. W. (1980). Causes of poor achievement in WAEC mathematics examinations in River State secondary school Nigeria. *International Journal of Mathematical Education in Science and Technology,* 21 (3).

Gibson, J. T. (1976). *Psychology for the classroom*. Englewoodcliffs, NJ: Prentice Hall.

Gesinde, A. M. (2000). Motivation. In Z. A. A. Omideyi (Editor) *Fundamental of guidance and counseling*. Ibadan: kanead Publishers.

Hall .F. (1989).*Learning and memory (2nd Ed.*). Massachusetts: Aliyn and Bacon.

John, J. O. (1996). *Child psychology*. Calabar: Wusen press limited.

Mioore, B. D. (1973). The relationship of 5th grade students self concept and attitude toward mathematics to Academic achievement in arithmetic computations concept and application. *Dissertation Abstract international,* 32, 4426.

Ohuche ,R. O. (1978). Receipt Attempts at mathematics Curriculum renewal in English Speaking West Africa. *Abacus*, 12(1).

Odogwu, H. N. (1994). Primary secondary teachers and the teaching of time concept in schools. *Education Today*, 7(2).

Okoye, N. N. (1985). *The psychology of motivation.* Ibadan: Adebara Publishers limited.

Oshibodu, B. M. (1984). An investigation of teacher's Instructional Problems in mathematics. *Benin Journal of Education Studies,* 11(3), 43 – 54.

Oshibodu, B. M. (1988). Mathematics at primary level. *Abacus,* 18(1), 13 - 20.

Osiki, J. O. (2001). *Motivation for academic study scale.* Ibadan: Stirling-Horden Publisher

Sandra, D. (2002). Mathematics and science achievement effects of motivation, interest and academics engagement. *Journal of Educational Research* . Available at: http // www.findarticles.com (Accessed 07/09/2006).

Skemp, R. R. (1989).*Mathematics in the primary school.* London: Rutledege.

Stephens, J .M. (1966.).*The psychology of classroom learning.* New York: Holt, Rinehart and Winston,Inc.

Umoinyang, I. E. (1999). *Student socio - psychological factors as determinants of achievement in senior Secondary mathematics.* Unpublished PhD. Thesis, University of Ibadan, Ibadan.

Wentzel, K. R. (1998). Social relationship and motivation in middle school. the role parents, teachers and peers. *British Journal of education psychology, 68 (2), 35 - 43.*

Yoloye, E. A. (1976). *Causes of poor academic performance in Northern Nigeria. A monograph.* Institute of Education, University of Ibadan, Ibadan.

GLOBALIZATION OF HUMAN CAPACITY BUILDING THROUGH INFORMATION AND COMMUNICATION TECHNOLOGY IN TEACHER EDUCATION IN NIGERIA

NSOFOR, C. C. PhD[1]., OBUNADIKE, G. N[2]., BELLO, A.[3] & ABUBAKAR, H.[4]
[1]Science Education Department, Federal University of Technology, Minna, Nigeria
[2]Computer Science Department, Federal University Deutse-M, Katsina State.
[3]Firdaus International School Minna, Nigeria
[4]School of Health Technology Minna, Nigeria
E-mail: chinnansofor@yahoo.com Phone No: +234-803-678- 3024

Abstract
Teacher education has always received considerable attention in education planning and this is because it is concerned with capacity building of teachers to acquire the competence and skills that will equip them to function in the teaching task as highly motivated and conscientious teachers of our time. In the light of the above, the teacher education process has to move and change with time. One area of noticeable change in the world is in the area of Information and Communication Technology (ICT). However, the human capacity building of teachers through Information and Communication Technology (ICT) should not be restricted to improving computer literacy of the teachers but more importantly, the intention should be to exploit the potential of ICT to build the professional competence of teachers. This will enable teachers to integrate ICT in their day-to-day teaching activities, disseminate and share ideas among colleagues irrespective of where they are. In this process, human capacity building can be maximized for optimal performance. This paper discussed the concept and roles of ICT integration in teacher education; examined globalization of human capacity building through ICT integration, highlighted the critical issue that, without adequate capacity building, even well-designed policies and the most sophisticated technologies would not be able to achieve the desired results. Finally the challenges in integrating ICT in teacher education were pointed out and some recommendations proffered.

