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EVALUATION OF AQUIFER PROTECTIVE CAPACITY OF GROUND WATER RESOURCES WITHIN AFE BABALOLA UNIVERSITY, ADO –EKITI, SOUTHWESTERN NIGERIA.

Oladimeji L. Ademilua

Department of Geology , Ekiti State University, Ado Ekiti , Nigeria

Oluwaseun S. Ogungbemi

Department of Petroleum/Chemical Engineering, Afe Babalola University, Ado Ekiti.

Abstract:

Many investigation techniques are commonly employed with the aim of estimating the spatial distribution of transmissivity and protective capacity of groundwater resources. Unfortunately, the conventional methods for the determination of hydraulic parameters such as pumping tests, permeameter measurements and grain size analysis are invasive and relatively expensive. A non-invasive and less-expensive geoelectric investigation involving vertical electrical sounding was carried out in some parts of the campus of Afe Babalola University, Ado Ekiti, Ekiti State, Nigeria. A total of fifty-nine (59) vertical electrical sounding (VES) data were acquired using R 50 D.C. Resistivity meter within the campus which is underlain by the Precambrian basement rock of southwestern Nigeria. Following the interpretation of the VES data, maps and 2D-sections were generated. The geoelectric sections enabled the subsurface to be characterized into five geoelectric layers namely: Topsoil, clayey/sandy-clay, weathered layer, fractured basement and basement. The assessment and analysis of the materials above the aquifers showed that longitudinal conductance (S) values ranged from 0.08438 to 0.73449 mhos; thus classifying the area into weak (0.1 – 0.19 mhos), moderate (0.2 – 0.69 mhos) and good protective capacity(> 0.7 mhos). The major aquifer delineated is the weathered/fractured basement aquifers. The aquifers are characterized by thick overburden, moderate/good protective capacity and also exhibit moderate to relatively high value coefficients of anisotropy and low transverse unit resistance which suggests that the materials above the aquifers act as seal, thus protecting the

major aquiferous units, the aquifer matrix itself being relatively permeable. Areas with weak protective capacity are therefore vulnerable to infiltration of polluting fluid.

Keywords: Basement aquifer, Dar-Zarrouk parameters, Aquifer protective capacity, overburden, geoelectric section.

1.0 Introduction

Groundwater exploration within the basement complex rocks of Africa is usually carried out with the use of Vertical Electrical sounding (VES) (Palacky, 1989; Benson and Jones, 1988). This is because the successful exploitation of basement terrain groundwater requires a scrupulous understanding of the hydrogeological characteristics of the aquifer units viz-a-viz its susceptibility to environmental pollution. This is particularly important in view of the localized nature of the basement aquifers, (Satpatty and Kanugo, 1976). Water is essential for life. It had been and will continue to be a hot topic in both the political and scientific arena for years to come (Miller, 2006). The most probable use of the electrical resistivity survey is in hydrogeological investigation in relation to aquifer delineation, lithologic boundaries and geological structures to provide subsurface information (Bose et al., 1973). The method has been used extensively in groundwater investigation in the basement complex terrains (Barongo and Palacky, 1991; Olayinka and Olorunfemi, 1992; Olorunfemi et al., 1993; Omosuyi, 2000) and also in the sedimentary basins (De Beer and Blume, 1985; Mbonu et al., 1991; Shemang, 1993). Hence, drilling programmes for groundwater development in areas of basement terrain are generally preceded by detailed geophysical investigations. This discontinuous nature of the basement aquifer system makes detailed knowledge of the subsurface geology, its weathering depth and structural disposition through geologic and geophysical investigations inevitable (Adiat et al., 2009). The study area is underlain by Precambrian basement complex rocks. These rocks are inherently characterized by low porosity and near negligible permeability. The highest groundwater yield in basement terrains is found in areas where thick overburden overlies fractured zones. Afe Babalola University, Ado-Ekiti (ABUAD) is a fast growing private University in Nigeria. The continuous increase in population and the progressive infrastructural development within the campus daily emphasize the need for the development of a sustainable water supply network. The University has spent fortunes in purchasing water to ensure that the daily demand for potable water on the campus is met. ABUAD is underlain by the Basement Complex Rocks of Southwestern Nigeria.

1.1 Study Location And Geology

The study area is located within Latitude 840700 and 841710 and Longitude 753800 and 755080 in Universal Traverse Mercator (UTM). It is situated directly opposite the Federal Polytechnic Ado-Ekiti, along Ijan-Ekiti road. The topography is approximately flat with elevation ranging from 1167 to 1230 ft above sea level. Part of the Campus is drained by River Ogbese. The geology of the study area can be explained within the context of the geology of the Precambrian basement Complex of southwestern Nigeria which form a part of the basement complex of Nigeria (Rahaman, 1976). The major rock type within the area is typically Migmatite-gneiss comprising of undifferentiated granite, charnockitic rocks, medium to coarse granite and migmatite gneiss rocks (Figure 1). The vegetation in the area is of rainforest type, characterized by short dry season and long wet season, with high annual rainfall of about 1,300 mm. Annual mean temperature is between 180°C and 330°C with relatively high humidity (NIMET, 2007).

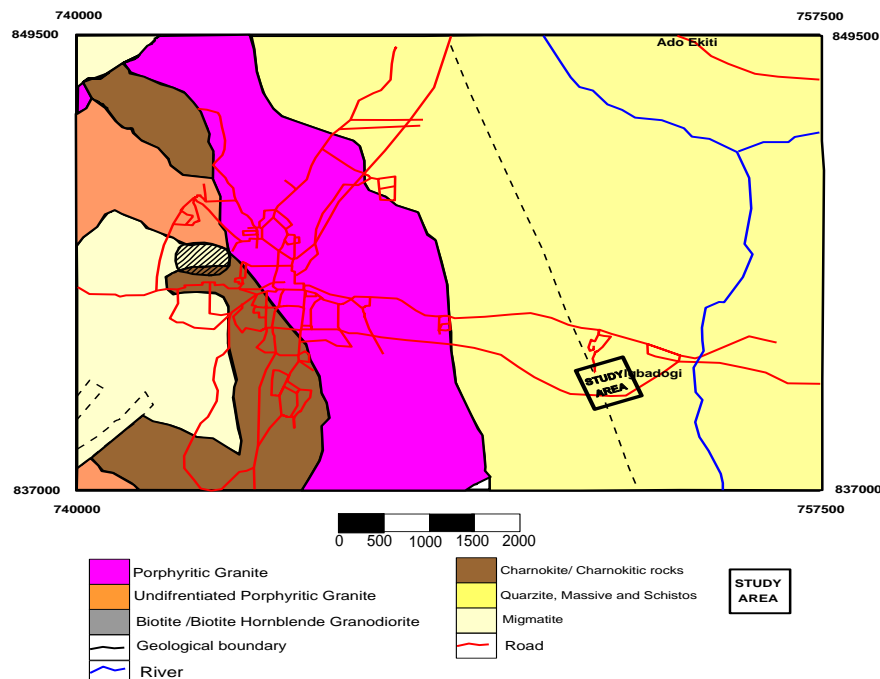


Figure 1: Geological map of Ado Ekiti showing the study area.

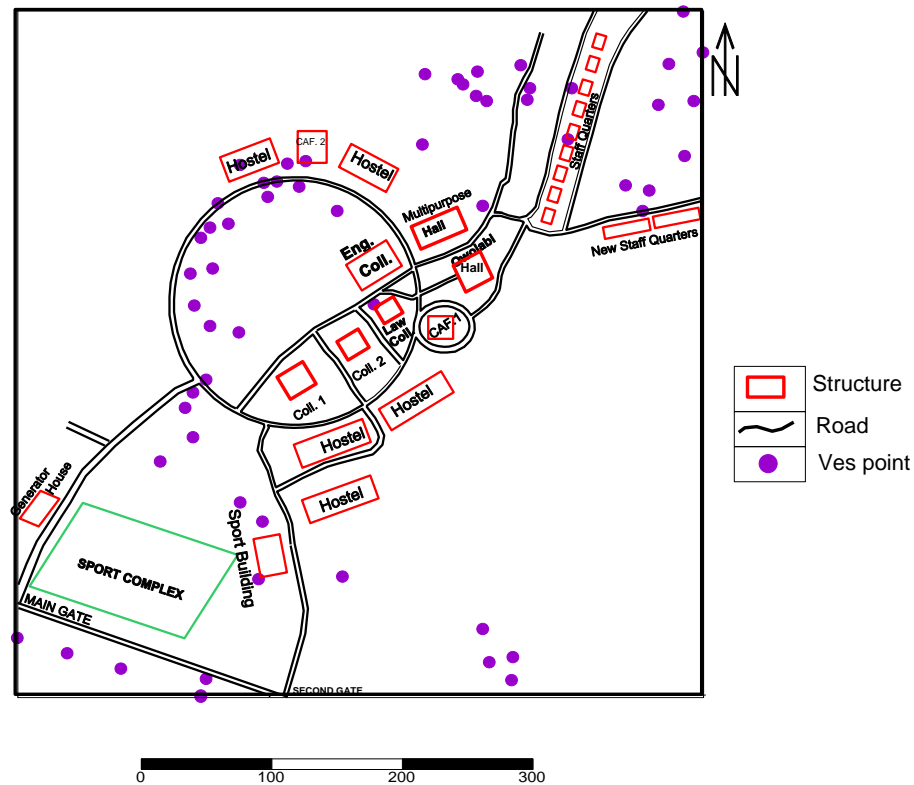


Figure 2: Base map of the study area showing VES points.

2.0 MATERIALS AND METHOD OF STUDY

The geophysical data was acquired with the R-50 D.C. resistivity meter which contains both the transmitter unit, through which current enters the ground and the receiver unit, through which the resultant potential difference is recorded. Other materials include: two metallic current and two potential electrodes, two black coloured connecting cable for current and two red coloured cable for potential electrodes, two reels of calibrated rope, hammer for driving the electrodes in the ground, compass for finding the orientation of the traverses, cutlass for cutting traverses and data sheet for recording the field data.

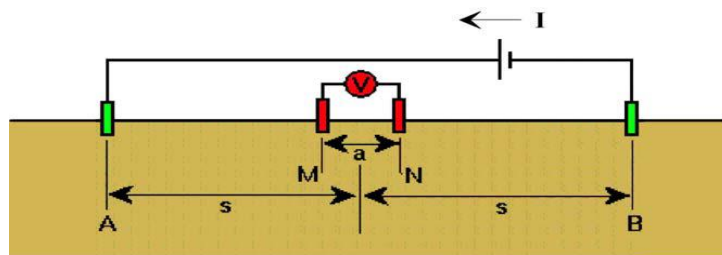


Figure 3: Sketch diagram of Schlumberger array

The Schlumberger array was adopted. The electrode spread of AB/2 was varied from 1 to a maximum of 150 m. The expected depth of investigation was $(D) = 0.125 L$, where $L = AB/2$ and AB the current electrode separation. Sounding data were presented as sounding curves, by plotting apparent resistivity against AB/2 or half the spread length on a bi-log paper.. The models obtained from the manual curve matching interpretations were used for computer iteration to obtain the true resistivity and thickness of the layers. Computer-generated curves were compared with corresponding field curves by using a computer program “Resist” version 1.0. The software was further used for both computer iteration and modeling. Computer iteration of between 1 - 29 were carried out to reduce errors to a desired limit and to improve the goodness of fit. The Dar-Zarrouk parameters are obtained from the first order geoelectric parameters (layer resistivities and thicknesses), these include the Total longitudinal unit conductance (S), Total transverse unit resistance (T), and coefficient of anisotropy (λ).

These secondary geoelectric parameters are particularly important when they are used to describe a geoelectric section consisting of several layers (Zhody et al; 1974). For n layers, the total longitudinal unit conductance is:

$$S = \sum_{i=1}^n \left(\frac{h_i}{\rho_i} \right) \dots \dots \dots (1)$$

$$T = \sum_{i=1}^n \rho_i h_i \dots \dots \dots (2)$$

$$\lambda = \left(\frac{\rho_T}{\rho_L} \right)^{\frac{1}{2}} \dots \dots \dots (3)$$

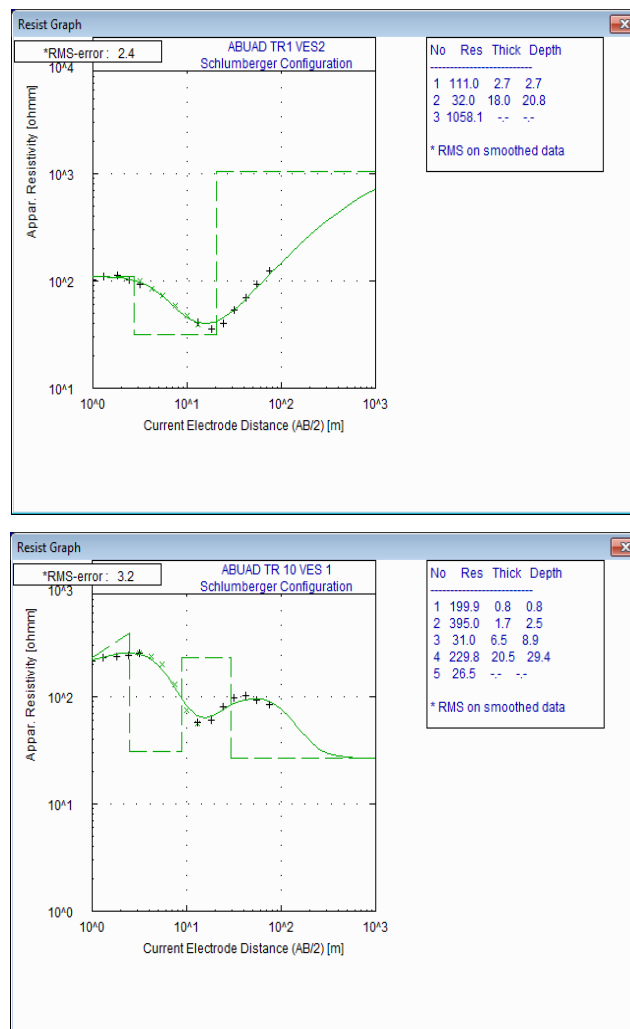
where h_i is the layer thickness, ρ_i is layer resistivity while the number of layers from the surface to the top of aquifer, (i) varies from 1 to n. Electrical anisotropy is a measure of the degree of inhomogeneity (Billings, 1972; Maliek et al., 1973) in a basement terrain; which arises from near surface effects, variable degree of weathering and structural features such as faults, fractures, joints, foliations, and beddings. These in turn are responsible for creating secondary porosity (Φ_s) and hence effective porosity (Φ_e).

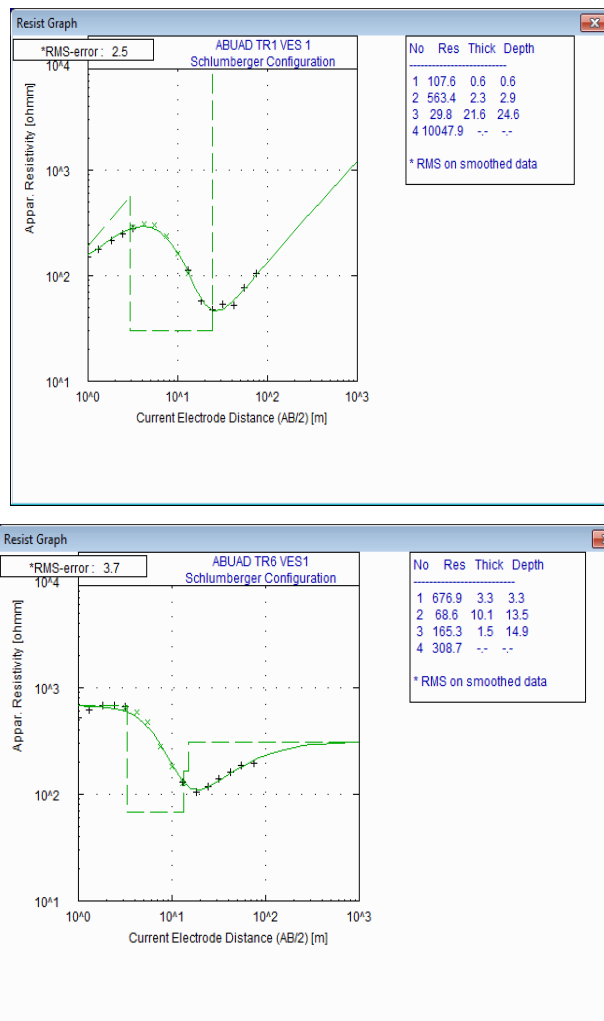
Table 1: Modified longitudinal conductance/protective capacity rating.

Longitudinal conductance (mhos)	Protective capacity rating
>10	Excellent
5 - 10	Very good
0.7 - 4.9	Good
0.2 - 0.69	Moderate
0.1 - 0.19	Weak
<0.1	Poor

3.0 RESULTS AND DISCUSSION

Sounding curves and aquifer types



Figures 4 (a-d): Typical sounding curves

3.1 Aquifer Protective Capacity Evaluation

The nature of the materials that overlain the mapped aquifers were evaluated using the layer parameters (i.e. resistivity and thickness), the longitudinal unit conductance (S), the transverse unit resistance (T) and the coefficient of anisotropy (A) to determine its capacity to prevent infiltration of unwanted fluids into the aquifer. It should be noted that the earth materials act as a natural filter to percolating fluids; therefore its ability to retard and filter percolating ground surface polluting fluids is a measure of its protective capacity (Olorunfemi et al., 1999). That is to say that the geologic materials overlying an aquifer could act as seal in preventing the fluid from percolating into it. The longitudinal unit conductance map (Figure 5), derived from equation 1 for all the VES locations, was used for the overburden protective capacity rating of the study area. The highly impervious clayey overburden, which is characterized by relatively high longitudinal conductance, offers protection to the underlying aquifer (Abiola et al., 2009).

The longitudinal unit conductance (S) values obtained from the study area, ranges from 0.08438 to 0.73449 mhos. Clayey overburden, which is characterized by relatively high longitudinal conductance, offers protection to the underlying aquifer. According to the classification of Oladapo and Akintorinwa, (2007) in Table 1, the longitudinal unit conductance values from the study area enabled us to classify the area into weak, moderate and good protective capacity zones. Where the conductance is greater than 0.7 mhos are considered zones of good protective capacity. The portion having conductance values ranging from 0.2 to 0.69 mhos was classified as zone of moderate protective capacity; and area with values ranging from 0.1 to 0.19 mhos were classified as exhibiting weak protective capacity while the zones where the conductance value is less than 0.1 mhos were considered to have poor protective capacity. This work has revealed that the overburden materials in the area around the south-western and north-eastern portions of the study area have good to moderate protective capacity and are relatively thick (between 19 to 33 m thick). The central and western portions have moderate protective capacity materials with thin overburden (between 6 to 17 m thick), while the northern, southern, eastern and part of the central region exhibit weak to poor overburden protective capacity and thin overburden thickness. This map (Figure 5) further reveals that about 60% of the area falls within the poor/weak overburden protective capacity, while about 40% constitutes the moderate/good protective capacity rating.