Keywords: Human Capacity Building, Globalization, Information and Communication Technology, Teacher Education

Introduction
Teacher education is a vital component of most educational system and according to Ezugwu (2011), it is the process of preparing or developing teachers with the necessary knowledge and skills that will enable them to effectively direct learning situation. Teacher education is highly indispensable for any nation that wants rapid development and progress. It is in recognition of the above that the national policy on education Federal Republic of Nigeria (2008) stated that teacher education programmes should be structured to equip teachers for the effective performance of their duties. In addition, the policy remarked that teacher education shall continue to take cognizance of changes in methodology and in the curriculum and that teachers shall continue to be regularly exposed to innovations in their profession. One of such innovations in the curriculum is in ICTs which is already integrated in teacher education programme. Herein lays the challenge for teacher- trainers to use innovative strategies which abound through ICTs to spur varied potentials and abilities of teacher trainees by equipping them with up- to-date methodological skills to function as highly motivated and conscientious teachers of our time. Capacity building of teachers through ICT according to Carlson and Gadio (2002) should however not merely mean to give them the ability to use ICTs or "ICT Literacy." Though this is an essential prerequisite, it is rather trivial for a policy to be limited to this. The real meaning and power of Information and Communication Technologies (ICTs) for "capacity building" would be to

give the teachers the ability to use ICTs in their own processes of teaching-learning in a manner they deem fit arising from their engagement with ICTs.

The importance of capacity building of teachers cannot be over emphasized. The teacher is the greatest interactive agent, pilot, captain, mother, motivator, governor, chief executive officer and managing director of any effective instructional system all over the world (Ofoefuna and Ebeoga 2010). The teacher can provide the much needed quality control devices in the educational system, thus teachers hold the key to a better world and very few people can do without them. Consequently, within the 21st century, the Nigerian teachers will perform their professional responsibilities more effectively and efficiently if they can be empowered to create learner-centered learning environment where students are enabled to learn as emphasized by the constructivist theory of learning. The realization of this constructivist approach to learning lends itself to globalization of capacity building of teachers through integration of ICT into teacher education. Globalization through appropriate use of ICT can catalyze the pragmatic shift from teacher-centered pedagogy to a more effective learner- centered pedagogy. Capacity building of teachers can play major role in enabling this shift. ICTs can enhance the quality of teaching and learning by providing access to a great variety of educational resources and by enabling participatory pedagogies. ICTs can also improve the management of education through more efficient administrative processes, including human- resource management, monitoring ICT evaluation, and resource sharing.

Information & Communication Technology (ICT): Concept, Roles and Integration in Teacher Education

ICT can be defined as a diverse set of electronic technologies and technological tools and resources used to communicate, create, disseminate, store, and manage information (Tinio, 2003; Adomi & Kpangban, 2010). These technologies may include computers, the internet, broadcasting technologies and telephony. ICT is a critical tool in preparing and educating learners with the required skills for the global workplace. It educates students so that they can continually adapt to a work world of continuous technological innovations. ICT makes it easier for teachers and students to access knowledge; it is regarded as an engine for growth and tool for empowerment, with profound implications for educational change and socioeconomic development (Adomi & Kpangban, 2010). The impact of ICT on learning is the vision that it enables learning anywhere, anytime and anyhow'. With ICT, knowledge is not constrained by geographic proximity; it also offers more possibilities for sharing, archiving, and retrieving knowledge (Arinto 2006). The widespread use of ICT generates a need for new digital skills and competences for employment, education and participation in the society.

ICT has the potential to widen access to educational resources, improve the quality of learning and improve management efficiencies of the educational system. ICT use in education is not all about ICT literacy but it also involves the building of higher-order skills, which implies knowing and understanding what it means to live in a digitized and networked society and use digital technology in everyday life. It involves the understanding of how ICT applications and services function; how to search process and evaluate certain information and access the reliability and trustworthiness of multiple sources of information. ICT can lead to greater digital opportunities including economic and human development. ICT is a potent tool in reducing poverty, extending health services, expanding educational opportunities and generally improving the quality of life. ICT can, therefore, promote educational change, improve the skills of teachers and learners and prepare them for global economy and information society.

ICT can expand access to education anytime and anywhere because ICT can transcend time and space, thus it permits asynchronous and synchronous learning (Ihenunekwu, Nwamuo & Amaraihu 2010). Access to remote learning resources occur with the use of the internet and World Wide Web (WWW). The teachers and students do not rely solely on printed and other materials in physical media housed in libraries. They can be assessed in almost all subjects and in a variety of media anywhere at any time of the day and by an unlimited number of people. ICTs can improve the quality of education by Increasing learners motivation and engagement through Networked computers with internet connectivity. Also Videos, TV & multimedia computer software (text, sound, colour, moving images) can be used to provide challenging and authentic content that will engage the student's learning process. ICT improves the quality of education by facilitating the acquisition of basic skills which serves as the foundation of higher order thinking skills and creativity through drill and practice.

The effective integration of ICT in teacher education portrays a paradigm shift from a teacher-centered to a learner-centered learning environment in our educational system (Ofoefuna & Ebeogu 2010). This forms the basis for the acquisition of the knowledge and skills required for a lifelong learning in students. ICTs integration in teacher education enables new ways of teaching and learning, the theoretical framework for this lies on constructivism (Driscoll, 2005). Essentially, traditional pedagogy paves way for the adoption of an emerging pedagogy enabled by ICT. Generally, a ICTs-emerging pedagogy will accommodate "just-in-time' learning where learners can choose what to learn and when they need to learn it. There is interaction and cooperation among learners, teachers and experts irrespective of where they are culminating in the manipulation of existing information and the creation of real-world products than mere regurgitation of received information. A ICTs-emerging pedagogy encourages student-directed and diagnostic pathways of learning; students can explore and discover rather than listen and remember. The importance of integrating ICT in teacher education cannot be over emphasized, when teacher are equipped with the skills and competency in ICT the multiplier effect on the learners and in the larger society will be enormous.

Globalization of Human Capacity Building through ICT Integration in Teacher Education System

Globalization is a process of interaction and integration among the people, companies, and governments of different nations. Information and Communication Technology (ICT) is a driving factor in the process of globalization. Improvements in the early 1990s in computer hardware, software, and telecommunications have caused widespread improvements in access to information and economic potential in Nigeria. These advances have facilitated efficiency gains in all sectors of the economy. Globalization through ICT provides the communication network that facilitates the expansion of products, ideas, and resources among nations and among people regardless of geographic location, creating efficient and effective channels to exchange information; ICT has been the catalyst for global integration (Scott, 2011).

Important parameters that determine the success of ICT integration in Education sector are the appropriateness of technologies, the suitability and quality of instructional materials, educational services made available, learning effectiveness and appropriation of new ways of work, and the cost-benefit ratio. It is, therefore, important that policy-makers are sensitized on the importance of incorporating these aspects within the plans for ICT integration in teacher education system. Consequently, the need for globalization of human capacity building of educational institutions principally arise due to the issues raised above plus high initial cost associated with setting up the infrastructure, lack of trained personnel

and lethargy on part of management and faculty to upgrade themselves, initial resistance to change by the teachers, lack of bandwidth and other technical support functions across geography, and above all the lack of awareness with regard to utility of ICT for education.

To maximize the effect of globalization through ICT on knowledge and growth, it is required to create maximum connectivity, adequate network capacity and minimum required infrastructure. Further, the diffusion of this process depends on the capacity of the human element to absorb and exploit the benefits of the technology. The policy framework and institutional mechanism coupled with the capacity to absorb and invest costs associated with both technology and human capacity building influence the role of ICT to support knowledge and growth. Sustained educational capacity building through ICT in today's advanced globalization process and communication infrastructure can be achieved by integrating the sustained "local" capacity into a "global" educational environment. The key components to this "sustainability" within this globalized framework are not only "access" to global communication flows, but the creation of communication hubs as integral elements of global educational networks.