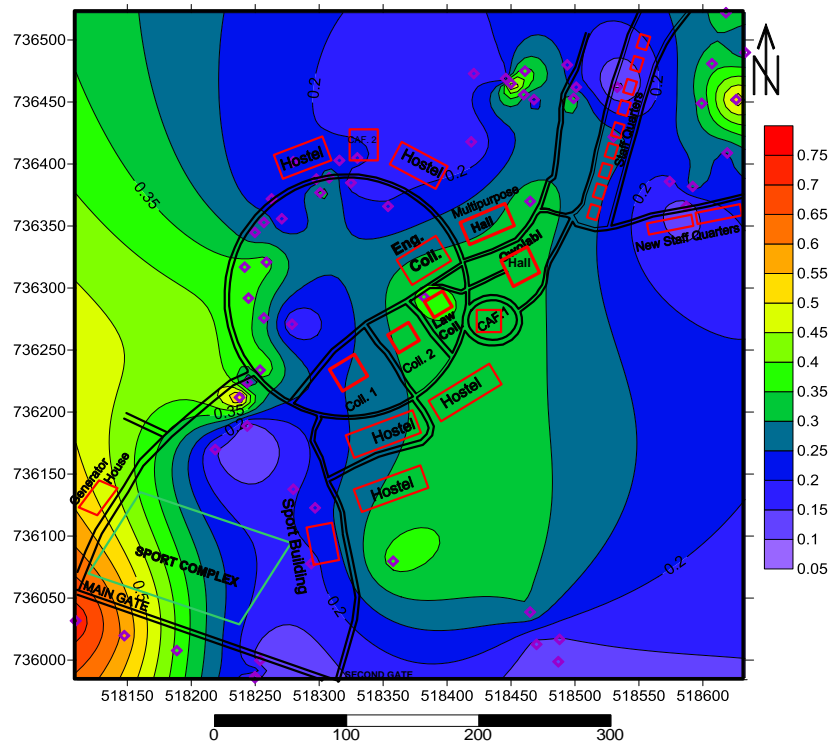


Figure 5: Longitudinal Conductance map of the study area

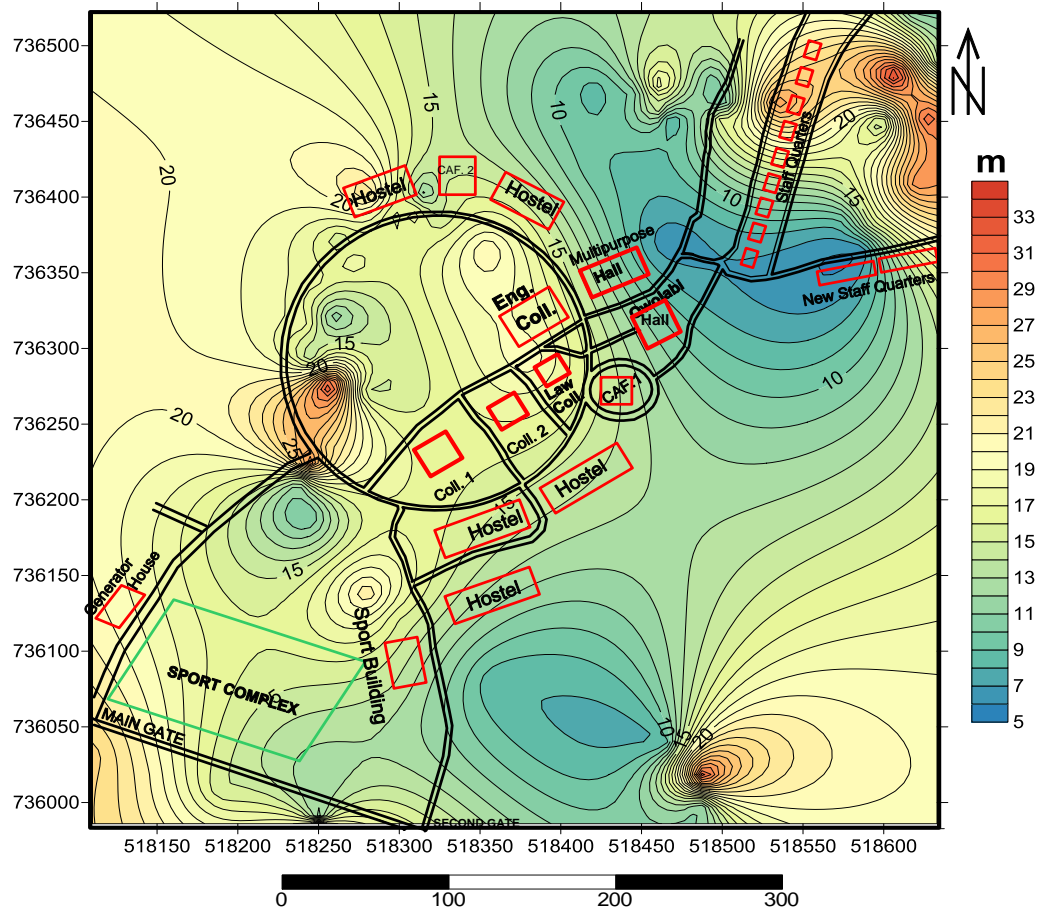


Figure 6: Overburden thickness map of the study area

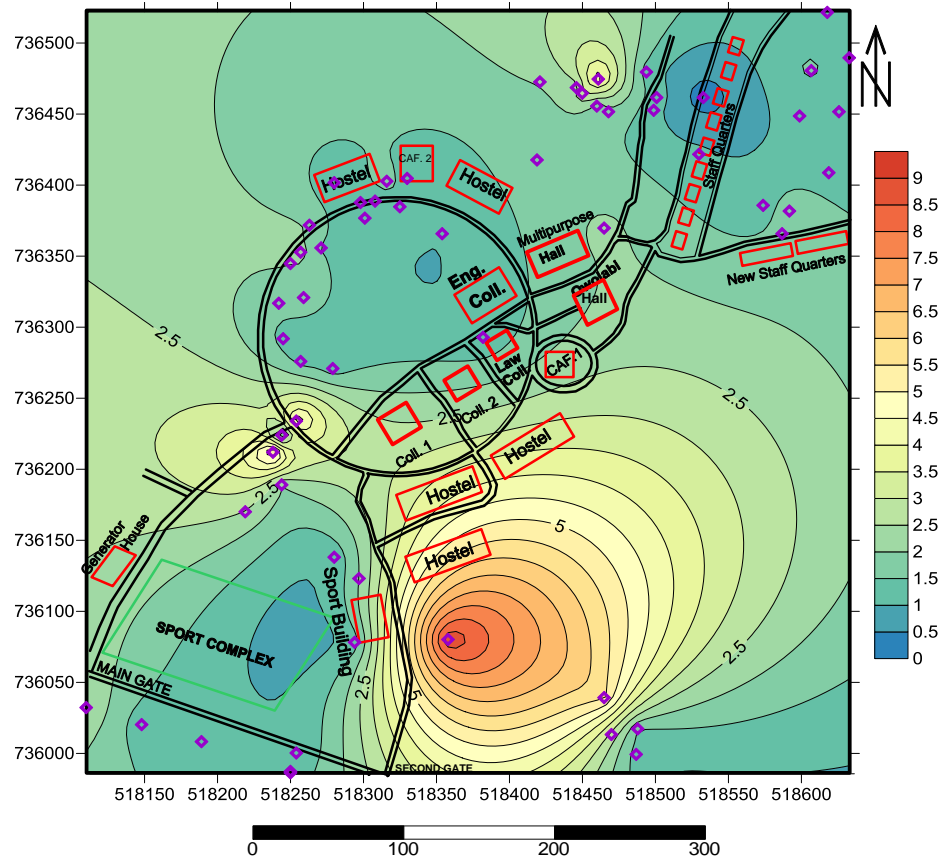


Figure 7: Coefficient of Anisotropy map of the study area

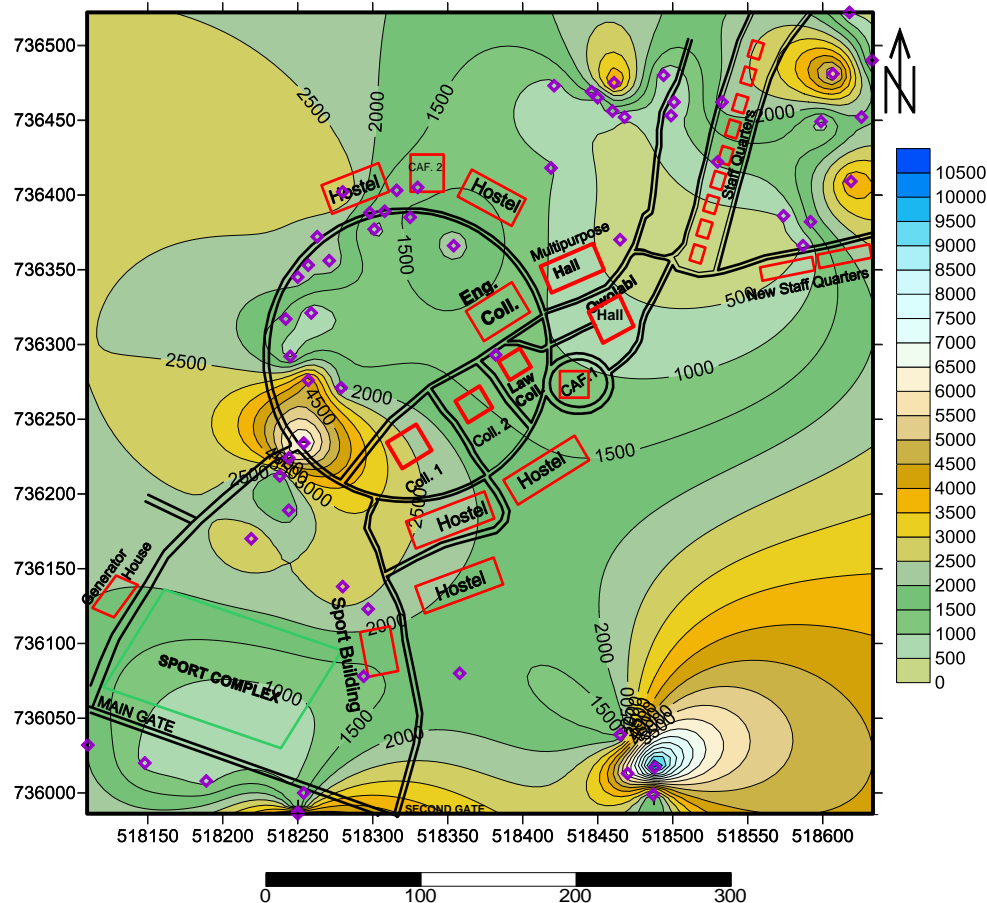


Figure 8: Transverse unit resistance map of the study area.

3.2 Geo-Electric Sections

The 2-D geoelectric sections (9a - c) were drawn in N-S and NW-SE directions. Figure 9a has varying topsoil resistivity of 77 - 256.1 ohm-m and thickness of 0.5 to 2.0 m. The second lithologic layer corresponds to clayey-sand with layer resistivities of 227 to 699 ohm-m and thickness of 1.0 to 1.5 m. The third layer is the weathered layer having resistivities of 26.8 to 58.9 ohm-m and thickness of 5.6 to 14.6 m. There is the presence of fractured basement with resistivities of about 303.5 to 963.6 ohm-m and infinite thicknesses. The structural variation showed thickening of the overburden under the VES-Points WC38 and TR25/1, the depth to bedrock is deep towards the south-eastern side, while the basement is dipping towards the south-eastern side. The down dip side has the highest depth to bedrock, which is controlled by structural features relevant for groundwater development. In Figure 9b the topsoil resistivities range from 100.7 to 134 Ω -m with thickness of about 0.5 to 2.7 m. The second layer has resistivities of 111 to 563.4 Ω -m and thicknesses range of 1.6 to 2.6 m, which correspond to clay materials. Under TR1/1 the clayey topsoil layer with resistivity of 111 to 563.4 Ω -m. There is the presence of weathered layer with resistivity of 29.8 to 33.9 Ω -m and thickness of 8.0 to 21.6 m. It is relatively thick under TR1/1 and the

area is suspected to have harboured abstractable amount of portable groundwater. Structurally, the basement is depressed towards the NW part and is assumed to be groundwater flow direction. There is the presence of a fractured basement under TR2/1 which is also trending towards the north-western direction. In Figure 9c the topsoil resistivities range from 96.6 to 496 Ω -m with thicknesses of about 0.6 to 1.8 m. The second layer, which is the sandy-clay, has resistivities of 233.8 to 466.6 Ω -m and thicknesses of 1.5 to 2.6 m. The clayey layer underlay the Topsoil only under TR8/1 and TR14/2 across the section.

There is the presence of weathered layer with resistivities between 25.3 and 83 Ω -m and thicknesses ranging from 0.7 to 16 m. It is thickest under TR11/1 and TR16/2 and the area is favourable to groundwater accumulation and abstraction. Structurally, the basement is depressed towards the NW part and is assumed to be groundwater flow direction. There is the presence of a fractured basement under TR2/1 which is also trending towards the north-western direction. The aquifer mapped in the study area are the weathered/fractured layer (unconfined) and the fractured layer (confined) types.

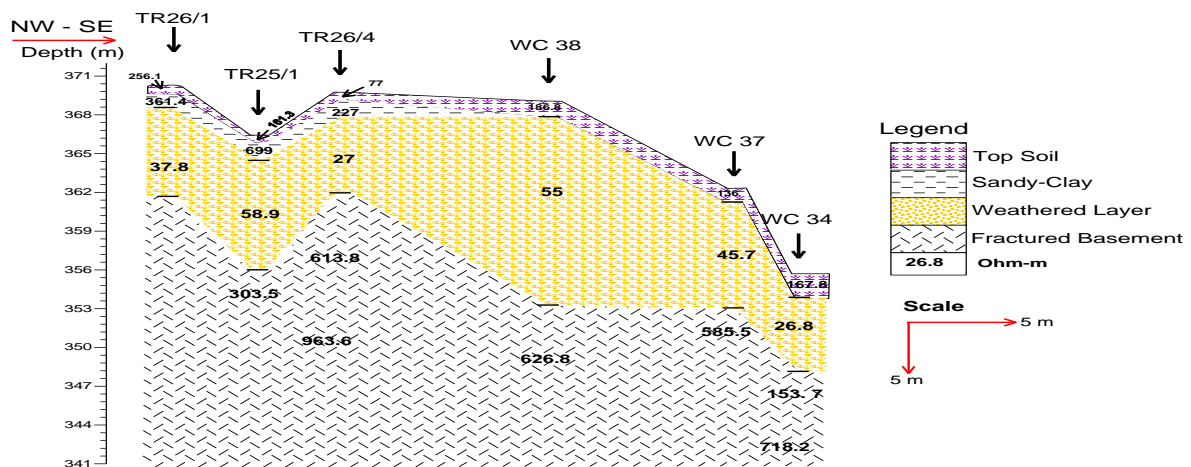


Figure 9a: Geo-electric section cutting across TR25/1, TR26/1, TR26/4, WC38, WC37 and WC34

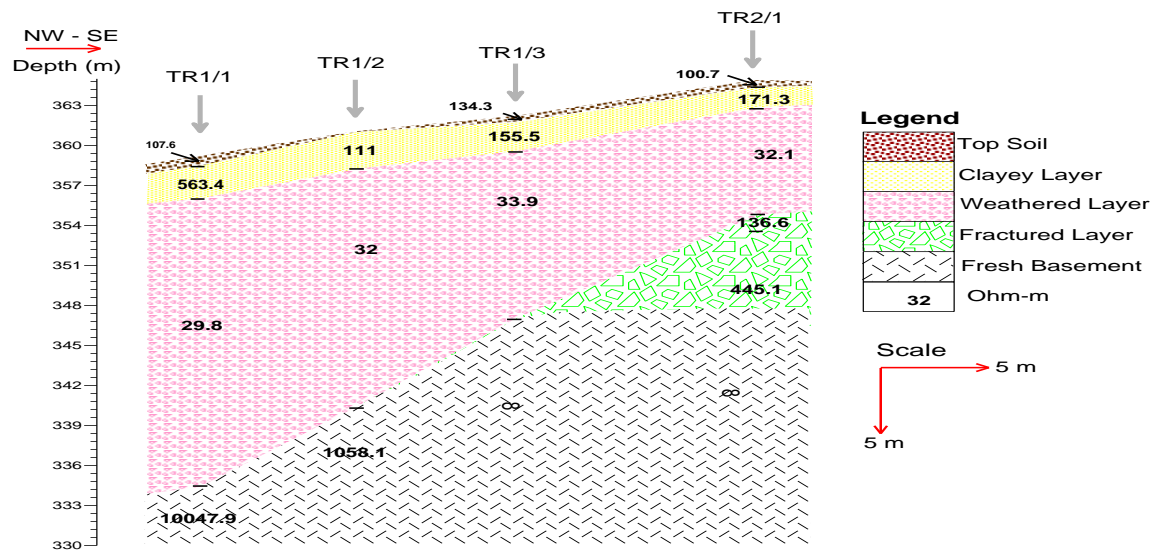


Figure 9b: Geo-electric section along traverse 1 (NW-SE) cutting across TR1/1, TR1/2, TR1/3 and TR2/1

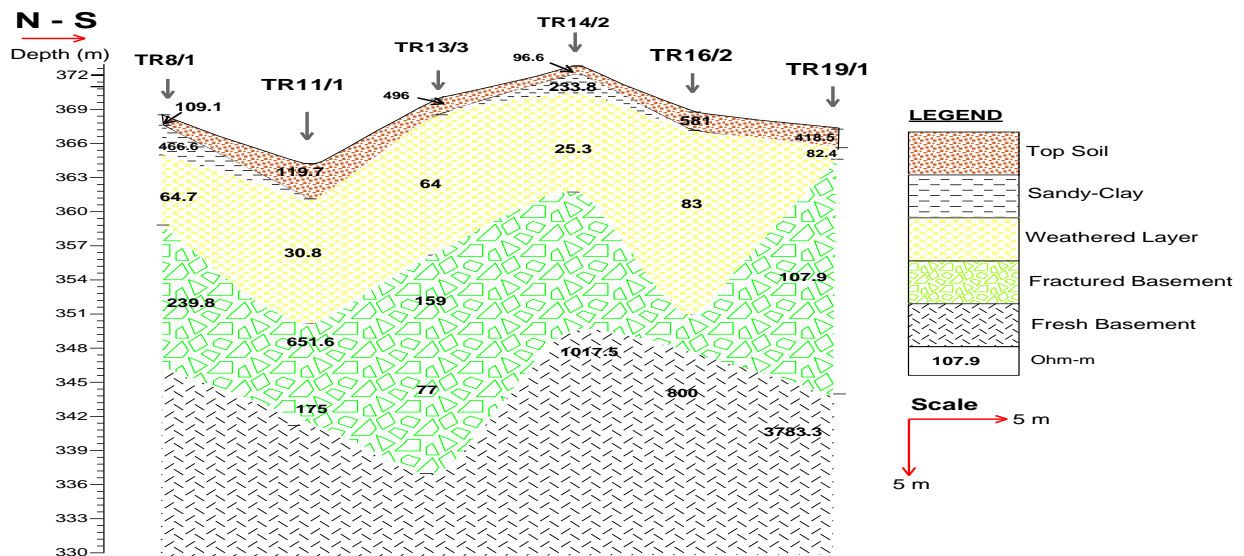


Figure 9c: Geo-electric section cutting across TR8/1, TR11/1, TR13/3, TR14/2, TR16/2 and TR19/1

4.0 CONCLUSION

In this study, the groundwater transmissivity and protective capacity evaluation of the rock units within Afe Babalola University, Ado-Ekiti, southwestern Nigeria were undertaken using 59 Schlumberger vertical electrical soundings (VES). The VES data interpretation involved quantitative partial curve matching and computer assisted 1-D forward modeling using resist 1.0 software. The curve types obtained include (A, H, HA, HK, HKH, KH, KHA,

KHK and QH types. The subsurface sequence comprise of the topsoil with limited hydrologic appeal, sandy-clay layer, weathered/fractured basement and the fresh basement. The weathered/fractured layer constituted the sole aquifer unit in the area. The geoelectric parameters (layer resistivity and thickness) at each sounding station were used to produce the overburden thickness map and the geoelectric sections and to also generate the secondary order parameters (Dar Zarrouk parameters) i.e. the longitudinal unit conductance (S), the transverse unit resistance (R) and the coefficient of anisotropy (Δ) values of the area. The geoelectric sections show the variations of resistivities and thicknesses values of layers within the depth penetrated in the study area at the indicated VES stations. The profiles were taken along the N-S and NW-SE directions.

Generally, the profiles revealed four to five subsurface layers: the top-soil, sandy-clay/clayey layer, the weathered layer, partially weathered/fractured basement and the fresh basement. The study also revealed that most parts of the area are underlain by materials of weak to moderate protective capacity. The central, the southwestern and the western portions of the area are underlain by materials of moderate to good protective capacity. The areas with good to moderate protective capacity coincide with zones of appreciable overburden thickness with clayey columns thick enough to protect the aquifer in the area from the surface polluting fluid. The area with thin overburden also coincided with weak protective capacity thereby exposing the groundwater in the area to pollution. If for example, there is leakage of buried underground storage tanks; this may constitute a serious environmental hazard. Therefore vulnerable zones include the southern, southeastern, eastern and northern region. The area with high values of coefficient of anisotropy and low values of transverse unit resistance which is a reflection of the transmissivity profile of rocks also coincide with relatively thin overburden thickness making the groundwater in the area vulnerable to polluting fluid. The results of this study have provided reliable information for an elaborate groundwater protection and environmental factors to be considered for planning, development and siting of academic, residential and commercial facilities within the central academic and residential area of the campus of Afe Babalola University, Ado Ekiti. For effective groundwater development programmes in the study area, it is recommended that pre-drilling geophysical investigations be carefully conducted for economic and environmental purposes. Future groundwater development in the study area by the management should be concentrated within the zones of moderate/good groundwater protective capacity with appreciably thick overburden. Also, siting of underground petroleum

storage tanks, sewage septic tanks and waste dump within the campus should be confined to zones of moderate/good ground water protective capacity

5.0 ACKNOWLEDGEMENT

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References:

- Abiola et al., (2009) Groundwater potential and aquifer protective capacity of overburden units in Ado-Ekiti, southwestern Nigeria, international Journal of Physical Sciences Vol. 4 (3), pp. 120-132
- Adiat, K. A. N, Olayanju, G. M, Omosuyi G. O. and Ako B. D., 2009. Electromagnetic profiling and electrical resistivity soundings in groundwater investigation of a typical basement complex – a case study of Oda town Southwestern Nigeria. Ozean Journal of Social Sciences 2(4), 333-359.
- Billings MP (1972). Structural Geology (3rd Edition) 33-34 Prentice-Hall Englewood Cliffr. NJ.
- Bose KN, Chatterjee D, Sen AK (1973). Electrical resistivity surveys for groundwater in the Aurangabad Sub-division, Gaya District, Bihar, Indian pp. 171-181.
- De Beer JH, Blume J (1985). Geophysical and Hydrogeological investigations of the Groundwater resources of Western Hereroland, South west Africa/Namibia Trans, Geol. Soc. S. Africa, 88: 483-493.
- Palacky GJ (1989). Resistivity characteristics of Geologic Targets. In MN Nabighion, Ed., Electromagnetic methods in Applied Geophysics, Vol. 1 (Theory) IG, No.3 (Society of Exploration Geophysicist), pp. 53-129.
- Barongo JO, Palacky GJ (1991). Investigations of electrical properties of weathered layers in the Yala area, Western Kenya, using resistivity soundings. Geophys. 56(O.I): 133-138.
- Nigeria Meteorological Agency, (NIMET), 2007. Daily weather forecast on the Nigerian Television Authority. Nigerian Metrological Agency, Oshodi, Lagos.
- Mbonu PDC, Ebeniro JO, Ofoegbu CO, Ekine AS (1991). Geoelectric sounding for the determination of aquifer characteristics in parts of the Umuahia area of Nigeria. Geophys. 56(2): 284-291.
- Miller R (2006). Hydrogeophysics: Introduction to this special section. The Leading Edge. P. 713.

- Rahaman MA (1989). Review of the basement geology of southwestern Nigeria: In Geology of Nigeria (Kogbe CA Ed.). Elizabeth Publishing. Co. Nigeria. pp. 41-58.
- Satpatty BN, Kanugo BN (1976). Groundwater Exploration in Hard rock terrain, a Case study, Geophysical Prospecting, 24 (4): 725 – 736.
- Shemang EN (1993). Groundwater potentials of Kubami River Basin, Zaria, Nigeria, from D.C. Resistivity study. Water Resources (1 and 2): 36-41.
- Oladapo MI, Akintorinwa OJ (2007). Hydrogeophysical Study of Ogbese Southwestern, Nigeria. Global J. Pure and Applied Sci. 13(1): 55-61.
- Olayinka AI, Olorunfemi MO (1992). Determination of geoelectrical Characteristic in Okene Area and implication for boreholes setting. J. Min. Geol., 28: 403 - 412.
- Olorunfemi MO, Ojo JS, Akintunde OM (1999). Hydrogeophysical evaluation of the groundwater potential of Akure metropolis, southwestern Nigeria. J. Min. Geol. 35(2):207-228.
- Maliek SB, Bhattacharya DC, Nag SK (1973). Behavior of fractures in hard rocks – a study by surface geology and radial VES methods. Geoexploration 21:529-556.
- Satpatty BN, Kanugo BN (1976). Groundwater Exploration in Hard rock terrain, a Case study, Geophysical Prospecting, 24 (4): 725 – 736.
- Shemang EN (1993). Groundwater potentials of Kubami River Basin, Zaria, Nigeria, from D.C. Resistivity study. Water Resources (1 and 2): 36-41.
- Vander Velpen, B.P.A. 2004. "Resist Version 1.0". M.Sc. Research Project. ITC: Delft, Netherlands.

CO-MORBID PSYCHIATRIC DISORDERS AMONG WOMEN ATTENDING THE FAMILY PLANNING CLINIC: THE LAGOS EXPERIENCE

Ayodele O. Coker

Department of Behavioural Medicine, Lagos State University Teaching Hospital
(LASUTH)/College of Medicine, Lagos State University (LASUCOM), Ikeja, Lagos. Nigeria

Rachael A. Akinola

Department of Radiology, Lagos State University Teaching Hospital (LASUTH)/College of
Medicine, Lagos State University (LASUCOM), Ikeja, Lagos. Nigeria

Oluwarotimi I. Akinola

Department of Obstetrics and Gynaecology, Lagos State University Teaching Hospital
(LASUTH)/College of Medicine, Lagos State University (LASUCOM), Ikeja, Lagos. Nigeria

Babajide O. Balogun

Department of Radiology, Lagos State University Teaching Hospital (LASUTH)/College of
Medicine, Lagos State University (LASUCOM), Ikeja, Lagos. Nigeria

Olukayode. A. Adegboyega

Department of Radiology, Lagos State University Teaching Hospital (LASUTH)/College of
Medicine, Lagos State University (LASUCOM), Ikeja, Lagos. Nigeria

Abstract:

Aims and Objectives: This study was aimed at investigating the levels of anxiety, depression and psychological distress among women attending the family planning clinic in Lagos, Nigeria.

Study Design: Cross Sectional, Prospective study.

Place and Duration of Study: Family planning clinic, Department of Behavioural Medicine and Department of Radiology, Lagos State University Teaching Hospital, Ikeja, between June and December 2010.

Method: One hundred and fifty women who were registered with the family planning clinic of the Lagos State University Teaching Hospital, Ikeja, were invited to complete the hospital

anxiety and depression scale and the 12th version of the general health questionnaire. Some of them underwent pelvic ultrasound scan to confirm or exclude pregnancy.

Result: Of the 150 participants 25.3% manifested with current anxiety while 44.4% had current depression and 32% had probable psychopathological distress as indicated by the general health questionnaire.

Conclusion: The findings of this study showed that women of reproductive age who were attending the family clinic manifested with various degrees psychopathology. It is therefore suggested that clinicians should integrate family planning services with routine antenatal care; carry out routine screening of depression among its attendees and provide referrals and mental health services to women with identified psychopathology.

Keywords: Anxiety, Depression, Psychological Distress. Family Planning Clinic, Nigeria

Introduction

Family planning clinic services are designed to avoid or postpone conception and also prevent adverse effects of unintended pregnancy (Lee et al., 2005). Thus, women who desire to reduce the number of children or need information on how to space her children are often referred to the family planning clinic (FPC). One major factor why women of reproductive age attend the FPC is to prevent unintended pregnancy because of the associated negative emotional outcomes found to be detrimental to both mother and child (Smith et al., 2010, Wischman et al., 2005). This is because the rates of unwanted pregnancies were observed to be on the increase and studies also noted that more than 50% of pregnancies were unplanned (Mowskosky et al., 2011). The prevalence of unintended pregnancies in the United States of America was documented to range from 14% to 49% (Mowskosky et al., 2011; Wischman et al., 2005). In this light, the presence of a new born baby from an unwanted pregnancy may precipitate psychological or psychiatric symptoms in both mother and baby during the perinatal period (Lee et al., 2005; Mowskosky et al., 2011). Similarly, babies from unintended pregnancies were found to develop mental health disorders when they grow probably due to lack of proper care from their mothers (Brenan and Opit, 1973; Wischman et al., 2005). Women of reproductive age in low and middle income countries were found not to have the privilege of any clinic services apart from the services they receive at family planning clinics (Brenan and Opit, 1973). Brenan and Opit (Brenan and Opit, 1973) claim that 64% of one Asian community had not received any form of clinic or contraceptive information although they would have preferred to have such services in their community.

Nonetheless, psychological and psychiatric symptoms have been documented to be common among women of reproductive age and the reported symptoms include anxiety, depression, mania, substance use and personality disorders (Rohrer and Young, 2004; Ukpong and Orji, 2006). The prevalence of anxiety among women attending FPC has been reported to range from 9.4% to 28% (Ukpong and Orji, 2006; Winokur et al., 1984). Similarly, the rate of reported depression has been found to also range from 14% to a high level of 54% (Berenson et al., 2003; Dyer et al. 2005). Some of the reported identified factors in the aetiology of these psychological disorders are the scarce resources needed to raise a new born child such as time, social and financial resources (Barson, 2006). Thus, a woman with an unwanted pregnancy may not adequately plan for or may find it difficult to allocate her scarce resources to an unwanted baby (Barson, 2006; Lee et al., 2005). Despite these scientific revelations, the studies on women of reproductive health who visit the family planning clinic remain scanty in Nigeria and indeed Africa. Electronic and print literature searches revealed very little studies from the Sub-Saharan region. Therefore, this study was designed to determine the levels of anxiety, depression and psychological wellbeing of women attending the family planning clinic of a tertiary institution in Lagos.

MATERIALS AND METHODS

This cross sectional prospective study was carried out at the family planning clinic of the Lagos State University Teaching Hospital, Ikeja, Lagos, Nigeria between June and December 2010. The study was approved by the Research and Ethics Committee of the hospital and written informed consents were obtained from each participant. Women who came voluntarily or were referred from other clinics to the family planning clinic were recruited for the study. A pro-forma questionnaire was designed for data acquisition on sociodemographic details. The participants also completed the Hospital Anxiety and Depression Scale (HADS) (Zigmond and Snaith, 1983) and the General health Questionnaire version 12 (Lee et al., 2005). The HADS is a self-report questionnaire designed to detect anxiety and depression in general medical outpatients. It has two sub-scales, seven for anxiety (HADS-A) and depression (HADS-D), each with seven questions. To avoid false positive cases in context of somatic diseases, no somatic items or items regarding sleep are included. The scores range from a minimum of zero to a maximum of three per question. The maximum score per sub-scale is 21. Scores between 0 and 7 are generally regarded as non-cases while those above 8 and 10 are regarded as “doubtful cases”. Scores between 11 and 21 are regarded as “definite cases.” The HADS “cases” were

considered as scores of 11 and above and non-cases, scores of 10 and below. The HADS has been used in Nigeria and found to have a high sensitivity and specificity (Abiodun, 1994). The respondents also completed the twelfth version of the general health questionnaire. The GHQ-12 (Goldberg, 1972) was designed as a self-administered screening instrument aimed at distinguishing between psychological ill-health and well-being. It assesses the symptoms of anxiety, depression and social dysfunction. The cut off mark is 2. Scores above 2 forms a case. It has been standardised and validated and used in both hospital and community studies in Nigeria (Gureje and Obikoya, 1990).

Ultrasound scans were also carried out on these participants using a 3.5MHz transducer of a DigiPrince Mindray ultrasound scan machine in some of the study subjects to confirm or exclude pregnancy which in most cases made them very anxious.

2.1 Statistical analysis

Data were processed and analysed using Statistical Package for Social Sciences, version 14.0 (SPSS, Inc., 2001, Chicago, Ill). Descriptive statistics (mean, standard deviation, minimum, maximum) were determined for continuous variables, while percentages and proportions were determined for categorical variable.

RESULTS

The study sample was made up 150 women seeking consultation for family planning at the family planning clinic of the hospital. A large majority 142 (94.9%) of the respondents were married and 49.5% of them were within the age range 31 to 40 years. Less than half of the participants 64 (42.7%) had secondary education while 14 (9.3%) had no formal education. As regards occupation, more than three quarter of the respondents were unskilled workers and only 24 (15.8%) were skilled workers. Of all the respondents, 96 (64.3%) were from the South Western geo-political zone followed by North Central 21 (14.3%) and South East 17 (11.2%). Less than one third of the study subjects (28.6%) were married for a period of 6 to 10 years and 26.6% for a period between 15 and 20 years. About half of the participants, 50.6% had between 3 and 4 children while 14.1% had between 5 and 6 children and only 9.6% had more than six children. However, 4.4% had no child but were pregnant during the study period. A large majority of the participants, 64.3% were from the south west geo-political zone followed by 14.3% and 11.2% from North central and south east respectively as reflected in Table 1. The various levels of psychopathology among the participants are reflected in Table 2. Close to half of the participants 44.6% scored higher

than the norm in the HADS-D indicating current depression and 25.3% manifested with current anxiety as regards the scores of HADS-A. Likewise, the GHQ-12 indicated that 29.3% scored higher than the norm indicating psychological distress among these participants.

Table 1: Sociodemographic details of the participants

Variables	Frequency	Percentages
Age (Years)		
15-20	1	0.6
21-30	11	7.1
31-40	74	49.5
41-50	64	42.4
Highest level of Education		
No education	14	9.3
Primary School	43	28.7
Secondary School	64	42.7
Higher Institution	29	19.3
Marital status		
Single	0	0

Married	142	94.9
Separated/ Divorced	8	5.1
Occupation		
Unskilled	126	84.2
Skilled	24	15.8
Years of Marriage		
1-5	17	11.1
6-10	25	16.7
11-15	18	11.8
16-20	25	16.7
Number of Children		
None	7	4.4
1-2	32	21.3
3-4	77	51.6
5-6	21	14.1
More than 6	13	9.0

Geo political zone

North East	6	4.1
North West	1	1.0
North Central	21	14.3
South-South	8	5.1
South East	17	11.2
South West	97	64.3

Table 2: Levels of psychopathology among participants

Instruments	Frequency	Percentages (%)
GHQ-12 scores < 2	106	68.1
GHQ-12 scores < 3	44	31.9
HAD-Anxiety	38	25.3
Scores < 11	112	74.7
Scores > 11	38	25.3
HAD-Depression		
Scores < 11	83	55.6
Scores > 11	67	44.6

DISCUSSION

Our findings revealed that 25.3% participants manifested with current anxiety while 44.4% had current depression and 32% had psychological distress. These results appear to be in agreement with other reported findings by authors from other countries (Dyer et al., 2005; Lee et al., 2005; Winokur et al., 1984; Wischman et al., 2005). With regard to anxiety, Ukpong and Orji (Ukpong and Orji, 2006) found a low rate of 9.4% anxiety level in women attending family planning clinic at Ile Ife, Nigeria while Winokur et al (Winokur et al., 1984) found a moderate rate of 28% among family planning attendees in England. Therefore, our findings are in more in keeping with those of Winokur et al (Winokur et al., 1984) than with findings in Ile Ife. This may be explained by the fact that Lagos is more of an urban setting and therefore more cosmopolitan (as in England) than Ife. Considering depression, Lee et al (Lee et al., 2005) found that more than 50% of women who were attending the family planning clinic in North Carolina, USA had high levels of depressive symptoms while Ukpong and Orji (Ukpong and Orji, 2006) found a rate of 12% depression among women attending FPC in Ile Ife, Nigeria. Likewise, Berenson et al (Berenson et al., 2003) found 54.3% depression among women attending family planning clinic in Texas, USA. Again, our results appear to be in consonance with those of Lee et al (Lee et al., 2005) and Berenson et al (Berenson et al., 2003). In the same vein, Hollander (Hollander, 2004) also reported 31%

rate of depression among women at the family planning clinic southern Texas. Winokur et al (Winokur et al., 1984) however found a very high rate of 74% of symptoms of depression among women attending a family planning clinic in Pennsylvania, USA. Some reasons that were adduced for the high rates of psychopathology among attendees of family planning include high poverty levels and low socioeconomic status of the users of such services, low educational levels, female illiteracy, unregulated fertility, inadequate primary health care and non-availability of family planning clinics in the rural areas (Tsui et al., 2010 Winokur et al., 1979). In our environment, the high poverty rates, low levels of education, inadequate primary health care and family planning clinics could probably explain the high depression rate found in this study.

Nonetheless, previous studies had demonstrated that the burden of unwanted pregnancies, non-availability of resources needed for the overall wellbeing of the new born baby and limited access to family planning clinic were found to predispose women with unwanted pregnancies to various forms of psychopathology (Barson, 2006; Tsui et al., 2010). Previous studies also indicated that some female adolescents, in particular, illiterate women and women with certain degrees of mental health disorders such as mania and substance abuse were inclined towards the practice of unprotected sexual intercourse which may culminate in unwanted pregnancy (Barson, 2006). For this reason, special birth control family planning services had been suggested for women in this vulnerable group (Barson, 2006). Public health experts therefore suggested that family planning clinics should be set up in primary health care settings because previous studies have shown that women from low and middle income countries had high prevalence of psychopathology and they could be detected at the family planning clinics. Similarly, the literature indicated that in most developing countries, the only source of health information and clinical care may be the family planning clinics (Barson, 2006; Berenson et al., 2003). Based on all these empirical revelations, it was therefore suggested that family planning clinics should have services that should be all encompassing to include comprehensive psychosocial educational activities for all fertile adolescents and women of children-bearing age (Adinma and Nwosu, 2005; Barson, 2006). The other suggested services the family planning clinics could also provide should include, psycho-education on the prevention of human immune virus transmission from mother to child and child spacing to further reduce the rates of child and maternal morbidity and mortality associated with unintended pregnancies; pelvic examination, treatment for sexually transmitted illnesses, breast and cervical screening, screening for blood pressure, diabetes and depression, immunisation and pregnancy testing (Adinma and Nwosu, 2005; Barson, 2006;

National family planning, 2011). Some workers also noted that the inclusion of such comprehensive services at the family planning clinics may also assist governments and policy makers from low and middle income countries towards the achievements of some of the Millennium Development Goals by lowering incidences of infant and maternal mortality and maternal morbidity associated with unintended pregnancies (Adinma and Nwosu, 2005; Tsui et al, 2010; Family Planning, 2011). However, Adinma and Nwosu (Adinma and Nwosu, 2005) opined that public health experts should regularly disseminate health information at the family planning clinics through public lectures, print and electronic media and entrenchment of family planning counselling into routine antenatal clinics and maternity hospitals. Nevertheless, the generalisability of this study may be limited by its small sample size. Nonetheless, it is however suggested that research on psychopathological disorders of women of reproductive age attending family planning clinics in Nigeria and other sub-Saharan countries should be further explored.

CONCLUSION

This findings of this study showed that women of reproductive age who were attending the family clinic manifested with a high degrees of depression, anxiety and psychological distress. It is however suggested that clinicians should integrate family planning services with primary health care settings and routine antenatal care; carry out routine screening of anxiety and depression among its attendees and provide referrals and mental health services to women with identified psychopathology.

References:

- Abiodun O.A, (1994). A validity study of the Hospital Anxiety and Depression Scale in general hospital units and a community sample in Nigeria. *Brit J Psych.*, 165, 669-672.
- Adinma J.I.B. and Nwosu B.O., (2005). Family planning knowledge and practice among women attending an antenatal clinic. *Adv in Contraception*, 11(4), 335-344.
- Barson R, (2006). Considering interventions for depression in reproductive age women in family planning programmes. Baltimore, MD, Women and Children's Health Centre, John Hopkins Bloomberg School of Public Health.
- Berenson A.B., Brekkopf C.R., Wu Z.H. (2003). Reproductive correlates of depressive symptoms among low-income minority women. *Obstetrics and Gynaecology*, 102(6), 1310-1317.

- Brenan M.E. and Opit L.J. (1973). Demand for family planning advice among patients in a district maternity hospital. *Brit Med J.*, 3,19-21.
- Dyer S.J., Abrahams N.A., Mokoena N.E., Lombard C.J., van-du Spuy Z.M., (2005). Psychological distress among women suffering from couple infertility in South Africa: a qualitative assessment. *Human Rep Advance*, 20(7),1938-1943.
- Family Planning in Relation to Millennium Development Goals in Nigeria. Retrieved from <http://nigeriafpconference.org/abstarcts-on>. Accessed February 2011.
- Goldberg D.P., (1972). The detection of psychiatric illness by questionnaire. Maudsley Monograph, No. 21, London; Oxford University Press.
- Gureje O. and Obikoya B. (1990). The GHQ-12 as a screening tool in primary care setting. *Soc Psych Epidemiol.*, 25, 276-280.
- Hollander D., (2004). Family planning clinic visits presents opportunities for providers to screen for mental health problems; *Perspectives on sexual & Reproductive Health*, 36(2),90-92.
- Lee L.C., Casanueva C.E., Martin S.L., (2005). Depression among female family planning patients: prevalence, risk factors and use of mental health services. *J Women's health*, 14(30), 225-232.
- Moskosky S.B., Zapata L.B., Whiteman M.K., Curtis K.W., Marchbank P.A., (2010). Contraceptive methods available to patients of office-based physicians and Titled X clinics in United States. *Morbidity and Mortality Weekly Report*, 2009-2010. Retrieved from <http://www.medscape.com/viewarticle/735925> May 2011. National Family Planning and Reproductive Health Association. Title X National Planning Programme. Retrieved from <http://www.nfprha.org/uploads/TitleXGeneralJuly2005.pdf>. Accessed February 2011.
- Rohrer J.E. and Young R. (2004). Self-esteem, stress and self-rated health in family planning clinic patients. *BMC Family Practice.*, 5,11-16.
- Smith P.B., Buzi R.S., Weinman M.L., (2010). Mental health screening in family planning clinics: a sexual risk reduction opportunity. *J Sex & Marital Therapy*, 36(3), 181-192.
- Tsui A.O., McDonald-Mosley R., Burke AE., (2010). McDonald-Mosley R, Burke AE. Family planning and burden of unwanted pregnancies. *Epidmiol Rev.*, 32(1),152-174.
- Ukpong, D, Orji E.O. (2006). Mental health of infertile women in Nigeria. *Turk J Psychiatr.*, 17, 259-265.
- Winokur A., Rickels K., Garcia C.R., Huggins G., Guthrie M.B., (1979). Emotional distress in family planning service patients. *Adv Planned Parenthood*, 19,33-40.

Winokur A., Winokur D.F., Rickels K., Cox DS., (1984). Symptoms of emotional distress in family planning services: stability over four-week period. *Brit J Psych.*, 144,395-399.

Wischmann T. (2005). Psychosocial aspects of fertility disorders. *Urologe A*, 44 (2), 185 – 94.

Zigmond, A.S. and Snaith R.P, (1983). The Hospital Anxiety and Depression Scale. *Acta Psych Scand* 67, 361-370.

ASSESSMENT OF UTILIZATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTS) AMONG POULTRY FARMERS IN NIGERIA: AN EMERGING CHALLENGE.

Olaniyi, O. A.

Corresponding Author: Department of Agricultural Extension and Rural Development,
Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomosho, Nigeria.

Abstract:

The study assessed the utilization ICTs among poultry farmers in Afijio Local Government Area of Oyo State, Nigeria. Multistage sampling technique was used in the selection of 120 respondents for the study. Validated and structured interview schedule was used to collect data from the selected poultry farmers. Data collected was analyzed with aid of frequency counts, percentages and Mean as descriptive statistical tools, while Pearson Product Moment Correlation was used as inferential statistical tool.

The result of analysis showed that majority (79.2%) of the respondents are male with mean age of 48 years and mean years of poultry farming experience was 8 years. Radio, TV and personal mobile phone ranked 1st, 2nd and 3rd respectively as the mostly used and accessible ICT facilities in receiving poultry related information. Technical knowhow, poor power supply and inadequate access to some of the ICT facilities are the major constraints encountered by the respondents in the use of ICTs in the area. The result of Pearson Product Moment Correlation shows that Age ($r=0.480$; $P<0.05$), household size ($r=0.437$; $P<0.05$), income per annum ($r=0.46$; $P<0.05$) and years spent in school ($r=0.247$; $P<0.05$) exhibited positive and significant relationship with the use of ICTs.

The study recommends among others that government should encourage the use of ICTs among the poultry farmers in the area and in Nigeria at large through its inclusion in the agricultural extension programme curriculum of different states.

Keywords: Information and Communication Technology; Utilization; Poultry Farmers; Nigeria.

Introduction

A major task in agricultural development is the transfer of improved technologies to farmers. According to Salau and Saingbe (2008) the farmers are constrained to obtain information from various sources of information. Given the urgent need for current agricultural knowledge and information system (AKIS) by farmers, the use of conventional communication methods such as farm and home visits and the use of contact farmers for extension information delivery is counterproductive. This therefore calls for the use of new emerging information and communication technologies by agricultural information providers for the benefit of farmers. Information and communication technology (ICTs) is often viewed as the “wheel” of economic activities since it facilitates the economic growth. Information and Communication Technology (ICT) has become, within a very short time, one of the basic building blocks of modern society. Many countries now regard understanding ICT and mastering the basic skills and concepts of ICT as part of the core of education, alongside reading, writing and numeracy. Information and Communication Technology (ICT) is the scientific, technological and engineering disciplines and the management technologies used in the handling of information, processing and application related to computers (Osuagwu, 2001). Several authors, Warren (2001), CTA (2003), Omotayo (2005) had earlier enumerated that Information and Communication Technology (ICT) is commonly used to embrace a multitude of media including telephone, television, video, telex, voice information systems and fax as well as those requiring the use of personal computers fitted with a modem or supply technologies that facilitate communication processing and transmission of information by electronic means ranging from radio, television, telephone (fixed or mobile) and internet. However, ICT has been classified into two namely : conventional ICT (radio, television) and contemporary ICT (telephones, computer/internet) (Adejo and Haruna, 2010).

One of the ways to bring about improvement in poultry production in Nigeria is the provision of right information through appropriate channel that is accessible to farmers whose such information are meant for. Poultry production in Nigeria has undergone tremendous changes over the past decades in terms of genotype, management and technological advancement. In the pre-independence era, poultry enterprise was mainly in the family backyard characterized by low productivity and primitive technology. This was gradually improved by colonial master from the low output to a better performance through introduction of various poultry schemes. The western government changed from the traditional method to the present modern poultry keeping with the introduction of breeds of

layers and broilers lines to meet the increasing demand for egg and meat for consumption in the country. The poultry industry specifically, has been described as the fastest means of bridging the protein gap prevailing in Nigeria (Apantaku *et al.*, 1998). The rationale for the production of poultry is predicated on the fact that it can be rapidly expanded to replace red meat in the countries with high population growth rate, it improves human nutrition, generates regular income for women, children and other disadvantaged groups, supplies input (e.g manure) for crop production and is generally accepted by the majority of the population (Steinfeld *et al.*, 2003).

The poultry industry in Nigeria can take advantage of the potentials of the development of ICTs for optimum poultry production. However, for this advantage to be adequately exploited, there is a need to determine the extent to which poultry farmers' have access and utilize information and communication technology for development. World Bank (1998) classified information into two types – knowledge about technology or knows who and knowledge about attributes. Both are critical for development. Information also play pivotal role among farmers due to its advancements. It is increasingly used in all aspects of human activity and many technologies assist in providing for everyday living. Stanley (1997) in elucidating the importance of information, he invariably viewed it as one of the basic necessity of life. Therefore, how far farmers progress in whatever they are doing depends largely on the availability and access to accurate and reliable information. Meera et al (2004) had earlier reported that ICT can bring about new information services to rural area where farmers will have much greater control over this resource than ever before. Therefore, access to such new information source is a crucial requirement for sustainable agricultural development especially in poultry industry. However, according to Olaniyi and Adewale (2013) information has been identified as a vital ingredient in adoption process . It is against this background that the study provided answers to the following research questions. These are

1. What is the level of awareness of ICT among poultry farmers in the study area?
2. What is the extent of accessibility of ICT tools to poultry farmers in the study area?
3. What is the level of utilization of ICT tools among the respondents?
4. What the constraints to utilization of ICT among the respondents?