Policy Considerations in ICT Capacity Building and Integration

Policy makers shape a country's education policies, including policy on who shall be educated, what they shall be educated about, and how they shall be educated. With respect to ICT in education, policy makers set the framework and make high-level decisions covering all aspects of program implementation (UNESCO 2008). Teachers, on the other hand, implement education policy. Weaknesses in policy making often lead to the misallocation of resources, which in turn worsen the existing lack of resources. For example, there is a tendency to emphasize the installation of ICT over the seamless integration of ICT in teaching and learning, that is making ICT a part of the educational milieu and ensuring that it results in improved learning outcomes. This results in an 'incredible influx of financial support for equipment but only a meager trickle for network support or staff training' (Monahan, 2004). In planning for ICT integration in education, policymakers would do well to begin by determining the educational purposes that technologies are to serve before they are brought on board. This means clarifying overall education policy, as this should serve as the rationale and road map for technology integration. It is important to note that technology is only a tool and as such it cannot compensate for weaknesses in education policy. (Guttman, 2003 & Haddad, 2007a). Once national education goals have been clarified, policy makers need to decide on what ICT integration approach to adopt. Monahan (2004) pointed out three different approaches being used in Asia Pacific countries as follows: (a) teaching ICT as a subject in its own right, usually beginning at the upper secondary level, to develop a labour force with ICT skills; (b) Integrating ICTs across the curriculum to improve teaching and learning; (c) Using ICTs to foster learning anywhere and anytime as part of the development of a knowledge society in which all citizens are ICT savvy.

Each of these approaches has different infrastructural, personnel, and management requirements, among others. The key considerations in selecting any of the approaches are appropriateness, cost-effectiveness, and sustainability of the infrastructure and hardware (Guttman 2003 & Haddad 2007a). Appropriateness refers to fitness for purpose and context, which implies that policymakers must resist the pressure to adopt the newest technologies simply because they are 'high-tech' and other countries are adopting them. As Guttman (2003) noted, 'some of the greatest educational problems are in the most remote areas, where electricity supplies may be irregular or non-existent, telephones scarce and lines difficult to maintain.' Policymakers need to be mindful that ICT does not become a source of further inequality, causing digital divide by deepening existing disparities. At the same time,

in ensuring universal access to technologies, the policy must keep in mind the need to ensure sustainability, which has technological, political, and social dimensions aside from the economic or financial dimensions. Technological sustainability has to do with choosing technology that will be effective over the long term, taking into account the rapid evolution of technologies and the availability of technical support. Political sustainability has to do with the policy environment and management of the change processes involved in technology integration in schools. Social sustainability comes from the involvement of all stakeholders, including those who will use the technology (teachers, learners), those who will be affected by its use and others with a legitimate interest in education processes (parents, political leaders, and business and industry leaders) (Tinio, 2003).

The financial cost of ICT acquisition in schools is usually a major focus of attention in policy making and project planning. But the cost of acquisition is only one aspect, policy makers and administrators need to budget for the-recurring costs that form part of the Total Cost of Ownership (TCO) and maintenance and support which account for about a third to half of the initial investment in computer hardware and software (Haddad, 2007b). Thus, even if computers may be acquired for free, as in the case of donated computers, they require a substantial financial investment for maintenance and support. The development of content for ICT-supported teaching and learning is another key policy area. According to Haddad (2007b), 'introducing TVs, radios, computer and connectivity into schools without sufficient curriculum-related ICT-enhanced content is like building roads but not making cars available, or having a CD player at home when you have no CDs. Development of content software that is integral to the teaching/ learning process is a must.' Policy makers will need to make a choice between acquiring or creating new ICT-enhanced educational content and software. Suitability, availability and cost are key considerations in making this choice.The selection of appropriate content and software has to be made not once but many times, since different learning contexts will have different requirements, for example in terms of age, learning abilities, subject-specific demands, culture and language. The need for trained personnel who will implement technology integration in schools is also a key area that policy makers need to pay attention to, and they must do so from the outset. Technology by itself is not enough to transform education processes and improve educational outcomes but as Haddad (2007b) puts it, 'appropriate and effective use of technologies involves competent, committed interventions by people. The required competence and commitment cannot be inserted into a project as an afterthought, but must be built in from the conception and should be designed with the participation of those concerned in mind.' Capacity-building for teachers is especially crucial and is a key component of ICT integration in education.