OBJECTIVES OF THE STUDY

Generally, the study assessed the utilization of ICTs among poultry farmers in Afijio Local Government Area of Oyo State, Nigeria. Specifically, the study described the socio-

economic characteristics of poultry farmers; ascertained the level of awareness of ICTs; determined level of utilization of ICTs among the respondents, assessed the accessibility of respondents to ICT facility and identified the constraints to utilization of ICT tools among the poultry farmers in the study area.

HYPOTHESIS

Based on the objectives of the study, hypothesis was postulated in a null form stated as:

There is no significant relationship between selected socio economic characteristics of the respondents and level of utilization of ICT.

METHODOLOGY

The study was conducted in Afijio Local Government Area (LGA) of Oyo State, Nigeria. The study was conducted in Afijio Local Government Area of Oyo State, Nigeria. It lies in the South western Zone of the State, which is roughly enclosed by latitude 7.8^0 and 4.4^0 North of the equator. It covers a total land mass of 1.365 square kilometers, with about 30 towns and villages. Afijio Local Government Area has a population of 84,504 (NPC, 2006). The local government is bounded in the West by Akinyele Local Government, in the East by Oyo West Local Government, in the North by Iseyin Local Government and in the South by Lagelu Local Government. Major towns in the Local Government include, Akinmoorin, Aawe, Ilora, Ilu-Aje, Imini, Iware, Jobele and Fiditi. The major occupation of the people is farming, where by the major crops grown are fruits and vegetables. Also many of the people in the local government are involved in livestock production especially poultry and fishery. Afijio Local Government was specifically selected for this study because of its contribution to the Poultry industry in Nigeria and high concentration of poultry farmers within the area.

A multistage sampling technique was adopted in the selection of the respondents. First stage involved purposive selection of four (4) communities out of eight (8) communities because of concentration of poultry farmers in the area. Second stage involved the random selection of one hundred and twenty (120) poultry farmers from the selected communities in the LGA. Respondent's level of use of ICTs was measured on a 4-points rating scale of Never=0, rarely=1, occasionally=2 and regularly=3. Likewise, respondents were asked to state the accessibility of ICTs using 4-point rating scale of not easy=0, fairly=1, easy=2 and

very accessible=3. Frequency counts, percentages, Mean and Pearson product moment correlation (PPMC) were employed in data analysis.

RESULTS AND DISCUSSION

(A) Profile of the Poultry Farmers

Data presented in Table 1 revealed that more than half (52.2%) of the respondents have their ages ranged between less or equal to 30 and 31- 40 years respectively. About 34 percent of the respondents have their age between 41-50 years and others (13.1%) were 51 and above years of age. The mean age was 48 years. This implies most of the poultry farmers sampled are in their productive age and this is expected to have a positive influence on their level of use of various information related to poultry production. The result also shows that most (79.2%) of the respondents sampled are male, while only 20.8% were female. This implies that majority of the poultry farmers in the area are male, a fact that suggest that male are more involved in poultry farming than their female counterparts. In addition, a high percent (81.7%) of the respondents were married, while only 18.3% of them were single. This implies that most of the poultry farmers sampled are married and an indication that they should be responsible and knowledgeable in the use of appropriate information retrieved from different ICT facilities in respect to poultry production. Majority (65.9%) of the respondents have between less and equal to 5 household size, 33.4% indicated 6-10 members and only 0.8% indicated above 10 household size. The mean household size of the respondents was 8. This is considered to be large compared to the average household size of 4 reported in NPC (2006). This shows that the farmers had opportunity of family labour for poultry farming.

From the same Table 1, majority (58.3%) of the respondents had spent between 13 and 18 years in school while 20.0percent of the sampled farmers spent between 7 and 12 years in school and about 17 percent of the respondents spent more than 18 years in school. Only few (5.0%)of the respondents spent between 1 and 6 years in school. This implies that the poultry farmers in the study area are literate and this is expected to influence their use of ICT to improve their poultry production level. Although, Ajala (1992) had earlier reported that there is positive correlation between education and acceptance of innovation among farmers. This finding tally with Ayanwuyi *et al's* (2012) finding that majority of fish farmers are literate with different educational background and it is expected to have positive and significant impact on their production. The same table revealed that the sampled poultry farmers had acquired a wide range of farming experience as majority (50.6%) of the farmers had between 6 and 10 years of poultry farming experience followed closely by 31.6% of the

respondents with less than or equal to 5 years of farming experience and 18.3% had above 10 years of farming experience in poultry production. The mean year of farming experience was 8 years. This finding follows the assertion of Nwaru (2004) that the higher the farming experience, the more the farmer would have gained more knowledge and technological ideas on how to tackle farm production problems and the higher would be his output and income. A high percentage (64.2%) of the respondents were members of Poultry association while the remaining (35.8%) were non members of any association. This may be a matter of interest and affiliation.

Table 1 further shows that (99.2%) of the respondents practiced intensive system of poultry farming, only 0.8% were into extensive system. This implies that majority of the respondents practiced poultry farming under intensive method. The variation in the type of farming method adopted may probably be due to difference in the size of bird keep, capital requirement, educational background and other related input require for the different farming method. In terms of size of birds kept, the result shows that 33.3% of the respondents keep less and equal to 1000 birds, followed by those that keeps between 1001 and 2000 birds (32.5%), between 2001-3000 birds (15.8%) while 10.0% of them keep between over 4000 birds and a low percentage (8.3%) of the respondents keeps between 3001 and 4000 birds. The difference in the size of birds kept may be due to differences in their access to various poultry production inputs.

The response of the respondents on ICT proficiency it was revealed that majority (70.8%) claimed to be self trained in ICT, 14.2% of them indicated that they were trained by poultry association of Nigeria while 8.3% had no training on ICT at all and the remaining (6.7%) had certificate in ICT. This finding implies that majority of the respondents are ICT compliance.

The mean annual income of the respondents was N420,000. From another section of Table 1, it was shown that 59.2% of the respondents earns between N100,001 and N300,000 per annum while 16.7% of the respondents earns between N300,001 and N400,000 and about 14% earns above N500,000 per annum. The variation in the annual income may be due to difference in the number of birds keeps, system of poultry management and size of birds offered for sale.

(B) Awareness of ICT among Poultry farmers

Table 2 showed that a larger percentage (93.3%) of the respondents indicated low and moderate level of awareness of ICT facilities and few (6.7%) of them indicated high level of

awareness of ICTs as source of receiving agricultural information related to poultry production. This implies that majority the respondents are aware of the potentials and opportunities of ICTs as a means of receiving agricultural information especially on poultry production.

(C) Accessibility of ICT to Poultry farmers

Table 3 shows the distribution of respondents by their level of access to ICT facilities. Mobile phone, radio and Television were the most accessible ICTs facilities to the respondents with WMS of 2.90 each and 2.70 respectively. Whereas, VCD/Audio CD, newspaper and CD-ROM ranked 4th, 5th and 6th respectively in terms of access. Also, computer, e-mail and flash drive and website/internet ranked least in term of accessibility. It implies that most of the poultry farmers have better access to mobile phone, radio and television compared to all other identified ICTs facilities considered in the study.

(D) Use of ICT by Poultry farmers

Table 4 revealed the level of utilization of different ICT facilities among the respondents and Radio ranked 1st with weighted mean score of 2.98 among ten different ICT facilities available to the respondents in the area, follow by Television (2.97) and mobile phone ranked 3rd with WMS of 2.93. Newspaper, Compact Disk Read-Only- Memory, VCD/Audio CD and computer were ranked 5th, 6th and 7th respectively. Other ICT facilities used by farmers include e-mail, website and use of flash drive ranked among the least ICT used by the poultry farmers in the study area. This implies radio, television and mobile are the most often used ICTs by the respondents. This may be due to various advantages attached to these ICTs facilities which others do not have. These are personal interaction, language and literacy clarity and avoidance of time wasting. Greenherg (2005) enumerated the strength of telephone as a communication tool to be language and literacy independent and the use of telephone can aid proper time management by avoiding the risk of traveling long distance. Moemeka (1990) and Benjamin (2005) had earlier stated the potential of ICT (Television) which has a greater advantage over radio because of its audio and visual qualities.

(E) Constraints to use of ICT among Poultry farmers

Table 5 revealed the identified constraints to the use of ICT facilities. Inadequate technical knowhow ranked 1st among other in terms of severity of constraints with WMS of 1.88 , follow by poor power supply with WMS of 1.55 and inadequate access to ICTs ranked

third with WMS of 1.25. Other constraints to use of ICTs are high cost of ICTs infrastructure, lack of physical access to some of the ICT facilities and poor network connectivity. This implies that poultry farmers are faced with certain constraints which affect the utilization of most of ICT facilities. This finding is in line with Greenberg (2005) states that high cost of communication gadgets and lack of skills are the major barriers to wide use of internet-based communication.

Test of Hypothesis

Table 6 shows the summary of Pearson correlation analysis establishing relationship between selected socio-economic characteristics of the respondents and level of use of ICT facilities. The result revealed that age ($r=0.480$; $P<0.05$), household size ($r=0.437$, $P<0.05$), income per annum ($r=0.46$; $p=0.000$) and years spent in school ($r=0.247$; $P<0.05$) all exhibited positive and significant relationships with the level of use of ICTs. This implies that all the afore-mentioned variables have decisive influence on the utilization of ICTs among the poultry farmers in the study area. That is, as the poultry farmer's advances in age, their level of use of ICTs increases; also as the farmers' increases in household number, the probability of some of the household members understand the use of ICTs is high. Again it is revealed that as the income of the poultry farmers increases, the tendency to increase in the level of use is high. May be as income increases, the tendency to procure ICT facilities is high; and an increase in the years spent in school, the probability of utilization of ICT facilities increases. This finding corroborates the findings of Henri-Ukoha et al (2012).

CONCLUSION AND RECOMMENDATION

The study concluded that poultry farmers make use of ICTs; however, the level of use is moderate. Poultry farming in the study area is male dominated, and they are still in their active age and can make effective use of ICTs for improve poultry production. Poultry farmers acquired ICTs knowledge through different sources and they have different level of awareness on ICTs as sources for receiving agricultural information. The most frequently accessible and utilized ICTs by the respondents include radio, television, and telephone and they were ranked 1st, 2nd and third respectively. Inadequate technical knowhow, poor power supply and inadequate access to ICTs are among the major constraints associated with the use of ICTs. The study recorded significant relationship with the selected socio-economic variables which include age, household size, and income per annum and years spent in school and level of utilization of ICTs. Therefore, better infrastructure, such as electricity as well as

skill acquisition on the use of Information and communication technologies should be made available to poultry farmers in the study area for maximum utilization of the potentials of Information and communication technologies.

References:

- Adejo, P.E and Haruna, U. (2009): Access of Farmers to ICTs for Agricultural Development in Bauchi Local Government Area, Bauchi State. Proceedings of the 43rd Annual Conference of the Agricultural Society of Nigeria held in Abuja, 2009
- Ajala, A.A (1992): Factors associated with adoption of improved practices by goat producers in South Eastern Nigeria, Research Monograph No5, Dept. of Agricultural Extension, UNN, P.14
- Ayanwuyi, E., Akintonde, J.O. and Aremu, P.A. (2012): Assessment of catfish production in Egbeda Local Government Area of Oyo State. *International Journal of Advanced Research in Management and Social Sciences*, Vol.1, No. 2. Pp 284-291
- Apantaku, S.O., Omotayo, A.M. and Oyesola, O.B. (1998): Poultry Farmers willingness to Participate in NACIC Scheme in Ogun State. In: Oduguwa et al., (eds) Proceeding of the Silver Anniversary Conference of NSAP Gateway Hotel Abeokuta, pp.542.
- CTA (2003): ICTs- Transforming Agricultural Extension, An e-discussion, 20th August to September, 2003.
- Greenberg, A. (2005): ICTs for Poverty Alleviation: Basic tool and Enabling sector. Swedish International Development Agency (SIDA). Available (on-line) <http://www.sida.se/publication>. Accessed 14/08/2012.
- Henri-Ukoha, A, C. Chikezie, Osuji, M.N, Ukoha, I. I.(2012): Rate of Information Communication Technology (ICT) Use: Its Determinants Among Livestock Farmers in Ukwu West Local Government Area of Abia State of Nigeria. *International Journal of Agricultural and Food Science* 2(2): 51-54.
- Moemeka, A.A. (1990): Mass media Communication and Rural dwellers: Towards Effectiveness of Development Message. In Adebayo, L. (eds) Communication and Rural Development in Nigeria. Ogun State printing corporation, pp.55-73.
- National Population Commission (NPC) (2006): Fact sheet for Nigeria Population Retrieved from URL: www/npc.org/population.htm.
- Nwaru, J.C. (2004): Rural Credit Market and Arable Crop Production in Imo State of Nigeria. Unpublished Ph.D Dissertation, Michael Okpara University, Umudike, Nigeria 80-92

- Olaniyi, O.A. and Adewale, J.G. (2013): Categorization of agricultural Information Users' among Young Arable crop farmers in SouthWest, Nigeria. *American Journal of Experimental Agriculture (In Press)*
- Omotayo, O.M . (2005: ICT and agricultural extension: Issues in transferring agricultural technology in developing countries. Proceedings of the annual conference of AESON, Adedoyin, S. F (Ed) Ilorin, AESON pp. 159-169.
- Osuagwu, D. E. (2001): 'New technologies and services in internet businesses. *Journal of Professional Administration, July - Sept, 29-41.*
- Salau, E.S. and Saingbe, N.D. (2008): Access and Utilization of Information and Communication Technologies (ICTs) among Agricultural Researchers and Extension Workers in Selected Institutions in Nasarawa State, Nigeria. *Production Agriculture and Technology (PAT)* 2008; 4(2): 1-11 accessed on 23 April, 2012 from <http://www.patnsukjournal.com>
- Stanley, G.O. (1997): A critique of information systems and services in Kenya and the role of Kenya national library services in their cooperation. In Huttemann, L. and Sk mg' anga (eds), *coordination of information systems and services* in Kenya, Bonn Education science and documentation centre, Bonn, pp.3-98
- Steinfeld, C., Huyseman, M., Jang, C., David, K. Veld, M., Poot, J. and Mulder, I. (2003): Virtual Terms and the appropriation. *Communication Technology Exploring the Concept of Media Stickiness in Computer Supported Cooperative*, 12 (4):411-435.
- Warren, M. F (2001): Adoption of ICT in agriculture: Intrinsic and Instrumental roles in Technology in Agriculture, Food and the Environment, Montpellier, Agromontpellier, Pp. 675-675.
- World Bank (1998): Viewing Development from the perspective of knowledge. World Bank policy and research bulletin, July-Sept., vol. 9 No. 3. Available (on-line) <http://www.worldbankuq/htm/dec/publication/bulletin/9.3.pdf>. Accessed 20/09/2012

Table1: Distribution of respondents by socio-economic characteristics

Variable	Frequency	Percentage
Age (years)		
≤ 30	30	24.8
31-40	33	27.4
41-50	41	34.2
Above 50	16	13.1
Mean: 48		
Sex		
Male	95	79.2
Female	25	20.8
Marital Status		
Married	98	81.7
Unmarried	22	18.3
Household size		
≤ 5	79	65.9
6-10	40	33.4
Above 10	1	0.8
Mean: 8		
Years spent in school		
1-6	6	5.0
7-12	24	20.0
13-18	70	58.3
Above 18	20	16.7
Mean: 14		
Years of experience		
≤5	38	31.6
6-10	60	50.1
Above 10	25	18.3
Mean: 8		
Membership of association		
Yes	77	64.2

No	43	35.8
Management type		
Intensive	119	99.2
Extensive	1	0.8
Number of birds kept		
≤1000	40	33.3
1001-2000	39	32.5
2001-3000	19	15.8
3001-4000	10	8.3
Above 4000	12	10.0
Mean: 2400		
ICT Proficiency		
Self trained	85	70.8
Certificate in ICTs	8	6.7
Trained by association	17	14.2
No response	10	8.3
Income per annum (#)	Frequency	Percentage
≤ 100,000	2	1.7
100,001-200,000	42	35.0
200,001-300,000	29	24.2
300,001-400,000	20	16.7
400,001-500,000	10	8.3
Above 500,000	17	14.2
Mean: 420,000		
Total	120	100.0

Source: Field survey, 2012

Table 2: Distribution of respondents by ICTs proficiency and level of awareness of ICTs as source of receiving agricultural information

Level of awareness	Frequency	Percentage
High	8	6.7
Medium	100	83.3
Low	12	10.0
Total	120	100.0

Source: Field survey, 2012**Table 3: Distribution of respondents by level of accessibility to ICT facilities**

ICT facilities	Frequency (Percentage)					
	Level of accessibility to ICT facilities					
	Very easy	Easy	Fairly easy	Not easy	WMS	Rank
CD-ROM	56(46.7)	64 (53.3)	0(0.0)	0(0.0)	2.47	6 th
E-mail (personal)	2 (1.7)	14 (11.7)	17 (14.2)	87 (72.5)	0.43	8 th
Website/Internet	2 (1.7)	14 (11.7)	0(0.0)	104 (86.7)	0.28	10 th
VCD/Audio CD	80 (66.7)	28 (23.3)	12 (10.0)	0(0.0)	2.57	4 th
Mobile phone	100 (83.3)	18 (15.0)	2 (1.7)	0(0.0)	2.90	1 st
Newspaper	58 (48.3)	62 (51.7)	0(0.0)	0(0.0)	2.47	5 th
Radio	108 (90.0)	12 (10.0)	0(0.0)	0(0.0)	2.90	1 st
Television	77 (64.2)	40 (33.3)	13(10.8)	0(0.0)	2.70	3 rd
Flash drive	0(0.0)	18 (15.0)	2 (1.7)	100 (83.3)	0.32	9 th
Computer	28 (23.3)	77 (64.4)	15 (12.5)	0(0.0)	2.11	7 th

Source: Field survey, 2012**Figures in parentheses are percentage**

Table 4: Distribution of respondents by level of utilization of ICTs

ICT facilities	Frequency (Percentage)					
	Level of utilization					
	Regularly	Occasionally	Rarely	Never	WMS	Rank
CD-ROM	66(55.0)	32 (26.7)	14 (11.7)	8 (6.7)	2.30	5 th
E-mail (personal)	23 (19.2)	38 (32.5)	11 (9.2)	47 (39.2)	1.30	8 th
Website/Internet	13 (10.8)	36 (30.0)	15 (12.5)	56 (46.7)	1.05	9 th
VCD/Audio CD	22 (18.3)	60 (50.0)	20 (10.0)	18 (15.0)	1.72	6 th
Mobile phone	111 (92.5)	9 (7.5)	0(0.)	0(0.0)	2.93	3 rd
Newspaper	61 (50.8)	55 (45.8)	4 (3.3)	0(0.0)	2.48	4 th
Radio	118 (98.3)	1 (0.8)	1 (0.8)	0(0.0)	2.98	1 st
Television	117 (97.5)	2 (1.7)	1 (0.8)	0(0.0)	2.97	2 nd
Flash drive	2 (1.7)	50 (41.7)	17 (14.2)	51 (42.5)	1.03	10 th
Computer	20 (16.7)	41 (34.2)	42 (35.0)	17 (14.2)	1.53	7 th

Source: Field survey, 2012

Figures in parentheses are percentage

Table 5: Distribution of respondents by identified constraints to the use of ICTs

Constraints	Frequency (Percentage)				
	Level of severity				
	Serious constraint	Mild constraint	Not a constraint	WMS	Rank
Technical knowhow	107(89.2)	11 (9.2)	2 (1.7)	1.88	1 st
Poor power supply	68 (56.7)	50 (41.7)	2 (1.7)	1.55	2 nd
Inadequate access to ICTs	43 (35.8)	64 (53.3)	13 (10.8)	1.25	3 rd
Poor network reception	27 (22.5)	66 (55.0)	27 (22.5)	1.00	6 th
Lack of physical access	38 (31.7)	54 (45.0)	28 (23.3)	1.08	5 th
High cost of ICTs	39 (32.5)	63 (52.5)	18 (15.0)	1.18	4 th

Source: Field survey, 2012

Figures in parentheses are percentage

Table 6: Result of Pearson correlation showing significant relationship between socio-economic characteristics of the respondents and level of use of ICTs

Variables	Correlation	P-value	Remark
Age	0.480***	0.000	S
Household size	0.437***	0.000	S
Income per annum	0.464***	0.000	S
Years spent in school	0.247***	0.007	S

*****: Significant at 1% level**

Source: Field survey, 2012

S: Significant

FACTORS ASSOCIATED WITH THE ADOPTION AND NON-ADOPTION OF IMPROVED CITRUS SEEDLING IN OGO-OLUWA LOCAL GOVERNMENT AREA OF OYO STATE, NIGERIA.

Aremu P .A

Research Outreach Department National Cereals Research Institute (NCRI)Badeji, Niger State, Nigeria.

Ayanwuyi E

Department of Agricultural Extension and Rural Development, Ladoke Akintola University of Technology, Ogbomosho, Oyo State, Nigeria.

Abstract:

The study assessed the factors associated with the adoption and non-adoption of the improved citrus seedlings in Ogo-Oluwa Local Government Area of Oyo State, Nigeria. It highlights the socio-economic characteristics of the respondents; factors influence the adoption and non-adoption of the improved citrus seedling in the area. Data were collected through the structured interview schedule administered on 60 farmers that were randomly selected for the study. Percentage, frequency distribution were used to describe socio economic characteristics of the respondents, while correlation coefficient was used to test the stated hypothesis. Results show that majorities (76.7%) of the respondents were male, 65.0% were married, and 55.0% were educated while 86.7% were farmers.' It was found that significant correlation exist between Marital status($r=0.442$) level of education ($r=0.443$) extension programme ($r=0.401$), social participation ($r=0.547$) and adoption of new improved citrus seedling, at $p=0.05$. Research institute should always consider farmers' literacy ability before the introduction of any improved agricultural technology, so that the technology would be easy for the farmers to adopt and not to discontinue after adoption.

Keywords: - Factors, Adoption, Non-Adoption, Improved, Citrus Seedling.

Introduction

Citrus species belongs to the family, *rutaceae* which contains about 150 general and nearly 2000 species all over the world. Citrus species is probably believed to have originated

in north-eastern India, in Barma and in the adjoining area (1). It is believed that cultivation of Citrus started in north east and south and east Asia in the year AD1178 (2). However, it was believed that travelers and missionaries from Europe were known to have greatly assisted the spread of the citrus group throughout the world, especially since it became known that fresh fruits like sweet oranges (*Citrus sinensis*) were the best remedy against scurvy. The British navy even made it compulsory for their sailors to drink lime and orange juice everyday, a sensible measure which however earned them the nickname the "limeys" (2).

Citrus is cultivated throughout the sub-tropics and tropics roughly between 40° North and South of the Latitude. The total area planted with citrus now amounts to about two million hectares in the world (2). All cultivated citrus grows well in the subtropical region of the world like in the in South-western part and the middle belt region of Nigeria in Africa (1). He emphasize that it was due to the sufficient moisture and the temperature in the area which does not drop below freezing point. Citrus growth best under 1100-1500mm of rainfall per annum, distributed over 9 months of the year. The temperature range for good growth and productivity varies from 13°C with the optimum for maturation. This explains that city fruits which mature under sub-tropical and Mediterranean. Conditions are superior in quality to those in tropical region (1).

It was noted in 1988, that about 46.7 million tones of citrus were produced in the Mediterranean region and in America (3). There exist about 1,100 cultivars which are divided into, common orange (found in Mediterranean region) and sugar oranges (parson brown,) (3). Sweet orange (*Citrus-sinensis*) are grown principally because of its juice which contains vitamin C for human diet. When juice has been extracted, the fruit pulp is a possible livestock feed.

Methology

The study was conducted in Ogo-Oluwa Local Government Area of Oyo State. The study area is located in North East of Oyo state, fall in the forest zone of the state and bordered in the south by Atiba Local government, in the north by Ogbomoso South Local Government, in the south west by Orire Local Government all in Oyo State while bordered in south east by Osun State. Multistage Sampling Technique was used for the study. The area made up of one extension block (Ajaawa) that consist of eight (8) extension cells out which five cells were randomly selected for the study in each of the selected cell three villages were randomly chosen making 15 villages selected for the study, from each selected village four tree crops farmers were randomly chosen useful information elicited from them through the

administration of interview schedule, due to the facts that the area is well known for tree crops especially citrus cultivation. Making a total of 60 respondents selected for the study. Data collected were subjected to descriptive statistics techniques such as frequency counts, percentages while stated hypothesis was test by correlation coefficient.

Results and Discussion

Reasons for Adoption of the Improved Citrus Seedling

Table 1 revealed that 16.7% indicated that its' ability to mature in short period of time are the reasons for adopting improved citrus seedling. While 6.7% adopted the citrus seedling due to its high and regular fruiting pattern and 3.3% of the respondents indicated that high quality produce of the improved citrus seedling as the major reason they have adopted improved citrus seedling, 2.3% of the respondents indicated reduction in the size of its' tree and 1.7% indicated that the ability of the improved citrus seedling to have resistance to pest and diseases are the major reason for adoption. While about 63.3% of the respondents did not give response. This implies that the major factors influencing the adoption of the introduced innovation (citrus seedlings) in the study area was its ability to fruiting and matures in the shortest period of time.

Reasons for non adoption of the improved Citrus Seedling

Table 2 reveal that 25.0% of the respondents indicated that high preference for local un-selected seedlings is the reason for non adopting improved citrus seedling, 16.7% indicated that the seedlings are complex to adopt while 13.3% indicated that major reasons for non adoption of the improved citrus seedlings are that its' expensive and out of reach, while 5.0% indicated shortage of land as the reason for not adopting improved citrus seedling and 3.3% reveals' that low quality of its' product, while 36.7% of the respondents gave no response. This implies that majority of respondents that did not adopt the innovation still preferred the local un-selected citrus seedlings than the improved one

Participation in related occupational association

Table 3, reveals that 56.7% of the respondents were members of the farmers' and other social organization; while 43.3% said they were not member of any association. This implies that social association had significant impact in the possible adoption of an innovation introduced in the study area. Also the table reveals that 51.7% of the respondents indicated that they participated in the extension programme while 48.3% said they do not

participate in the programme. This implies that some of the respondents who involved fully in the extension activities adopted the innovation (citrus seedling) introduced to them. The result agreed with (4) who Stated that the major roles of extension agent in many countries in the past was to transfer new technologies from researcher to the farmers. Now, it's more as a process of helping farmers to make their own decisions by providing them a range of options in given innovation from which they can choose, and by helping the farmers to develop insight into the consequences of each option

Results of correlation in Table 4 shows that marital status= $(r = 0.442)$ education= $(r=0.443)$ participation in extension services= $(r=0.401)$ and members of farmers and other social association= $(r=0.547)$ were significantly correlated at $p=0.01$ levels of significance with the adoption of the improved citrus seedling technology, while there was no significant relationship between sex= $(r=0.135)$, age= $(r=0.123)$ and the adoption of the improve citrus seedling. This implies that farmers' involvement in extension programme and interaction with members of the social organization they belong to influenced their adoption of the improved citrus seedling. This conforms to (5) who reported that agricultural extension agents are the most important source of information to farmers on agricultural innovation. He confirmed that the socio-economic factors have the greatest influence on farmers' ability to adopt innovation. Therefore, the major socio-economic factors affecting the possible adoption of the innovation (improved citrus seedlings), are marital status; participation in extension services and participation in social association.

CONCLUSION AND RECOMMENDATION

It is established from this study that farmers were aware of improved citrus seedlings and even participated in the extension services programme on the improved citrus seedling, but not all the farmers adopted the improved citrus seedlings introduced. Research institute should always consider farmers' literacy ability before the introduction of any improved agricultural technology, so that the technology would be easy for the farmers to adopt and not to discontinue after adoption. Improved technology should be available to the farmers at avoidable price all the time. There should be adequate visit of extension agent in the study area, so that relevant information will be disseminated to the farmers at the appropriate time.

1: Reasons for adoption of the improved citrus seedlings

Reasons for adoption	Frequency	Percentage (%)
Resistance of pest and diseases	01	1.7
High and regular fruiting pattern	04	6.7
High quality product	02	3.3
Reduction in tree size	05	8.3
Reduction in maturity date of the citrus	10	16.7
Not adopt improved citrus seedling	38	63.3
Total	60	100

Source: Field survey 2011**Tables 2: Reasons for Non-Adoption the improved citrus seedlings**

Reasons for non adoption	Frequency	Percentage (%)
The seedlings are expensive and out of reach	07	11.7
The seedlings are complex to adopt	08	13.3
Low quality product	06	10.0
High preferences for local unselected seedlings	10	16.7
It is not suitable for intercropping	05	08.3
Shortage of land	02	03.3
Adopted the improved citrus seedling	22	36.7
	60	100.0

Source: Field survey 2011

Table 3: Participation in related occupational association

Participation in association	frequency	percentage
Participate	34	56.7
Not participate	26	43.3
Total	60	100.0
Participate in extension programme	frequency	percentage
Participate	31	51.7
Not participate	29	48.3
Total	60	100.0

Source: Field survey 2011

Table 4: Results of Correlation analysis showing the relationship between socio economic characteristics of the respondents and adoption of improved citrus seedlings.

Variables	Correlation Coefficient	Decision
Sex	0.135	Not Significant.
Age	0.123	Not Significant
Marital status	0.442*	Significant
Level of education	0.443*	Significant
Participation in citrus related Extension programme	0.401*	Significant
Social Participation	0.547*	Significant

Source: Data analysis 2011* Significant at P 0.01 Critical value of r is 0.156

References:

- Ekong E. 2003 An Introduction to Rural Sociology. Dove Educational Publishers Uyo, Akwa ibom State, Nigeria. PP. 18-20
- Opeke.L.2002Tropical tree crops 4th edition published by spectrum books limited, Ibadan, Oyo state Nigeria. Pp202, 205
- Rehm S. 2001 The cultivated plants of subtropics: Elsevier publisher United Kingdom (U.K) Pp 168 -175.
- Samson J. A 2000 Tropical Fruits (2nd Edition), Published by Longman Books, limited, England: U.K. Pp 79-91,
- Van den Ban, A.W.and H .S Hawkins 1998. Agricultural Extension, Second Edition, Blackwell Science Publication. Oxford.pp.267-268.

CONTROL OF FOLIAGE PESTS OF ROSELLE (*HIBISCUS SABDARIFFA* L.) USING PLANT EXTRACTS OF *TEPHROSIA VOGELII* AND *AZARDIRACTHA INDICA* IN OGBOMOSO, NIGERIA.

O. A. Olaniran

School of Life Sciences, Keele University, Staffordshire, ST5 5BG, United Kingdom.

F. O. Alao

T. A. Adebayo

Department of Crop and Environmental Protection, Ladoke Akintola University of Technology, Ogbomoso, Nigeria

Abstract:

Plants extracts have been widely used to control agricultural pests in order to achieve an ecologically based pest management strategy. Evaluation of insecticidal activities of *Tephrosia vogelii* and *Azardiractha indica* A. Juss. (L) extracts against *Podagrica* species and *Zonocerus variegatus* compared to a synthetic insecticide were investigated in cultivated roselle in Ogbomoso, Nigeria. This study was carried out in the field in a randomized complete block design. Plant height, leaf defoliation, calyx yield and pest were monitored throughout the growing season from 2006 to 2008. The plant extracts were effective in the control of the studied insects compared to untreated plants (control). *T. vogelii* extracts exhibited high efficacy (59–80%) followed by *A. indica* applied at 25% w/v against *Podagrica* species but *A. indica* had higher efficacy (69%) than *T. vogelii* (51%) in the control of *Z. variegatus*. However, combination of the two plant extracts proved to be highly effective as synthetic insecticide (deltamethrin). All the botanical treated plants resulted to calyx yield increase of 2-3times over the untreated plants. The results showed that these plant extracts could be used in the management of insect pests of roselle particularly in the organic farming system.

Keywords: *Tephrosia vogelii*, *Azardiractha indica*, *Podagrica* species, *Zonocerus variegatus*, Roselle, Extracts.

INTRODUCTION

Hibiscus sabdariffa (Linn) commonly called roselle belongs to the family Malvaceae and is one of the common flower plants grown worldwide. It is cultivated in tropical and subtropical regions for its jute-like fibre in India, East Indies, Nigeria and South America (Abu-Tarboush et al. 1997; Babatunde & Mofoke 2006; Morton 1987). However, Benin, Sudan, Cote D'Ivoire, Ghana, Niger, Burkina Faso and Nigeria were reported as major areas of Roselle cultivation in Africa (Oyewole, I & Mera 2010). Roselle is a versatile plant found in almost all warm countries (Ismail et al. 2008). Though its origin is uncertain, it is generally believed to originate from India to Malaysia (Morton 1987) and Saudi Arabia (Abu-Tarboush et al. 1997). The most economical part of roselle is the calyx which is obtained by removing the petals of the flower from its capsule containing the seeds. They are used as valuable food products; wine, jelly, beverages, jam, colour and flavour ingredients (Ismail et al. 2008; Tsai et al. 2002). Non-food products include the pharmaceutical use of flower and fruits to treat cases of bronchitis and cough, hypertension, diarrhoea and many other diseases (Chewonarin et al. 1999; Haji Faraji & Haji Tarkhani 1999). The calyx is high in calcium, niacin, riboflavin and iron. It contains three and nine times more vitamin C than blackcurrant (*Ribes nigrum* L) and citrus (*Citrus sinensis* L) fruit respectively (Ismail et al. 2008). In Nigeria, the leaves are used in making soup as well as salad while red calyces are used as tea after adding sugar which is locally known as Zobo. In recent years, cultivation of roselle has gained wide acceptability among Nigeria farmers due to its medicinal importance.

Insect pests' infestation is one of the major factors militating against cultivation of roselle. Different phonologies of roselle have been reportedly attacked by insects. Among the insect pests, *Podagrica* species cause economic damage, attacking the lamina of the young foliage and matured leaves which result in reduction of the photosynthetic ability of the crop (Fasunwon & Banjo 2010). Komolafe (1979) observed that *Podagrica* species did not only damage the leaves and flowers but caused premature falling of the pods. This insect also transmit mosaic virus resulting in 20-50% yield reduction (Fajinmi & Fajinmi 2006). *Zonocerus variegatus* feed on wide range of crops among which is roselle (Babatunde Idowu & Akinsete 2001). The insect pest complex of roselle includes *Bemisia tabaci* (Genn.) *Aphis gossypii* Glover, *Earias insulana* (Boisd.) *Empoasca* spp (Abdel-Moniem & El-Wahab 2006)

Synthetic insecticides are used by the poor resource farmers in Nigeria to control arthropod pests, however, the problems of pesticide resistance and negative effects on non-target organisms including man and the environment necessitated the idea of developing effective, cheap and easily biodegradable alternative products (Franzen 1993). The ban of

chemical pesticides in European countries also encourages the use of alternative plant protection products which are safe for consumers, local farmers and residents (Parente 2006). Botanical insecticide is a promising alternative in the protection of crops against insect pests. They are generally pest-specific and relatively harmless to non-target organisms (Kabaru & Gichia 2001).

Tephrosia vogelii has been used as insecticide and to enrich soil across the African continent presumably due to the rotenoids present in the plant (Adebayo 2003; Kamanula et al. 2010; McDavid & Lesseps 1995; Nyirenda et al. 2011) with the leaves having the highest concentrations (Adebayo 2003; Irvine & Freyre 1959; Nadine L 1993). *Azadirachtin* derived from the neem tree (*Azadirachta indica* L.) has been reported as antifeedant, repellent, oviposition deterrent and insect growth regulator (Isman 2008; Naumann & Isman 1995; Priyono & Hassan 1993).

This field study was conducted to determine the damage caused by *Podagrica* species and *Zonocerus variegatus* and effectiveness of *T. vogelii* and *A. indica* as a botanical pesticide.

MATERIALS AND METHODS

Experimental site: The study was conducted at Teaching and Research Farm, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Oyo state located in southern guinea savanna region of Nigeria. Ogbomoso lies between latitude 8° 07' N and longitude 4° 15' E with a mean annual rainfall of 1,224.7 mm and relative humidity between 75 and 95%. The rainfall is bimodal; the long rainy period is between March –July while August – October is the short period. The region has a mean annual temperature of about 26.2 °C and it is about 600 mm above sea level (NIMET, 2009)

Samples collection and preparation: Red roselle was purchased from the International Institute of Tropical Agriculture (IITA), Ibadan while fresh leaves of *T. vogelii* and *A. Indica* were harvested at full blooming from botanical garden, LAUTECH. The extraction method of Mcdavide and Leseeps (1994) was used for this study, 25 g and 15 g each of *A. indica* and 25 g of *T. vogelii* were weighed into separate plastic buckets. The weighed plants were washed to remove sand and other contaminants. Each of the materials was pounded separately in a mortar. The paste (crushed leaves) was then put into a 10-litre thick plastic bucket and the appropriate volume of distilled water added to make a 15% and 25% w/v mixture (15% w/v represents an extract made with 15 g of *T. vogelii* leaves per every 100 ml

of water). The pastes were soaked for 10 hours in a covered bucket. The aqueous mixture was filtered using muslin cloth to remove the uncrushed pieces of leaf material.

Field experimental layout: The experiment occupied 0.03 ha of land and it was ploughed and harrowed once. The layout was a Randomized Complete Block Design (RCBD) with three replicates. The plot size was 4 m x 4 m with 1 m x 1 m between plots and 2 m x 2 m between blocks respectively to prevent pesticide drift and inter-plot interference. Roselle was sown with three to four seeds per stand at a depth of 2 cm and spacing of 0.5 m x 0.5 m. Thinning was done two weeks after planting to achieve two plants per stand and six crop rows were established in each plot. Weeding was carried out manually to ensure clean plots.

Application of extracts: The treatments applied were *A. Indica* 25% w/v, *A. Indica* 15% w/v

T. vogelii 25% w/v, *T.vogelii*25% + *A.indica*15%, synthetic insecticide (Delthametrin) (0.8L/ha) and untreated plots (Control). Application of the treatment commenced 35 days after planting with hand-held sprayer of 2-litre capacity. The spraying was carried out weekly early in the morning to avoid photo decomposition and drifting of the extracts. After four weeks of plant extract treatment, synthetic insecticide (Delthametrin) was applied to all the plants to control flowering insects.

Data collection and analysis: Estimation of the population densities of *P. uniformis*, *P. sjostedti* and *Zonocerus variagatus* were taken weekly for 4 weeks after spraying. Number of insects on treated roselle plants was visually counted. All data were collected from plant stands in the two middle rows of each plot. Agronomic data on average plant height, defoliated leaves and calyx yield (kg/ha) were taken at maturity of the plant. All data were analysed by two-way ANOVA and Tukey's test was used for multiple comparisons. Statistical analysis was carried out with Minitab 16 (Minitab Inc., Pennsylvania, USA).

RESULT

Insect population: Table 1 shows the effect botanical treatments on *P. uniformis*. Plants treated with botanicals were able to reduce the number of this insect found on the treated plots. At four weeks after spraying, no insect was found on treated plots except on *A. indica* treated plots. Application of *A. indica* at 25% concentration was more effective against *P. sjostedti* than *A. indicia* at 15% w/v. No significant difference was observed between the plants treated with *A. indica* 25% w/v and *T. vogelii* 25% w/v and they both reduced the number of *P. sjostedti* similar to synthetic insecticide and mixed plant extracts. All the

imposed botanical insecticides recorded 100% efficacy by third week after spraying except plants treated with *A. Indica* at 15% (Table 2). Highest mean value of *Z. variegatus* was observed from untreated plant. By third week after spraying, no insect was found on all treated plots except plots treated with *T. vogelii* 25% and this recorded zero insect by fourth week after spraying. Plant treated with *A. indica* at 15% and 25% w/v exhibited high insecticidal activity than *T. vogelii* at 25% w/v. Combination of the two plant extracts had equal efficacy with synthetic insecticide (deltamethrin). However, all the botanical treated plants effectively controlled *Z. variegatus* compared to the untreated plants (Table 3).

Plant height: The highest height was observed with Plant treated with synthetic insecticide and the combined extracts while untreated plot was the lowest (Fig. 1). Though the height was not significantly different between control and *A. indica* 25%, all treated plants recorded higher height than the untreated plants. The height was significantly different for the plants extracts (ANOVA, $F_{5,71}=50.07$, $P<0.0001$).

Percentage defoliation: The least percentage leaves defoliation was observed from the plants treated with synthetic insecticide. However, all treated plants prevented the leaves from being defoliated compared to untreated plants (ANOVA, $F_{5,71}=41.36$, $P<0.0001$). (Fig 2). *A.indica* applied 25% w/v recorded highest percentage of defoliation among the botanical insecticides.

Calyx yield: The yield obtained from the plants treated with the combination of the extracts was significantly higher than the single application of *A. indica* and *T. vogelii* extracts and untreated plants. Among the single extracts used, calyx yield obtained from *A. indica* at 15% w/v was the least but higher than calyx yield obtained from untreated plants (ANOVA, $F_{5,71}=145.97$, $P<0.0001$) (Fig. 3).

DISCUSSION

Application of *T. vogelii* extracts at 25% concentration was not as effective in the control of *Z. variegatus* as *A. indica* extracts at 15% and 25% w/v. Presumably *Azardirachtin* derived from *A. indica* may be more effective than rotenoids which was extracted from *T. vogelii*. But *T. vogelii* extracts were more effective against *Podagrica* species than *A. Indica*. This suggests that *Podagrica* species were probably more easily susceptible to rotenoids.

Isman (1993) observed that closely related species can exhibit different susceptibilities to same plant extract or pure allelochemical. Synthetic insecticide (deltamethrin) exhibited a higher efficacy compared to botanical insecticides; which might be as a result of active ingredients of botanical insecticides being easily volatilized especially in the sun, thereby

leading to their limited efficacy (Ware 2000). The efficacy of the combination of the two plant extracts was comparable with Deltamethrin in suppressing the populations of both *Podagrica spp* and *Z. variegatus* suggesting a synergistic action. These results suggest that combinations of different plants active ingredients are not easily photo-decomposed, enhancing insecticidal activity thereby competing effectively with synthetic insecticide (Adebayo & Olaifa 2004; Alao 2009).

The field observation revealed that botanical treated plants sustained high populations of the three insects than Deltamethrin treated plants. They were unable to feed on the plants indicating antifeedant activity of the extracts causing starvation or migration to untreated plants or their wild hosts. However, increase in the population densities of insects in the untreated plants suggest migration from treated plants. Sadek (2003) observed that larvae of *Spodotera litoralis* moved gradually from food treated with *Adhatoda vasica* extract to the untreated food. The target insects are notorious for leaves defoliation resulting in reduction of photosynthetic ability of the infested plants which invariably affect the plant growth (Dent 1999). The botanical insecticides were not effective at first two weeks of spraying; delayed effect is reported to be one of the major problems of botanical insecticides (Isman 2008; Oparaeke 2006). Damage done by the insects was reduced due to the antifeedant activities of the two active ingredients. Many studies have reported the antifeedant activities of these two plant extracts on different species of insects (Adebayo 2003; Redknap 1981; Seljasen & Meadow 2006; TAYLOR 1970; Umoetok et al. 2009; Zhang YeGuang et al. 2000). Application of these two plant extracts as insecticide is effective in the control of studied insects. Due to different rate of susceptibility of the insects to the plant extracts, combination of extracts will be an effective means in the management of these insects especially in the organic farming system. These findings appreciate the importance of traditional knowledge in science through the use of plant extracts in the control of insect pests by poor resource farmers in Ogbomoso, Nigeria.

Table 1: Mean number of *Podagrica uniformis* found on roselle plants treated with different insecticide and untreated plants.

Treatment	Weeks after treatment			
	1	2	3	4
Control	3.40 ^{ab}	5.65 ^a	4.69 ^a	4.00 ^a
Delthametrin	1.72 ^c	1.00 ^c	0.00 ^c	0.00 ^c
<i>A. indica</i> 25%	3.00 ^{ab}	2.65 ^b	0.66 ^c	0.00 ^c
<i>T. vogelii</i> 25%	3.65 ^a	1.65 ^c	0.66 ^c	0.00 ^c
<i>A. indica</i> 15%	3.66 ^a	3.00 ^b	2.00 ^b	1.66 ^b
<i>T.vogelii</i> 25%+ <i>A.indica</i> 15%	2.33 ^{bc}	1.65 ^c	0.00 ^c	0.00 ^c

Means with different letters indicate significance at $P<0.05$ (Tukey).

Table 2: Mean number of *Podagrica sjostedti* found on roselle plants treated with different insecticide and untreated plants.