Nigeria ICT Policy

In order to husband the potentials of ICT, most nations of the world have evolved national information and communication technology policies, to serve as a framework for ICT integration in all facets of the society. African countries, and particularly Nigeria, are not exceptions to this practice. However, the digital divide between advanced and developing countries, particularly in Africa, is well established, like most African countries, Nigeria as a nation, came late and slowly in the use of ICT in all sectors of the nation's life. Although Africa has 12 per cent of the total world population, the continent has two per cent presence in ICT use (Jensen, 2002). In Africa, there is low access to basic ICT equipment, low internet connectivity, low participation in the development of ICT equipment, and even low involvement in software development (Jensen, 2002). The first national ICT policy for Nigeria was issued in 200I. This was followed up with the establishment of the National Information Technology Development Agency (NITDA), the National Information Technology Development Fund (NITDF) and supervising minister to designate and facilitate the establishment of Information Technology parks. The Act empowers NITDA to plan, develop,

and promote the use of Information Technology in Nigeria while the National Information Technology Development Fund (NITDF) constitutes the main intended Source of funding for NITDA programmes.

The general objectives of the policy were to: (1) Ensure that IC'I' resources are readily available to promote efficient National development, (2) Guarantee that the country benefits maximally and contributes meaningfully by providing the global solutions to the challenges of the information age, (3) Empower Nigerians to participate in software and IT development, (4)Encourage local production and manufacture of Information and Technology (IT) components in a competitive manner, (5) Improve accessibility to public administration for all citizens, (6) Bring transparency to government processes, (7) Establish and develop IT infrastructure and maximize its use nationwide, (8) Improve judicial procedures and enhances the dispensation of justice. It is now important to analyzing the document as it affects education. In making this analysis, the writers have been guided by four key questions: (a) what does the Nigerian national policy for information technology tell us about education? (b) How adequate is the policy for the integration of ICT in the Nigerian education system? (c) What implications are there for the Nigerian education system? (d) What agenda is needed to redefine the national policy to cater for the country's education system?

Answers to these questions are intended to provide basis for redefining and re-development of the Nigerian national policy on information technology (Federal Republic of Nigeria, 2008), The document has no specific direction on ICT or technology plan at institutional levels, Advanced countries have specific plans for ICT, for instance, in Britain the national Grid for learning initiatives and the strategy for Education Technology, specifically addressed ICT issues in United Kingdom and Northern Ireland respectively (Selinger & Austin, 2003). The Nigerian national policy does not give any guidelines on school technology plans, the implications of these inadequacies are that the national policy cannot adequately take care of the need of the Nigerian education system. Its educational focus is limited to the market driven goal. The need for integration in teaching and learning, the need for quality professional development programs for pre-service and serving teachers, research, evaluation and development, and the development of local context software are not addressed. These are major components of quality IC'T application in education. In view of these inadequacies, there is a need to revise the Nigerian national policy for information technology, such revisions should be undertaken to involve stakeholders in the area of education so that they can ensure that the policy covers issues related to learning about ICT and learning through ICT for capacity building. All these considerations are crucial because without adequate capacity building, even well designed policies and most sophisticated technologies like Information and Communication Technology would not be able to achieve the desired results.

Challenges of ICTs Integration for Capacity Building in Teacher education in Nigeria

This paper has presented the roles and needs of ICT integration in teacher education generally. However there seem to be challenges which include among others:

(1) Low infrastructure: There are low infrastructures in many of our Colleges and Universities. Low infrastructures may include: inappropriate rooms and buildings, lack of basic facilities for computer-based/online learning including access to computers in schools, as well as affordable internet services, ineffective and inaccessible electricity and telephony,. It is a known assumption that effective and appropriate telecommunication and information infrastructure can influence the educational technology infrastructure vis-a-vis ICT

integration for capacity building. There seem to be ICT connectivity problems in many schools, Colleges and Universities. Information and Communication Technology is electric power driven, electric power supply is one of the major problems affecting ICT activities in Nigeria. The problem of epileptic power supply and its effects on ICT application in Nigeria schools at all levels and in all locations both urban and rural was clearly observed by Association of Telecommunication Companies in Nigeria (2011). Given the current need to adopt the new technology, very often, users normally find alternative means of power generation. That is the use of small generating sets which litter the environment with attendant air and noise pollution. Many tertiary institutions do have big electricity generating sets which usually have defined hours of use or operation. The big generators run on diesel which is more expensive.