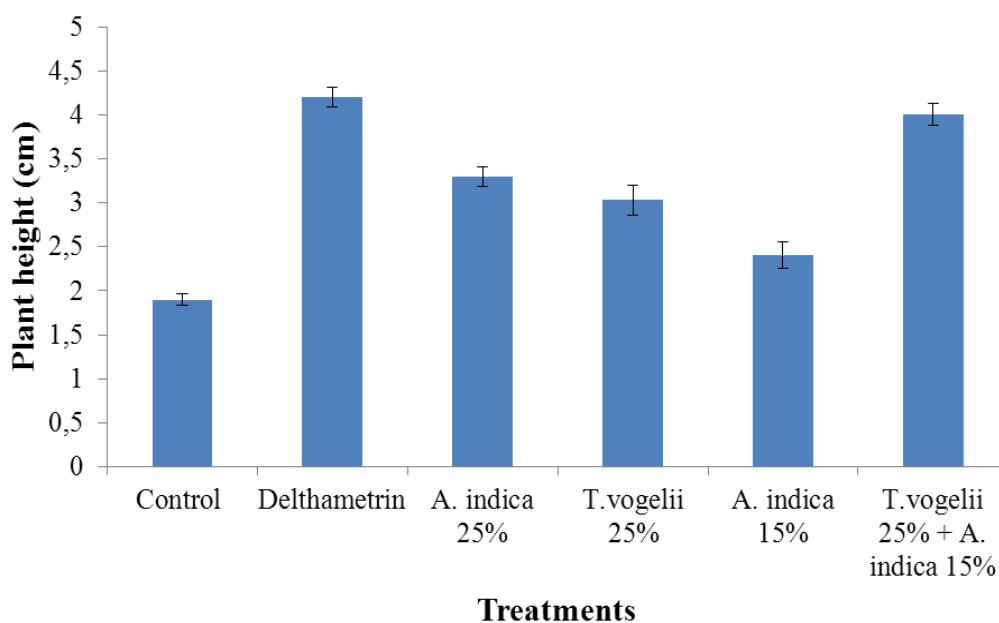
Treatment	Weeks after treatment			
	1	2	3	4
Control	1.65 ^a	2.66 ^a	3.00 ^a	2.66 ^a
Delthametrin	1.00 ^c	0.00 ^c	0.00 ^c	0.00 ^c
<i>A. indica</i> 25%	1.66 ^a	1.00 ^b	0.00 ^c	0.00 ^c
<i>T. vogelii</i> 25%	1.34 ^b	0.66 ^{bc}	0.00 ^c	0.00 ^c
<i>A. indica</i> 15%	1.69 ^a	2.00 ^a	2.00 ^a	0.66 ^b
<i>T.vogelii</i> 25%+ <i>A.indica</i> 15%	1.00 ^c	0.32 ^{bc}	0.32 ^{bc}	0.00 ^c

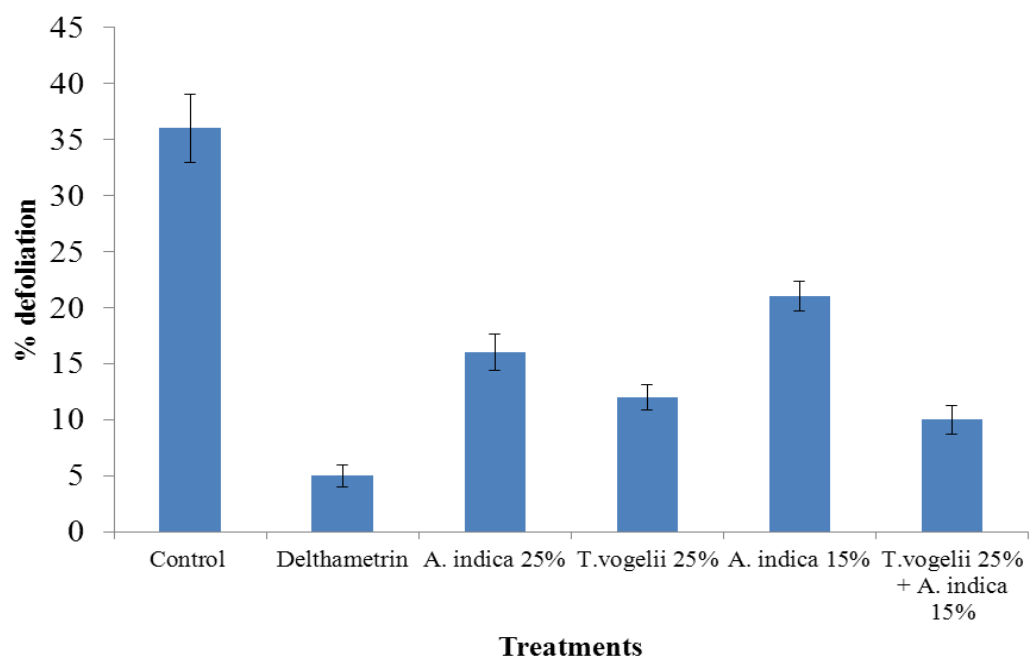
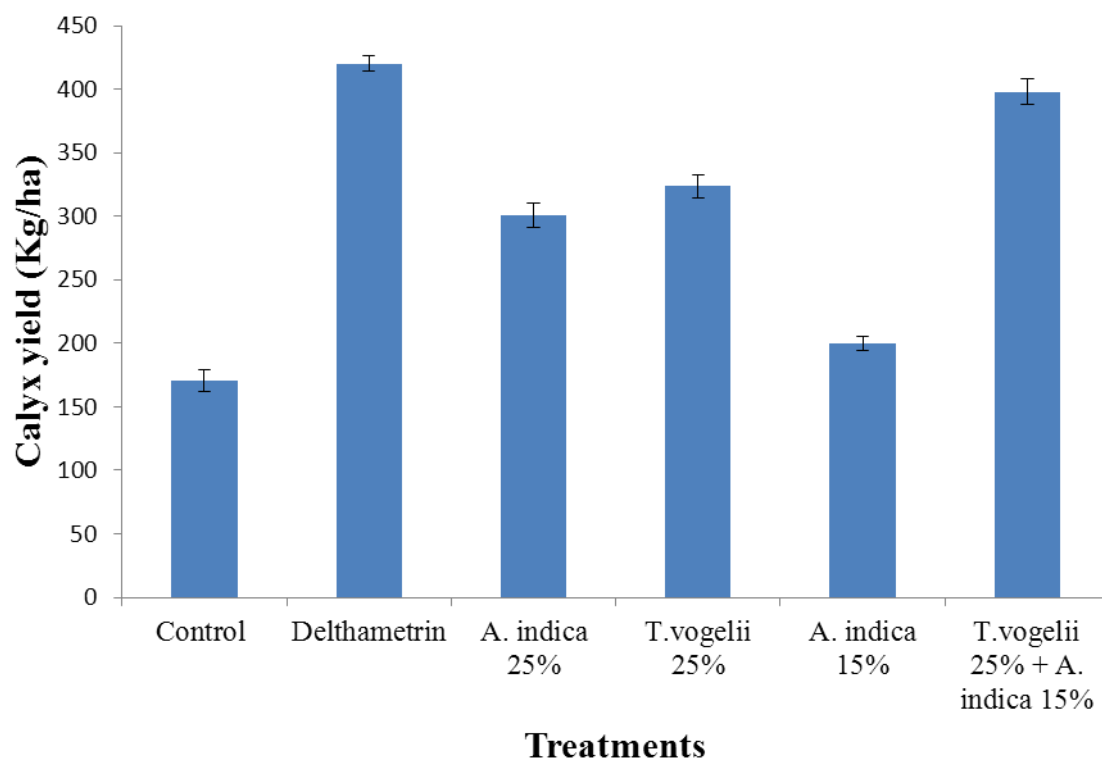
Means with different letters indicate significance at $P<0.05$ (Tukey).

Table 3: Mean number of *Zonocerus variegates* found on roselle plants treated with different botanical insecticides and untreated plants.

Treatment	Weeks after treatment			
	1	2	3	4
Control	2.00 ^a	1.66 ^a	1.00 ^a	0.60 ^a
Delthametrin	0.00 ^c	0.00 ^d	0.00 ^c	0.00 ^b
<i>A. indica</i> 25%	1.00 ^b	0.67 ^c	0.00 ^c	0.00 ^b
<i>T. vogelii</i> 25%	1.33 ^{ab}	1.00 ^b	0.33 ^b	0.00 ^b
<i>A. indica</i> 15%	1.33 ^{ab}	0.66 ^c	0.00 ^c	0.00 ^b
<i>T.vogelii</i> 25%+ <i>A.indica</i> 15%	0.66 ^b	0.00 ^d	0.00 ^c	0.00 ^b

Means with different letters indicate significance at $P < 0.05$ (Tukey).

**Fig. 1**

**Fig. 2****Fig.3**

Reference:

- Abdel-Moniem, A. & El-Wahab, T.E.A. (2006) Insect pests and predators inhabiting roselle plants, *Hibiscus sabdariffa* L., a medicinal plant in Egypt. *Archives of Phytopathology and Plant Protection*, 39, 25-32.
- Abu-Tarboush, H.M., Ahmed, S.A.B. & Al Kahtani, H.A. (1997) Some nutritional and functional properties of karkade (*Hibiscus sabdariffa*) seed products. *Cereal chemistry*, 74, 352-355.
- Adebayo, T.A. (2003) Efficacy of mixture formulations of synthetic and botanicals submitted insecticides in the control of insect pests of okra and cowpea. Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
- Adebayo, T.A. & Olaifa, J.I. (2004) Efficiency of the extract of *Tephrosia vogelii* in the control of insect pests of cowpea. *Science Focus*, 7, 47-52.
- Alao, F.O. (2009) Insecticidal principle of allelochemicals derived from *Tephrosia vogelii* and *Petiveria alliacea* against insect pests of cowpea (*Vigna unguiculata* L. Walp). Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
- Babatunde Idowu, A. & Akinsete, A. (2001) The attraction of *Zonocerus variegatus* (Orthoptera: Pyrgomorphidae) to different types of lure. *Revista de biologia tropical*, 49, 673-678.
- Babatunde, F.E. & Mofoke, A.L.E. (2006) Performance of Roselle (*Hibiscus sabdariffa* L.) as Influenced by Irrigation Schedules. *Pakistan Journal of Nutrition*, 5, 363-367.
- Chewonarin, T., Kinouchi, T., Kataoka, K., Arimochi, H., Kuwahara, T., Vinitketkumnuen, U. & Ohnishi, Y. (1999) Effects of roselle (*Hibiscus sabdariffa* Linn.), a Thai medicinal plant, on the mutagenicity of various known mutagens in *Salmonella typhimurium* and on formation of aberrant crypt foci induced by the colon carcinogens azoxymethane and 2-amino-1-methyl-6-phenylimidazo [4, 5-b] pyridine in F344 rats. *Food and chemical toxicology*, 37, 591-601.
- Dent, D. (1999) *Insect Pest Management*. CABI Publishing: Wallingford, UK.
- Fajinmi, A.A. & Fajinmi, O.B. (2006) Incidence of okra mosaic virus at different growth stages of okra plants (*Abelmoschus esculentus* L. Moench) under tropical condition. *Journal of General and Molecular Virology*, 2, 028-031.
- Fasunwon, B.T. & Banjo, A.D. (2010) Seasonal population fluctuations of *Podagrica* species on okra plant (*Abelmoschus esculentus*). *Res.J.Agric.Biolog.Sci*, 6, 283-288.
- Franzen, H. (1993) Need for development of new strategies for locust control. *New strategies for locust control*. Ed: Rembold, H. ATSAF. Bonn, 89, 9-13.

- Haji Faraji, M. & Haji Tarkhani, A.H. (1999) The effect of sour tea (*Hibiscus sabdariffa*) on essential hypertension. *Journal of Ethnopharmacology*, 65, 231-236.
- Irvine, J.E. & Freyre, R.H. (1959) Source Materials for Rotenone, Occurrence of Rotenoids in Some Species of the Genus *Tephrosia*. *Journal of Agricultural and Food Chemistry*, 7, 106-107.
- Ismail, A., Ikram, E.H.K. & Nazri, H.S.M. (2008) Roselle (*Hibiscus sabdariffa* L.) Seeds GÇô Nutritional Composition, Protein Quality and Health Benefits.
- Isman, M.B. (1993) Growth inhibitory and antifeedant effects of Azadirachtin on six noctuids of regional economic importance. *Pesticide Science*, 38, 57-63.
- Isman, M.B. (2008) Botanical insecticides: for richer, for poorer. *Pest management science*, 64, 8-11.
- Kabaru, J.M. & Gichia, L. (2001) Insecticidal activity of extracts derived from different parts of the mangrove tree *Rhizophora mucronata* (Rhizophoraceae) Lam. against three arthropods. *African Journal of Science and Technology*, 2.
- Kamanula, J., Sileshi, G.W., Belmain, S.R., Sola, P., Mvumi, B.M., Nyirenda, G.K.C., Nyirenda, S.P. & Stevenson, P.C. (2010) Farmers' insect pest management practices and pesticidal plant use in the protection of stored maize and beans in Southern Africa. *International Journal of Pest Management*, 57, 41-49.
- Komolafe, M.F. (1979) *Agricultural Sciences for most West Africa Schools and Colleges*. University of Ibadan press Ltd: Ibadan, Nigeria.
- McDavid, A. & Lesseps, R.S. (1995) Effects of *Tephrosia vogelii* leaf extracts on several crop pests. In: Berger, A. & Mugoya, C.F., *Natural plant products as pesticides: Proceedings from the first national symposium, Luzaka, Zambia. 5th - 8th August, 1994*, 63-71.
- Morton, J.F. (1987) *Roselle*. In: *Fruits of warm climates*. Available from: <http://www.hort.purdue.edu/newcrop/morton/roselle.html>, Accessed July 12, 2012.
- Nadine L, M.-F.T.C.N.a.H.C. (1993) Production of rotenoids by heterotrophic and photomixotrophic cell cultures of *Tephrosia vogelii*. *Phytochemistry*, 34, 1515-1520.
- Naumann, K. & Isman, M.B. (1995) Evaluation of neem *Azadirachta indica* seed extracts and oils as oviposition deterrents to noctuid moths. *Entomologia experimentalis et applicata*, 76, 115-120.
- Nyirenda, S.P., Sileshi, G.W., Belmain, S.R., Kamanula, J.F., Mvumi, B.M., Sola, P., Nyirenda, G.K.C. & Stevenson, P.C. (2011) Farmers' ethno-ecological knowledge of vegetable pests and pesticidal plant use in Malawi and Zambia. *African Journal of Agricultural Research*, 6, 1525-1537.

- Oparaeke, A.M. (2006) The potential for controlling *Maruca vitrata* Fab. and *Clavigralla tomentosicollis* Stal. using different concentrations and spraying schedules of *Syzgium aromaticum* (L.) Merr and Perr on cowpea plants. *Journal of Plant Sciences*, 1, 132-137.
- Oyewole, C., I & Mera, M. (2010) Response of roselle (*Hibiscus sabdariffa* L.) to rates of inorganic and farmyard fertilizers in the Sudan savanna ecological zone of Nigeria. *African Journal of Agricultural Research*, 5, 2305-2309.
- Parente, S. (2006) New EU legislation finally adopted. 10-11.
- Prijono, D. & Hassan, E. (1993) Laboratory and field efficacy of neem (*Azadirachta indica* A. Juss) extracts against two broccoli pests. *Zeitschrift fuer Pflanzenkrankheiten und Pflanzenschutz*, 100.
- Redknap, R.S. (1981) The use of crushed neem berries in the control of some insect pests in Gambia. *GTZ*, 205-214.
- Sadek, M.M. (2003) Antifeedant and toxic activity of *Adhatoda vasica* leaf extract against *Spodoptera littoralis* (Lep., Noctuidae). *Journal of Applied Entomology*, 127, 396-404.
- Seljasen, R. & Meadow, R. (2006) Effects of neem on oviposition and egg and larval development of *Mamestra brassicae* L: Dose response, residual activity, repellent effect and systemic activity in cabbage plants. *Crop Protection*, 25, 338-345.
- TAYLOR, T.A. (1970) On the Flight Activity of *Podagrica uniforma* and *P. sjostedti* (Coleoptera: Chrysomelidae) on *Urena lobata* in Nigeria. *Annals of the Entomological Society of America*, 63, 1471-1472.
- Tsai, P.J., McIntosh, J., Pearce, P., Camden, B. & Jordan, B.R. (2002) Anthocyanin and antioxidant capacity in Roselle (*Hibiscus sabdariffa* L.) extract. *Food Research International*, 35, 351-356.
- Umoetok, S.B.A., Osuagwu, A.N., Udo, I.A., Idiongette, M.I. & Ukeh, D.A. (2009) Effects of *Azadirachta indica* products on the management of *Ootheca mutabilis* on *Telfairia occidentalis* in Calabar, Southeast Nigeria. *Crop Protection*, 28, 583-587.
- Ware, G.W. (2000) *The Pesticide Book*. Thomson Publications, Fresno, California.
- Zhang YeGuang, Xu HanHong, Huang JiGuang & Chiu ShinFoon. (2000) The antifeeding activity of *Tephrosia vogelii* (Hook) against species of Lepidoptera. *Journal of South China Agricultural University*, 21, 26-29.

GENOTYPE BY HOUSING TYPES (TYRE AND PLASTIC BOX) INTERACTION ON THE GROWTH TRAITS OF ACHATINA SNAILS REARED IN SOUTHERN GUINEA SAVANNA ZONE OYO. NIGERIA

Amao, S.R

Department of Agricultural Education (Animal Sci. Division), School of Vocational and Technical Education, Emmanuel Alayande College of Education, P.M.B 1010, Oyo. Oyo State. Nigeria.

Abstract:

Differences in growth traits and survival of *Achatina achatina* snails were evaluated in the two housing systems (Tyre and plastic box) using an adult snails of 100g on average weight comprises of one hundred and eighty (280) snails. The snails were randomly assigned to two housing systems i.e tyres and plastic boxes. One hundred and forty (140) snails each were reared in tyre and plastic housing confinement respectively. Data were obtained on body weight (BDW), Shell length (SL), Shell Width (SW) and Shell thickness (ST) for the period of three months. Significant ($P<0.05$) differences was observed between the two housing systems and the growth traits. Superior values were only obtained for plastic housing system at earlier stage of the study for BDW (123.09g and 128.97g) at 1 and 2 week respectively while higher significant values were observed for BDW varied 129.41g to 176.77g, SL ranging 11.63mm to 12.40mm and SW ranging from 15.98mm to 16.91mm for tyre housing type at ages where the significant appeared with no significant ($P>0.05$) differences between the housing types and Shell thickness (ST) throughout the experimental period. It was concluded that *Achatina achatina* snails can perform well in the tyre housing system due to limited exposure to ray of light in southern guinea savanna zone, Oyo State, Nigeria.

Keywords: *Achatina achatina*, genotype, housing types, growth, southern derived savanna,

INTRODUCTION

The agricultural development programme in many states of the federation has been promoting snail farming but many interested farmers are still undecided about the breed of

snails to raise in term of growth, reproductive performance as well as acceptability (based on organoleptic properties (Ihekeronye and Ngoddy, 2008) of the three common breed of snails.

The performance of any animal is dependent upon the inherent genetic make-up and the environment in which it is raised, within the different genetic make-up, the different breeds perform differently within the same environment (Ibom *et al.*, 2012). Breed types has a marked on performance and productivity of snails than all other factors considered. This is attributed to physical adaptability to the environment and genetic variation among and within breeds. (Ibom *et al.*, 2012). Snails (*Achatina achatina*) are one of the most compact groups of animals which show a wide diversity (Odunaiya, 1995). In Nigeria, there are different breeds of snails and they vary in size, colour, adaptability and performance (Ibom *et al.*, 2012).

Snail farms may be outdoors; in building with a controlled of climate or closed system such as plastic box or “green house” .In addition, snail may breed and hatch inside a controlled environment and then (after 6 to 8 weeks) It may be place in outside pen to mature. Snail can be kept in a variety of tank and containers. It must be large enough to accommodate them, with good ventilation. The snails need light so an opaque box is out of the question, but a translucent nearly transparent container will be fins from the snail point of view. The most important thing is to remember is that it must be escape proof. Snail are extremely strong (They can lift 10-50 times their own weight) for their size and could lift a lid that is not clipped or weighted down. Wooden or cardboard containers are not suitable, they will not and in the case of cardboard, the snail will actually eat it (Jennifer, 1975).

Many researchers had conducted studies on two general of the edible land snail *Achatina achatina* and *Archachatina marginata* which are native of west African and other economic species common only neared in Nigeria by farmer include *Archachatina marginata*, *Achatina achatina* *Achatina fulica* (Amao *et al.*, 2011; Aboho *et al.*, 2009) despite their importance and growing interest in their cultivation, not much work has been done on *Archachatina marginata*, *Achatina achatina* and *Achatina fulica* in respect to housing types in this environment of guinea savanna zone of Oyo, Nigeria.

MATERIALS AND METHODS

Site of the experiment

The experiment was carried out at the snailery unit, Teaching and Research farm of the Emmanuel Alayande College of Education, Oyo. Oyo State, Nigeria. Oyo lies on the longitudes 3° 57' east of the Greenwich meridian and latitude 7° 51' North of the equator, it is about 55 kilometers North east wards from Ibadan, the Capital of Oyo State. The altitude is

between 300 and 600 metre above level. The mean annual temperature is about 27⁰C while that of rainfall is 1165mm. The vegetation of the area is Guinea savanna zone (Amao *et al.*, 2011).

Experimental animals and Management

A total number of 280 *Achatina achatina* snail were purchased from a reputable snailery farm in Ibadan, Oyo state of an average weight between 100g. One hundred and forty mature snails were kept in each housing system (tyre and plastic box). Twenty mature snails were replicated seven times in plastic box and ten mature snails were replicated fourteen times in plastic box housing system. Feed is the most important input in snail production, especially under captivity (intensive system of management). For optimal production, the snails have to be provided with efficient feed for growth and development.

Throughout, the three month (3month period of experiment the snail were fed a mixed feed regime of forage like pawpaw leaves bananas, peach water leaves plums etc and a formulated diet. The diet was formulated with the following ingredient, maize soybean meal, fishmeal, bone meal. Wheat offal, Oyster and mineral premix containing 24% CP, 15% Ca and 2650 kcal/kgME were given *ad libitum* in shallow troughs and watering was done twice.

Description of the snails used

Average shell length of the snails used for the experiment is 10cm, with an average diameter of 5cm. In exceptional cases the snail shell can grow to be 30cm long but this is very unlikely especially in captive. The average body weight of the snails used for experiment is 100g.