(2) Poor ICT policy and management strategy: Poor ICT policy and project management strategy is also a challenge. The policy indicated that infrastructure and personnel training would be intensified so as to encourage the integration of ICTs in our educational system. Sadly enough, there has not been any concerted effort to provide the infrastructure and trained personnel across board in our schools and colleges. Evoh (2007) reported that ICTs receive low financial priority in almost all African countries. There are no resources for a sustainable integration of ICTs in education. These are many competing development priorities (budgetary constraints, management challenges, shortage of teachers, etc).

(3) Poor maintenance cultures: Information and Communication Technology facilities suffer poor maintenance culture. Inadequate technical skills contribute to the poor maintenance and improper handling of ICT facilities. More often than not, the users of these facilities give little attention to equipment repair needs. In some instances, the equipment undergoes poor storage and careless handling.

(4) Funding: ICT integration for capacity building of teachers requires large capital investment; this is because facilities come in the form of hardware (equipment) and software (materials) or consumables. Consequently, there is an increasing demand for financing the cost of ICTs in colleges and universities. Most administrators generally provide low budgets for ICTs, colleges and universities who are involved in teacher education will release funds for ICTs acquisition and implementation only when accreditation exercise takes place by NUC and NCC and one wonders how these approaches can encourage ICT integration for capacity building

(5) Apathy in the use /application of ICTs: Apathy towards new technology is a challenge; a great population of teachers involved in teacher education programme are reluctant to use ICTs may be because of these reasons: Lack of knowledge for software design, Skepticism about the effectiveness of computers in improving learning outcomes, Lack of administrative support, Increased time and effort needed to learn and use the technology, Fear of losing authority in the classroom as a result of a shift to a learner-centered learning environment. Some teachers have poor perception of ICTs. Some teachers feel that ICTs can replace them thereby increasing unemployment. There is little attention paid to content development of the software needed for ICTs integration for capacity building of teachers/personnel. This is in addition to the fact that curriculum already designed has no provision for ICT integration.

Recommendations

The challenges identified in the full application of ICT in human capacity building can be remedied to fully realize the benefits of ICT.

(i) The problem of electric power supply is largely Government controlled. If Government improves the power supply, life would be much better in facilitating human capacity building and the enjoyment of global services.

(ii) As regards to ICT policy, there is need for a clear and concise policy formulation for ICTs integration for teacher's education. Specifically, there should be a rigorous analysis of the present state of teacher education system. ICT-based interventions must consider current institutional practices and arrangements. Emphasis should shift from the technology literacy approach to technology knowledge deepening and creation approaches. The present Nigeria national policy for Information Technology (IT) should be reviewed in such a way that access policy is addressed in concrete terms. Infrastructural needs must be addressed across zones and school levels.. Since teachers are vitally important to ICT integration in education, the national policy on IT should address the issue of teachers' professional development. This should incorporate issues relating to teacher training institutions and ICT, pre-service teacher education, in-service teacher education, and standards for teacher competence and certification in ICT. This will facilitate the conception and implementation of adequate and effective policies to encourage the integration of ICTs for capacity building of the personnel (teachers).

(iii) The apathy towards new technology can be remedied gradually through continues training and re-training. There is need to train more ICT- based instructional designers, evaluators, scriptwriters, audio & video production specialists, programmers, multimedia course authors, and web designers and developers. We need to stress content relevance and content availability when an issue of content development is considered for ICTs integration in education for teachers. Human capacity building could be in the field ICT use, application, maintenance and others.

(iv) The dearth of technicians who would maintain the new technology (ICT) can be improved through short term training programmes. Even the training in technical skills is another extension of human capacity building. If more technicians are produced, rural locations will not be at a disadvantage in terms of facility maintenance.

Conclusion

Educational goals and needs should drive ICTs integration and use. Education is the key to economic, social and national development. Globalization and integration of ICTs for capacity building in teacher education can produce efficient, effective and professional teachers who will become managers, facilitators and implementers of government's policies and strategies. The 21st century teachers require a knowledge and practice of ICTs for the development of a systematic instructional planning strategy. This will produce effective learner-centered learning environment that is anchored on the theoretical framework of constructivism.