Description tyres housing used

Half of the total snails (140 snails) were managed in car tyres. Five car tyres are placed on top of each other, with wire mesh between the topmost tyre and the second one from the top to avoid escape of the snails. Five car tyres are placed on top of each other were replicated seven times and twenty snails (20) were kept in each set.

Description of the plastic box housing used

Plastic boxes measuring 25cm by 35cm and 25cm high. A 6cm diameter hole were art in the bottom to drain excess moisture and the hole were art in the bottom to drain excess

moisture and the hole were cover with plastic screening well secure to kill all organisms (insect nematodes, bacteria etc) the plastic was cover to avoid escape of the snails.

Data collection

The parameters measure from the snail from each housing system were body weight, shell length, shell thickness and shell width with the below procedures. Body weight (BW) of the individual snail were measure using and electric sunshine balance, Shell thickness (ST) by the use of micrometers screw gauge to 0.01mm, Shell length (SL) and Shell width (SW) by means of venier caliper and all these were observed weekly throughout the study period of 3months.

Statistical analysis

Data were subjected to the analysis of variance using general linear model procedure of SAS (2009) while treatment mean were separated using the same procedure.

The statistical model for the analysis was.

$$Y_{ijk} = \mu + H_i + A_j + (HA)_{ij} + e_{ijk}$$

Y_{ijk} = The individual measurement in the animal

μ = overall mean

H_i = effect of housing system i^{th} ($i=1, 2$)

A_j = effect of age j^{th} ($j= 1, 2, 3$)

$(HA)_{ij}$ = Interaction between housing system i^{th} and age j^{th}

E_{ijk} = The random error common to measurement in each and snail and assume to be normally and independently distrusted with a mean of zero and variance δ^2

RESULTS

Table 1 shows the least square means effects of genotype and housing systems on *Achatina Achatina* one month of age. There is significant ($P<0.05$) differences between the age, housing systems and the growth that of the snail. BDW were significantly ($P<0.05$) differed for the two housing systems, with plastic housing system higher at age 1 and 2 (123.08g and 128.97g) respectively while the tyre housing type look the leads at age 3 and 4 (129.41g and 133.99g) respectively. SL was only significantly differed at age 4 with higher value in the tyre housing system (12.40mm). Higher SW value (16.91mm) was obtained at exactly a month for tyres housing system. There was no significant ($P>0.05$) differences between the housing types and the ST values.

Table 2 shows the least square means of effects of genotype and housing system on *Achatina Achatina* snail at two month of age. There were significant ($P < 0.05$) differences between the age, housing systems and the growth trait of the snail. BDW were significant ($P < 0.05$) at all age considered with housing systems, while plastic housing system higher (172.32) at 6 week of age while the tyre housing system superior than that of plastic housing type (149.92g, 175.67g and 175.12g) at age 5, 7 and 8 weeks respectively. SL were only significant and higher at age 6 for tyre housing system (12.43mm) while higher SW values (15.00mm, 15.43mm and 16.72mm) were obtained at age 6, 7 and 8 weeks for tyres housing system. There were no significant ($P > 0.05$) differences between the housing systems and ST values.

Table 3 revealed the least square means of effect of genotype and housing system on *Achatina achatina* at three month of age. There are significant ($P < 0.05$) differences between the age, housing systems and the growth trait of the snail. BDW were significant ($P < 0.05$) at all age considered for both housing systems while tyre housing system type shows higher values (178.01g, 182.03g and 187.29g) at age 9, 11 and 12 weeks respectively. SL value (11.63mm) was only higher for tyre housing type at 10 week of age while higher SW values (15.07mm, 15.89mm, 15.75mm and 15.98mm) were obtained at 9, 10, 11 and 12 weeks respectively for tyres housing system. No significant values were observed for ST for these ages.

DISCUSSION

The range and patterns of parameters in this study reveals for the first months for the genotype and housing systems for *Achatina achatina* snails regarded to the growth traits had been earlier reported by Ademolu *et al.*, (2006). These authors reveal the effect of stocking density on the growth of *Archachatina marginata*. Thus, the effects were superior in tyres housing system at the latter age which was due to the acclimatization to the environment. The increasing in the growth traits measured at the one month of age were in line with the report of Ademolu *et al.*, (2011) who reported a steady increases in the growth trait of two genotypes of snails. This also conformed to the study of Bobadoye *et al.*, (2010) for effect of domestication on the chemical composition of African giant snail (*Archachatina marginata* swaison)

The variation observed in the two month of age for growth trait of the snails in the housing systems were disagree with the findings of Ebenebe *et al.*, (2011) who reported lower values compared in cage system than the values obtained for this study. The

performance observed for tyres housing system on the growth trait of *Achatina achatina* snail over the plastic housing system at 3 month of age were agreed with the findings of Thompson and Cheney, (2008) while all the shell parameter values were in line with the findings of Abiona *et al.*, (2011) who reported a similar response for growth shell parameters for *Archachatina marginata* snails. The overall performance and pattern of growth traits parameters in this study were greatly favoured the tyre type of housing system which have to due to the fact that the snail performance were to be great in the dark environment which were observed in the tyre types.

CONCLUSION

The domestication of *Achatina achatina* snail should be encouraged in the both housing systems used (Tyre and plastic box) as the growth trait performance is now known and can thus be predicated the high growth trait observed in tyre housing system were due to exposure of ray of light which was limited compared to plastic box housing system. Based on the results obtained from the study the growth and survival of *Achatina achatina* responding well in tyre housing system. A prospective farmer can therefore rear *Achatina achatina* in tyre housing system for survival and faster growth.

References:

- Abiona, J.A., Omire, O., Osinowo, O.A and Abiola, M.O. (2011). Effect of vertebrate hormone on growth shell parameter and egg laying in giant African land snail (*Archachatina marginata*). *Proceeding 36th Conference of Nigerian Society for Animal Production (NSAP)*. University of Abuja, Nigeria. Pp.106-108.
- Aboho, S.Y, Anhwange, B.A. and Ber, G.A (2009). Screening of *Achatina Achatina* and *Pila ovata* for trace metals in Makurdi. Metropolis. *Pakistan Journal of Nutrition*. 8:1170-1171.
- Ademolu, K.O., Dedeke, G.A., Jayeola, O.A. and Idowu, A.B. (2011). Comparative Analysis of the Growth Performance and Haemolymph Biochemical Properties of Normal and Albino Giant Land Snail *Archatina marginata*. *Proceeding 36th Conference of Nigerian Society for Animal Production (NSAP)*. University of Abuja, Nigeria Pp 287-288.
- Ademolu, K.O., Idowu, A.B. and Mafiana, C.F. and Osinowo O.A. (2007). Performance proximate and mineral analysis of African Giant snail (*Archachatina marginata*) fed different Nitrogen sources. *Tropical Veterinarian* 25(4): 124-131.
- Amao, S.R., Ojedapo, L.O., Oyewumi, S.O., Sosina, A.O and Salami, T.B. (2011). Evaluation of

external growth traits on two strains of edible land snails in guinea savanna zone of Nigeria.

Proceeding 36th Conference Nigerian Society for Animal Production (NSAP). University Abuja,

Nigeria. Pp. 308-310.

Bobadoye, B.O., Bobadoye, O.A., Kehinde, A.S., Aluko, O.O., Nwachi A.C and Osaisi, C.S (2010). Effect of domestication on the chemical composition of African giant snail (*Archachatina marginata* swaison). *Proceeding of the 44th Annual Conference of Agricultural Society of Nigeria*. LAUTECH 2010. Pp 666 – 663

Ebenebe, C.I., Tagbo, E., Agunwa, E. and Ufele, A.N. (2011). Differences in Growth, Reproductive Performance and Organoleptic Properties of three Common Breeds of Snails (*Archachatina marginata*, *Achatina achatina*, *Achatina fulica*) Awka metropolis. *Proceeding 36th Conference, Nigerian society for animal Production (NSAP)*, Pp 327-329.

Ihekeronye, A.I and Ngoddy, P.O. (1985). Integrated food science and technology for the tropics Macmillan pubi Hong Kong 191pp.

Ibom, L.A , Okon, B., Ettah, H.E., and Ukpuho, I.E (2012). Effect of Genotype, Dietary protein and energy and reproductive and growth traits of parents and Hatchling of *Achatina achatina* (L) snails in Nigeria. *International Journals of Applied Science and Technology*, 2 (1) : 95-105.

Jenifer, M.P (1975). Observation on the reproduction, growth and longevity of a laboratory colony of *Archachatina* (*calachatina*) *marginata* (swainson). Subspecies ovum. *Proc. Malac Soc. Lond.* 41: 395-413.

Odunaiya, O and Akinyemi, A.A (2008). Performance of two snail species *Archachatina marginate* (s) and *Achatina achatina* (L) reared under the same management practices. *Nigerian Journal of Animal Production*. 35 (2): 224-229

SAS (2009). Statistical Analysis System. User's guide statistical Analysis Institute. (version 9.2) Inc. Carry North Caroline. USA.

Thompson, R and Cheney, S. (2008): Raising Snails. Special References Brief series no, SRB 96-05. The alternative farming systems information center. National Agricultural Library. Beltsville, Mary Land.

TABLE 1:- Least square means of effects of genotype and housing on *Achatina achatina* snail system at one month of age

<u>Age</u>	<u>Housing types</u>	<u>BDW</u>	<u>SL</u>	<u>SW</u>	<u>ST</u>
1	Tyres	100.09±18.40 ^b	10.93±1.09	15.21±0.64	2.43±0.58
	Plastics	123.09±9.75 ^a	11.16±1.60	15.85±0.86	2.18±0.14
2	Tyres	121.99±11.87 ^b	10.33±0.74	15.06±1.64	2.28±0.01
	Plastics	128.97±2.28 ^a	11.29±0.44	14.96±0.63	2.26±0.05
3	Tyres	129.41±13.42 ^a	10.18±0.87	15.84±0.81	2.36±0.03
	Plastics	125.09±21.97 ^b	10.69±1.26	14.68±1.00	2.34±0.01
4	Tyres	133.99±10.07 ^a	12.40±0.76 ^a	16.91±0.92 ^a	2.42±0.01
	Plastics	133.24±11.76 ^b	10.24±1.35 ^b	14.69±0.97 ^b	2.42±0.02

^{ab} Means along the same column at housing type with different superscript are significantly (P<0.05) different.

BDW= Body weight (g), SL= Shell length (mm), SW= Shell width (mm), ST= Shell Thickness (mm)

Table 2: Least square means of effects of genotype and housing types on *Achatina achatina* snail at two month of age.

Age(wk)	Housing types	BDW	SL	SW	ST
5	Tyres	149.92±7.55 ^a	11.35±0.76	15.03±0.78	2.46±0.01
	Plastics	144.88±13.82 ^b	10.61±0.49	14.52±0.95	2.51±0.01
6	Tyres	166.95±7.43 ^b	12.43±0.79 ^a	15.00±0.96 ^a	2.90±0.32
	Plastics	172.32±9.71 ^a	10.02±0.67 ^b	14.19±1.30 ^b	2.26±0.30
7	Tyres	175.67±9.59 ^a	11.23±0.81	15.43±0.98 ^a	2.91±0.09
	Plastics	166.24±12.28 ^b	10.87±0.37	14.86±0.82 ^b	2.84±0.02
8	Tyres	175.12±13.24 ^a	11.37±0.72	16.72±0.81 ^a	2.93±0.02
	Plastics	170.50±4.03 ^b	10.76±1.18	14.23±0.86 ^b	2.94±0.04

^{ab}Means along the same column at housing type with different superscript are significantly (P<0.05) different.

BDW= Body weight (g), SL= Shell length (mm), SW= Shell width (mm), ST= Shell Thickness (mm)

TABLE 3: Least square means of effect of genotype and housing types *Achatina achatina* at three months of age.

Age(wk)	Housing types	BDW	SL	SW	ST
9	Tyres	178.01±12.21 ^a	11.25±0.86	15.07±0.83 ^a	3.05±0.23
	Plastics	170.14±5.78 ^b	11.23±0.82	14.70±0.70 ^b	2.99±0.24
10.	Tyres	181.34±9.60	11.63±0.38 ^a	15.89±0.68 ^a	3.04±0.02
	Plastics	181.957±1.8	10.37±0.64 ^b	14.13±0.68 ^b	3.00±0.01
11	Tyres	182.03±5.53 ^a	12.15±0.33	15.75±0.72 ^a	3.10±0.06
	Plastics	173.62±12.35 ^b	10.64±1.18	13.99±0.83 ^b	3.04±0.02
12	Tyres	187.29±11.25 ^a	11.82±0.44	15.98±0.85 ^a	3.27±0.01
	Plastics	176.37±10.30 ^b	10.64±1.18	14.70±0.76 ^b	3.19±0.06

^{ab}Means along the same column at housing type with different superscript are significantly (P<0.05) different.

BDW= Body weight (g), SL= Shell length (mm), SW= Shell width (mm), ST= Shell Thickness (mm)

ASSESSMENT OF HEAVY METALS IN SOIL, LEACHATE AND UNDERGROUND WATER SAMPLES COLLECTED FROM THE VICINITY OF OLUSOSUN LANDFILL IN OJOTA, LAGOS, NIGERIA

H.O. Adedosu

Department of Science Laboratory Technology, Ladoke Akintola University of Technology,
Ogbomosho, Nigeria

G.O. Adewuyi, Ph.D

G.U. Adie Ph.D

Department of Chemistry, Faculty of Science, University of Ibadan, Ibadan, Nigeria

Abstract:

The safety of landfills situated within the heart of many developing cities of the world continues to be a source of worry within the scientific community. The extent of environmental pollution by Olusosun landfill in Ojota, Lagos was investigated by determining the concentrations of Fe, Zn, Cu, Pb and Cd in 4 pooled soil samples, 4 leachate samples collected from leachate collection points and 6 underground water (UGW) samples collected from the vicinity of the landfill. Environmentally available metals were acid extracted from soil, leachate and UGW samples and determined using atomic absorption spectrometer powered by solar software. Fe, Zn, Cu, Pb and Cd levels in soil ranged from 9961-11383, 827-1836, 597-1468, 361-457 and 10.1-28.1 mg/kg, respectively. These levels for all metals were far higher in varying degrees than background levels, suggesting serious anthropogenic influence from the landfill. The average concentrations of metals in both leachate and UGW samples followed the trend $Fe > Pb > Cu > Zn > Cd$ with concentrations of Pb, Cd and Fe in all UGW samples higher than permissible limits for drinking water set by Nigerian Industrial Standards (NIS) and WHO. Correlation for all metals between soil, leachate and UGW samples indicated a common origin for the metals. Pollution and Geoaccumulation indices revealed gross pollution of soil, leachate and UGW, therefore, an urgent attention to mitigate this menace is required by government and stakeholders.

Keywords: Heavy metals, Landfill, Soil, Water, Leachate, Solid waste

1. Introduction

The soil from antiquity has been the primary repository of all wastes (Evans, 1989). Millions of tons of toxic solid wastes from a variety of sources annually find their way unto dumpsites or so-called landfills. Pollutants from these wastes most often penetrate towards the lower soil horizons and subsequently polluting the ground water at varying degrees. The presence of heavy metals in the environment beyond acceptable limits calls for concern because of the deleterious effects of toxic metals on humans, animals and plants (Caylak and Tokar, 2012). Exposure to toxic heavy metals like Pb and Cd have been reported to cause blood and bone disorders, kidney damage, decreased mental capacity and neurological damage (Esakku, *et al.*, 2003; Yurtsever and Sengil, 2009).

Municipal and industrial solid wastes contain a variety of potentially significant chemical constituents and pathogenic organisms that could negatively affect public health, air, soil and groundwater qualities. These constituents include regulated hazardous priority pollutants such as heavy metals, poly aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and other persistent organic pollutants (POPs) (Ikem, *et al.*, 2002; Osibanjo, 2003; Anetor, *et al.*, 2008).

Disposal of solid wastes in major cities of Nigeria in the last few decades has posed major environmental and public health problems. This has become a source of worry for rural and urban planners in Lagos, the most populous city in Nigeria because of the explosive population growth and urbanization. Most open dumpsites/landfills which were sited at the outskirts, are now within the heart of the mega city. Olusosun landfill, the biggest landfill in Lagos is an example. It has been in existence since 1978 and receives at least 25,000 tons of assorted waste per annum (Lagos Waste Disposal Board, 2006). Few studies have been reported on the heavy metals content of leachate and soil within the vicinity of the landfill (Ogundiran and Afolabi, 2008; Oyelola and Babatunde, 2008). There is need to simultaneously and regularly assess the levels of some toxic heavy metals in soil, leachates and underground water samples from the vicinity of the landfill to know the effectiveness of the engineered clay lining in holding pollutants from leaching out and also to assist in tracing the source (s) of these metals through correlation studies.

The objectives of this study were to (1) to assess the levels of Pb, Cd, Zn, Cu and Fe in leachate, soil and underground water samples from the vicinity of Olusosun landfill (2) correlate the levels in soil, leachate and underground water samples to ascertain their source (3) relate these levels with previous studies and permissible limits.

2. Materials and Methods

2.1. Description of study area

Olusosun landfill is located in Ojota area of Lagos State, Nigeria on latitude $6^{\circ}. 20' N$ and longitude $3^{\circ}. 20' E$. It is a few kilometers from the Lagos lagoon and the Bight of Benin (Ogundiran and Afolabi, 2008). The landfill is surrounded by some factories, a gasoline filling station, a motor park, automobile repair workshop and road network (Fig.1) which are sources that can release heavy metals especially Pb in addition to the assorted wastes that are discharged at the landfill everyday (Oyelola and Babatunde, 2008). The Olusosun landfill is about 18 meters deep and covers an area of 42 hectares of land (LAWMA, 2004).

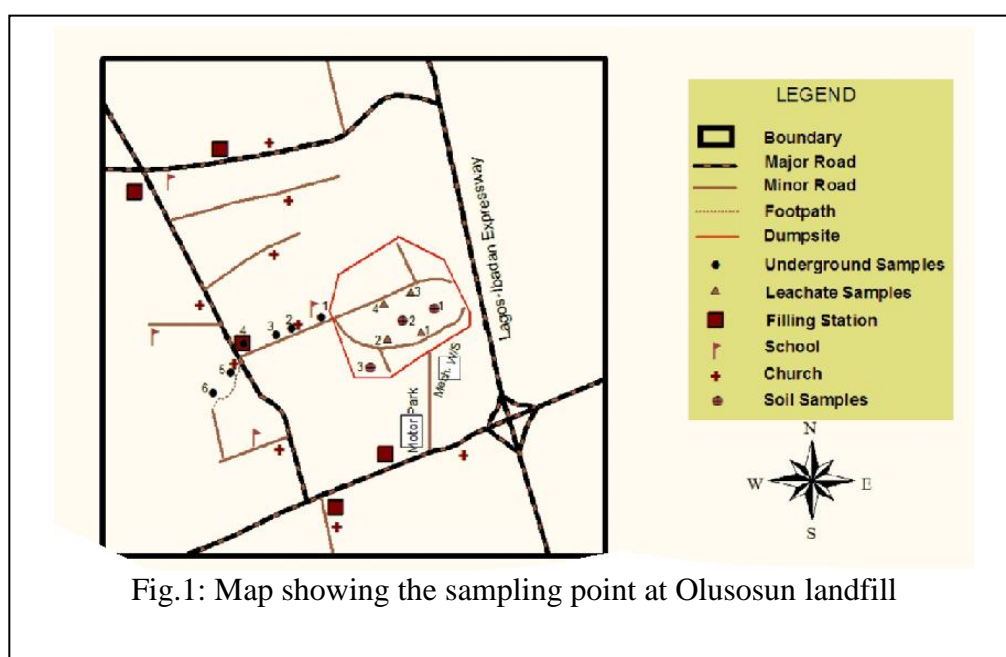


Fig.1: Map showing the sampling point at Olusosun landfill

2.2. Sample collection

About 1 kg each of four (4) composite soil samples at a depth of 0 -15cm from the soil surface within the landfill in such a manner that represented the entire landfill were collected. The sampling points are depicted in Fig. 1. These samples were kept in a clean airtight polythene bag immediately after sampling and transported to the laboratory for further analysis. A total of four (4) leachate samples were also collected with a clean plastic container from the leachate collection points within the landfill. Six (6) underground well water samples were also taken from residential areas within the vicinity of the landfill. All water samples were collected in an acid washed polyethylene bottles and samples for heavy metals determination were acidified with concentrated HNO_3 (1 mL/L of water sample) (Ogundiran and Afolabi, 2008) in order to keep the pH of the samples low, subsequently

preventing precipitation of the metals. The samples were further preserved in an ice chest before transported to the laboratory to suppress microbial activity.

2.3. Preparation and analysis of samples

The soil samples were air dried and sieved with a 0.5 mm mesh size sieve. The pH of soil samples was determined by adopting the method by International Institute of Tropical Agriculture, Nigeria (IITA, 1979). The method involved taking the pH of 1:1 soil: deionized water extracts with a calibrated pH meter. Environmentally available metals in soil samples were leached in the laboratory according to Miroslav and Vladimir (2005). This was carried out by accurately weighing 1g each of dried and sieved soil samples (≤ 0.5 mm) into a series of acid washed beakers covered with wash glass; 30 mL of 1:1 HNO₃: deionized water were added to each of the beakers containing the soil. They were each boiled gently on a hot plate in the hood while stirring intermittently until the volume reduced to about 5 mL. Exactly 10 mL of 1:1 HNO₃: deionized water were again added and the procedure was repeated. The second 5 mL for each case were diluted appropriately with standard flasks and preserved at 4 °C before for Atomic absorption spectrometric (AAS) analysis.

The pH of leachate and underground water samples was taken in situ. Also a volume of 100 mL each of both leachate and underground water samples were concentrated with some drops of concentrated HNO₃ to less than 50 mL and made up to mark in 50 mL standard flask for each sample. The concentrated extracts were kept at 4 °C until AAS analysis. Blanks for all analyses were prepared and carried through the same experimental procedures as the samples. They were analyzed and subtracted from the results of samples. This was done to check reagent impurities and other interferences.

All extracts from soil, leachate and underground water samples were analyzed for Zn, Cu, Pb, Cd and Fe using atomic absorption spectrometer (Unicam 929, London) powered by solar software.

2.4. Risk assessment indices

Two different risk assessment indices were used to assess the extent of pollution of soil and water within the vicinity of the landfill. The pollution index (Lee, *et al.*, 1998) and geoaccumulation index (Muller, 1998) were adopted. Pollution index (PI) assesses pollution level by considering the joint effect of all the polluting metals in soil or water. The PI is obtained by calculating the ratios of the average metal concentration with the permissible/ tolerable level.