References

Adomi, E. E. & Kpangban, C. (2010). Application of ICTs in Nigerian secondary schools. *Library Philosophy&Practice(e-journal),*March,1-8. http://digitalcommons.unl.edu/libphilprac345.

Arinto, P. B. (2006). Reflections on ICTs in basic education policy and practice in the Philippines. Paper presented at the 2nd National ICTs in Basic Education Congress, waterfront Hotel, Lahug, Cebu City, Philippines, 6-7 September.

Association of Telecommunication Companies in Nigeria (2011). *Poor electricity is ICT sector's greatest challenges.* IT WORLD; Kaduna: Daily Trust Newspaper Ltd. Monday, 1st August, 2011, 27 (46) 49.

Carlson, S. & Gadio, C. T. (2002). Teacher professional development in the use of technology. In W.D. Haddad and A. Draxler (Eds), *Technologies for education: Potentials, parameters, and prospects.* Pans and Washington, DC: UNESCO and the Academy for Educational Development.

Evoh, C. J. (2007). Policy networks and the transformation of secondary education through ICTs in Africa: The prospects and challenges of the NEPAD e-schools initiative *International Journal of Education and development,* 3(1), 64 – 69.

.

Ezugwu, K. U. (2011). Qualitative teacher education in Nigeria: Issues & insight into the 21st century. *Knowledge Review,* 13(5), 118 - 130.

Federal Republic of Nigeria (2008). *Nigeria national policy for information technology (IT).* [Online). http://www.nitda.gov/docs/policy/ngitpolicy.pdf [Accessed 11th July,20 I I

Guttman, C. (2003). *Education in and for the information society.* Paris: UNESCO Publications for the World Summit on the Information Society. Retrieved November 23rd 2008 from http://unesdoc.unesco.org/images/0013/001355/135528e.pdf

Haddad, W. D. (2007a). Part I: Decision makers essentials. ICTs for education: A reference handbook. *ICT-in-Education Toolkit for Decision Makers, Planners & Practitioners 1 - Version 2.0.* Washington, DC: infoDev/World Bank.

Haddad, W.D. (2007b). Part 2: Analytical review. ICTs for education: A reference handbook. *ICT-in-Education Toolkit for Decision Makers, Planners and Practitioners Version 2.0.* Washington DC: infoDev/World Bank.

Ihenunekwu, S., Nwamuo, C. N. N. & Amaraihu, S. (2010). The essence of integrating information communication technology into higher education. *Journal of Educational Media and Technology.* 14(1), 50 - 55.

Jensen, M. (2002). *The African internet. a status report.* [Online].http://www3.sn.apc.org/africalafstat. htrn [Accessed July, 17, 2011].

Monahan, T. (2004). Technology policy as a stealth agent of global change. *Globalization Societies and Education*, 2(3), 355-76. www.globalizationl01.org Technology and Globalization"accessed 11th July, 2011.

Ofoefuna, M. O. & Ebeogu, U. M. (2010). Integrating ICT in teacher education in Nigeria: A Myth or Reality'. *Journal of Educational Media and Technology (JEMT)* 14(1) 41-47

Scott, P. (2011). Globalization and higher education: Challenges for the 21st century. Retrieved July, 27th 2011 from http://jsi.sagepub.com/cont/4/1/3.shot

Selinger, M. & Austin, R. (2003). A comparison of the influence of government policy in information and communications technology for teacher training in England and Northern Ireland. *Pedagogy and Education,* 12 (1), 19 - 38. Retrieve July, 17th 2011 from http://www.triangle.co.uk/jiti

Tinio, V. L. (2003). *ICT in education. e- Primers for the Information Economy, Society and Polity.* Manila: E-ASEAN Task Force/UNDPAPDIP. Retrieved July 17th 2011 from http://www.apdip.net/publications/ iespprimers/ICTinEducation.pdf

UNESCO (2008). ICT competency standards for teachers: policy framework. Retrieved Sept 10th 2011 from http://portal.unesco.org/ci/en/ev.php URL ID