It is given by:

$$\text{Pollution index (PI)} = \frac{1}{n} \left(\frac{M_1}{TL_1} + \frac{M_2}{TL_2} + \dots \frac{M_n}{TL_n} \right) \quad (1)$$

Where M_1, M_2, \dots, M_n are the average concentrations of the polluting metals; TL_1, TL_2, \dots, TL_n are the permissible concentrations for each polluting metal; n is the total number of metals.

The geoaccumulation index (I_{geo}) was adopted in this study as another type of index to determine the extent of pollution of soil within the landfill under study and to compare with the pollution index. The geoaccumulation index is a tool that provides the extent of pollution of soil with regards to the background concentrations of the polluting metals. The content accepted as background is multiplied in each case by a factor 1.5 in order to account for natural fluctuations of a given metal in the environment and as well as small anthropogenic influences (Loska, *et al.*, 2003). Geoaccumulation index is given mathematically as:

$$\begin{aligned} \text{Geoaccumulation index (I}_{geo}\text{)} \\ = \log_2 \left[\frac{C_n}{1.5 \times B_n} \right] \end{aligned} \quad (2)$$

Where C_n = Average concentration of metal in the soil, B_n = Background concentration of the metal

The geoaccumulation index consists of six (6) descriptive classes as shown in Table 4. The correlation studies for all the metals under study for soil, leachates and underground water were carried out using Origin 8 software.

3. Results and Discussion

3.1. Chemical analysis of soil samples

The pH and concentrations of Zn, Cu, Pb, Cd and Fe in soil collected from the vicinity of Olusosun landfill are presented in Table 1. The pH ranged from 7.12 -7.80 for all the landfill soil samples while average pH of the background soil samples was 6.34 ± 0.02 . The pH of soil from landfill and background is comparable with previous study on the same area (Oyelola and Babatunde, 2008). It has been reported that most metals in the pH range 6.0-9.0 are not always in the free form, hence not likely to be available (Porteus, 1985). The pH of all the soil samples investigated are within this range. Therefore, the concentrations of the metals investigated in this study possibly may have leached into the soil when favourable conditions like acidic precipitation prevailed on the landfill.

The average concentrations of heavy metals studied in the soil followed the order Fe >> Zn > Cu > Pb > Cd. The concentrations of these metals compared with the background were higher by more than tenfold for all metals (Table 1). This suggests very serious anthropogenic influence which is not unconnected with the landfill which receives all kinds of assorted wastes ranging from domestic, commercial and industrial wastes (Aboyade, 2004). The concentrations for all the heavy metals studied were higher than previous study on this site a couple of years back (Ogundiran and Afolabi, 2008). This may have been as a result of redistribution of metals from the weathered wastes as a result of continuous acidic atmospheric precipitation which favours the release of bound or complexed metals.

Table 1: Concentrations of Heavy metals in soil, leachate and underground water samples within the landfill

S/N	Sample ID	pH	Zn	Cu	Pb	Cd	Fe
1	SS1	7.66±0.01	1836±139	599±37	376±116	15.5±4.9	11383±13
2	SS2	7.71±0.03	1447±129	1468±230	457±241	10.1±9.3	10971±467
3	SS3	7.12±0.02	1407±238	597±180	432±59	15.3±5.8	11378±694
4	SS4	7.80±0.01	827±75	648±116	361±45	28.1±4.7	9961± 204
5	Background	6.34±0.02	30.3±0.2	9.30±0.10	15.1±0.2	0.26±0.03	16.4±0.5
EU limit values		pH > 7	200	100	100	1.5	NA
1	LS1	7.82±0.02	0.29±0.01	0.19±0.0	0.38±0.0	0.04±0.01	3.09±0.23
2	LS2	7.65±0.03	0.20±0.0	0.25±0.0	0.34±0.1	0.04±0.02	3.44±0.36
3	LS3	7.84±0.01	0.62±0.7	0.48±0.2	0.30±0.3	0.03±0.00	9.66±6.14
4	LS4	7.25±0.05	0.22±0.2	0.34±0.0	0.33±0.2	0.06±0.07	9.85±7.28
1	UG1	6.80±0.02	0.21±0.1	0.08±0.0	0.55±0.7	0.06±0.05	6.44±4.33

			2	7	4		
2	UG2	7.01±0.03	0.27±0.0 1	0.01±0.0 0	0.36±0.2 6	0.02±0.03	2.32±0.01
3	UG3	7.12±0.05	0.19±0.0 1	0.03±0.0 1	0.78±0.0 8	0.09±0.02	16.4±2.76
4	UG4	6.85±0.04	0.18±0.0 1	0.05±0.0 1	0.93±0.3 5	0.06±0.04	2.07±0.12
5	UG5	7.02±0.03	0.19±0.0 0	0.18±0.0 4	0.84±0.1 6	0.04±0.02	2.13±0.21
6	UG6	7.50±0.05	0.16±0.0 4	0.09±0.0 0	0.64±0.1 3	0.05±0.01	2.32±0.12
Nigerian Industrial Standards		6.5 - 8.5	3.0	1.00	0.01	0.003	0.3
World Health Organization		6.5 - 8.5	3.0	1.00	0.05	0.01	0.3

NA – Not Available, n = 2

Higher levels of metals could also be from fresh deposition of high metals content wastes on the landfill. These metals get into the soil and subsequently underground water. A survey of heavy metals status in a similar landfill soil in Cameroon showed Pb level comparable with present study (Adjia and Fezeu, 2008). A study on heavy metals content on the fine grain fraction of municipal solid waste has also been carried out by Esakku *et al.*, (2003). The report showed lower concentrations for all the metals considered in this study.

Some of the factors that determine the heavy metals content in landfill soil include, the type of wastes that are dumped, the ability to sufficiently stabilize the pollutants in wastes to tolerable limits before dumping, and the life span of the wastes within the landfill. The low content of metals in Esakku *et al.*'s report may have been that the wastes dumped were segregated or stabilized before dumping.

3.2. Risk assessment of soil at landfill

The results of two indices used to predict the pollution status of the landfill used in this study are presented in Table 2. The pollution index (PI) for soil in this study took into account the combined polluting contributions of Zn, Cu, Pb and Cd. Iron (Fe) was not used in the computation because its EU permissible limit in soil was not available (EEC Directive, 2000). The geoaccumulation index compared the levels of each individual polluting metal

with their background concentrations. The results of the two indices revealed gross pollution of all soil samples collected. By the I_{geo} rating, at least 75% of all the soil samples showed strong to very strong pollution statuses for Zn, Cu and Cd. Lead (Pb) showed 75% for all soil samples within the range of moderately to strongly polluted. All the soil samples showed far higher concentrations for all metals investigated compared to EU permissible level in soil (EEC Directive, 2000).

Table 2: Pollution and Geoaccumulation indices for Olusosun landfill soil

Sample ID	Pollution Index(PI)	Geoaccumulation (I_{geo})			
		Zn	Cu	Pb	Cd
SS1	7.31	1.89	1.91	1.49	1.88
SS2	8.30	1.79	2.22	1.59	1.70
SS3	6.88	1.78	1.91	1.56	1.88
SS4	8.24	1.53	1.94	1.47	2.10

$I_{geo} : < 0 =$ practically unpolluted,
 $> 0 - 1 =$ uncontaminated – moderate
 $> 1 - 2 =$ moderate
 $> 2 - 3 =$ moderate – strong
 $> 3 - 4 =$ strong
 $> 4 - 5 =$ strong –very strong
 $> 5 =$ very strong
 Interpretation: $PI > 1 =$ polluted, $PI < 1 =$ unpolluted

3.3. Correlation studies

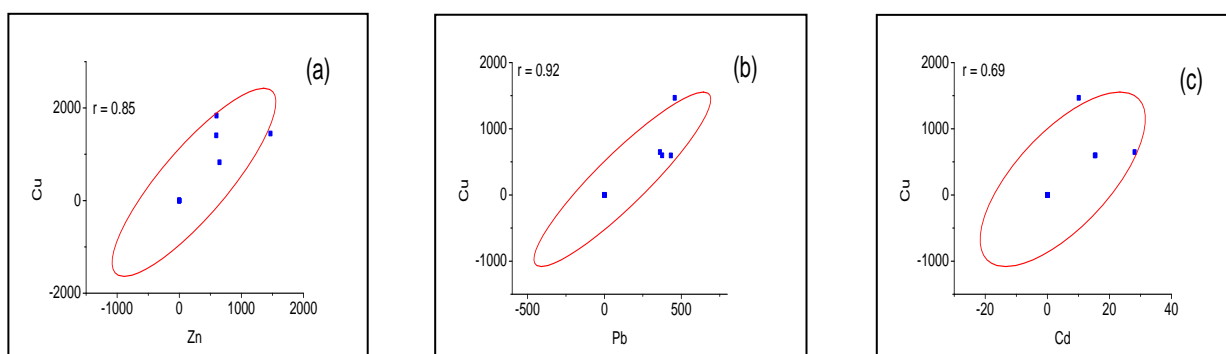
The correlation for all the metals in soil, leachate and underground water samples is shown in Fig. 2 (a-j). The correlation for ‘very strong’ category showed the order $Pb/Fe > Zn/Fe > Zn/Pb > Cu/Pb$. The category for ‘strong’ showed the order $Cd/Fe > Cu/Fe > Pb/Cd > Cu/Zn$ while for ‘moderate’ category, the order $Zn/Cd > Cu/Cd$ was depicted. The correlation between these metals suggests that most of them have a common source. This assertion may be true because most industrial wastes dumped on this site are made from various alloys of these metals. Literature has reported combination of many of the metals either in

electroplating processes or additions to improve the properties of previous alloys (Mathiessen and Von Bose, 1962; Sorahan, *et al.*, 1995; Sunthankar, 1991).

3.4. Chemical analysis of leachate and underground water

The results of leachates and underground water analyses from the vicinity of Olusosun landfill are shown in Table 1. The pH of the leachate samples ranged from 7.25 – 7.82 while the pH for the underground water samples ranged from 6.80 – 7.50. The pH range for underground water in this study was a little higher (6.80 – 7.50) compared with underground water from four major urban cities in south-western Nigeria which include Ekpoma (6.00 ± 0.24), Lagos (5.68 ± 0.69), Warri (5.19 ± 0.20) and Benin City (5.56 ± 0.15) (Agatemor and Agatemor, 2010). The increase in pH of underground water samples within the vicinity of Olusosun landfill may have possibly come from basic industrial solvents that are dumped and probably NH_4^+ containing compounds, which impart basic pH on receiving water. The pH for both the leachate and underground water samples complied with the Nigerian Industrial Standard for drinking water (NIS, 2007) and World Health Organization (WHO, 2004) permissible limit of 6.5 – 8.5.

Metals concentrations for all the leachate samples ranged from 0.20 – 0.62 mg/L for Zn, 0.19 – 0.48 mg/L for Cu, 0.30 – 0.38 mg/L for Pb, 0.03 – 0.06 mg/L for Cd and 3.09 – 9.85 for Fe. Underground water samples showed 0.16 – 0.27 mg/L for Zn, 0.01 – 0.18 mg/L for Cu, 0.36 – 0.93 mg/L for Pb, 0.02 – 0.09 mg/L for Cd and 2.07 – 16.4 for Fe. The levels of Zn and Cu in all leachate and underground samples were lower than the permissible limits set by NIS and WHO despite the fact that they were high in soil while 100% of all leachate and underground water samples for Pb, Cd and Fe showed higher concentrations compared with the limits of NIS and WHO. This trend may not be unconnected with the mobility of these metals in soil. Mobility of metals in soil is a complex phenomenon, but could be affected by factors like the chemical forms of the metals in the soil, the chemical properties of



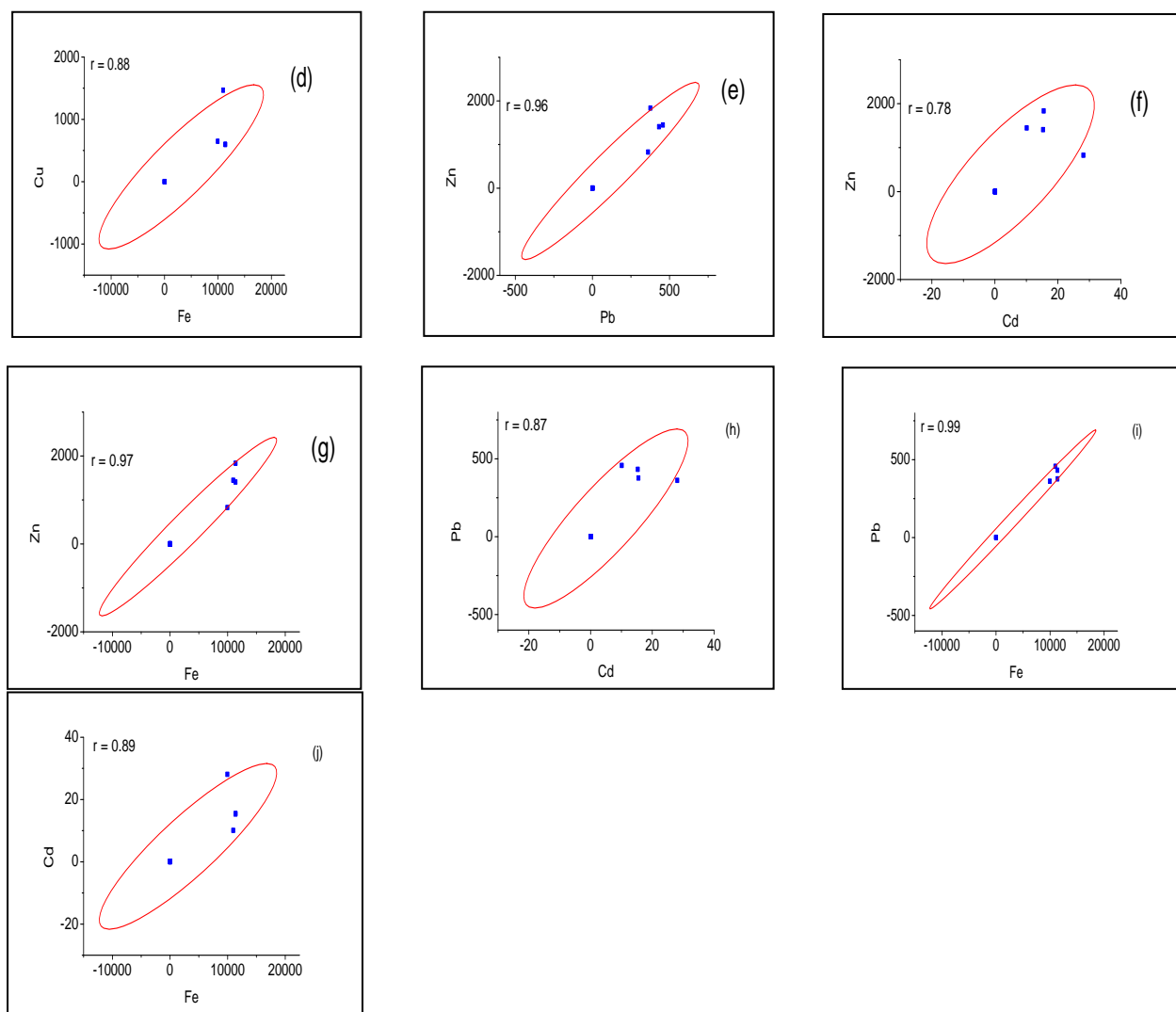


Figure 2. Correlation between (a) Cu/Zn (b) Cu/Pb (c) Zn/Cd
 (d) Cu/Fe (e) Zn/Pb (f) Zn/Cd
 (g) Zn/Fe (h) Pb/Cd (i) Pb/Fe
 (j) Cd/Fe

Correlation rating: > 0.91 = very strong, $0.90 - 0.81$ = strong, $0.80 - 0.31$ = moderate, < 0.30 = weak

the soil, the soil pH, organic carbon content, metal concentration and ionic radii of the metals (Altaher, 2001).

3.5. Risk assessment of underground water within the landfill vicinity

The results of the Pollution Index for the leachate and underground water samples is shown in Table 3. The pollution index interpretation according to Nigerian Industrial Standard

and WHO permissible limits showed gross pollution at varying degrees among the sampling points for both leachate and underground water samples. This demonstrates that the underground water around the vicinity of Olusosun landfill is highly polluted with heavy metals and unsafe for drinking and some other domestic and industrial chores.

Table 3: Pollution Index (PI) for Underground water within the vicinity of Olusosun landfill

S/N	Sample ID	Based on NIS	Based on WHO standards
1	UG1	19.3	7.73
2	UG2	10.1	3.41
3	UG3	40.7	15.9
4	UG4	24.0	6.32
5	UG5	20.9	5.63
6	UG6	17.7	5.13

Interpretation: $PI > 1$ = polluted, $PI < 1$ = unpolluted

4. Conclusion

Assessment of the concentrations of Fe, Zn, Cu, Pb and Cd in soil, leachate and underground water (UGW) samples within the vicinity of Olusosun landfill in Ojota, Lagos, Nigeria was carried out. The concentrations of all metals for all soil samples collected from the vicinity of the landfill were far higher than those at background (collected from reserve area within the same geographical area) suggesting serious anthropogenic influence. The concentrations of Pb, Cd and Fe in underground water samples were higher than permissible limits for drinking water set by Nigerian Industrial Standards and WHO. Correlation studies between soil, leachate and UGW samples revealed common origin of all metals. The Pollution and Geoaccumulation indices suggested gross pollution of soil, leachate and UGW. The results strongly suggest leakage of the leachate from the landfill to surrounding environment, which would pose great danger to human health living in the surrounding environment. The dumping of wastes especially toxic waste on this landfill should be highly regulated and possible urgent fortification/ or evacuation of the landfill needs to be done. Awareness of the pollution statuses of soil, surface and ground water within the vicinity of the landfill needs to be urgently created especially among people living in the surrounding

environment to avert health related problems from drinking water and consuming plants from this vicinity.

References:

Aboyade, A.(2004) *The Potential for Climate Change Mitigation in the Nigerian Solid Waste Disposal Sector: A case study from Lagos*, a thesis presented in partial fulfillment of the requirements of the Lund University International Masters Programme in Environmental Science, Lund University, Sweden, 47p.

Adjia, R., Fezeu, W.M.L., Tchatchueng, J.B., Sorho, S., Echevarria, G., Ngassoum, M.B. (2008) Long term effect of municipal solid waste amendment on soil heavy metal content of sites used for periurban agriculture in Ngaoundere, Cameroon Afr. J. Environ. Sci. Tech., 2(12): 412-421.

Agatemor, C.; Agatemor, U.M (2010) Physico chemical characteristics of well waters in four urban centres in Southern Nigeria, Environmentalist, 30(4):333-339(7).

Altaher, H.M. (2001) *Factors affecting mobility of copper in soil-water matrices*, a Ph.D dissertation in Civil and Environmental Engineering Department, Virginia Polytechnic Institute and State University, Blacksburg, Virginia; **2001**, 103p.

Anetor, J. I., Anetor, G.O., Iyanda, A.A., Adeniyi, F.A.A. (2008) Environmental chemicals and human neurotoxicity:magnitude, prognosis and markers, Afr J Biomed Res, 11:1-12.

Caylak, E., Tokar, M. (2012) Metallic and microbial contaminants in drinking water of Cankiri, Turkey, E-Journal of Chemistry, 9(2): 608 - 614.

EEE Directive (2000) Directive 86/278/EEC. Third Draft Working Document (Env.E.3/LM), Brussels, 10.

Esakku, S., Palanivelu, K., Kurian, J. (2003) *Assessment of Heavy Metals in a Municipal Solid Waste Dumpsite*, Workshop on Sustainable Landfill Management, Chennai, India, 3–5 December, p 139-145.

Evans, L.J (1989) Chemistry of metal retention by soils, Environ. Sci. Technol. 23(9):1046-1056.

Ikem, A.O.; Osibanjo, O.; Scridler, O.; Sobande, A. (2002) Evaluation of ground water quality characteristics near two waste sites in Ibadan and Lagos, Nigeria, Waste Air Soil pollut,140: 307-333.

International Institute of Tropical Agriculture (IITA) (1979) *Selected methods for soil and plant analysis*, Manual series No.1, Nigeria.

Lagos State Waste Management Authority (LAWMA) (2004) *Landfill gates records*, Ijora head office, Ijora, Lagos, Nigeria.

Lagos Waste Disposal Board (2006) *Organization development and waste management system project*, Lagos Waste Disposal Board, Assessment report, 1: 1 – 5.

Lee, J.; Chon, H.; Kim, K. (1998) Migration and dispersion of trace elements in the rock-soil-plant system in areas underlain by black shales and slates of the Okchon zone, Korea, J. Geochem Explor, 65(1): 61 - 78.

Loska, K.; Wiechula, D.; Barska, B.; Cebula, E., Chojnecka, A. (2003) Assessment of arsenic enrichment of cultivated soil in Southern Poland, Pol. J Environ Stud., 12(2): 187 - 192.

Matthiessen, A.; von Bose, M. (1962) *On the lead-zinc and bismuth-zinc alloys*, proceedings of the Royal Society of London. p 430.

Miroslav, R.; Vladimir, N.B. (2005) *Practical Environmental Analysis*, 2nd edn., Royal Society of Chemistry publishers, Cambridge, UK.

Muller, G. (1969) Index of geoaccumulation in sediments of the Rhine river, Geojournal, 2, 108 - 118.

Nigerian Industrial Standards (NIS). (2007) *Nigerian Standard for Drinking Water Quality*, Approved by Standard Organization of Nigeria, NIS 554, ICS 30.060.20.

Ogundiran, O.O., Afolabi, T.A. (2008) Assessment of the physicochemical parameters and heavy metals toxicity of leachates from municipal solid waste open dumpsite, Int. J. Environ. Sci. Tech., 5(2): 243 -250.

Osibanjo, O. (2003) *Organochlorines in Nigeria and Africa, The handbook of Environmental Chemistry*, Chapter 12, Vol.3, part O, ed. by Fiedler, Springer-Verlag, Berlin, p 322-326.

Oyelola, O.T.; Babatunde, A.I. (2008) Effect of municipal solid waste on the levels of heavy metals in Olusosun dumpsite, Lagos State, Nigeria, Int. Jor. P. App. Scs, 2(1): 17-21.

Porteus, A. (1985) *Hazardous Waste Management Handbook*, Butterworth and Co Publishers, UK. p146-166.

Sorahan, T., Lister, A., Gilthorpe, M.S., Harrington, J.M. (1998) Mortality and cancer incidence in Swedish battery workers exposed to cadmium and nickel, Occup. Environ. Med., 55(11), 755-759.

Sunthakar, M. (1991) *Environmentally safer zinc-cadmium alloy dry plating as a substitute for cadmium electroplating*, US EPA small business innovation research, pollution prevention/sustainable development, USA .

World Health Organization (WHO) (2004) *Guidelines for Drinking Water Quality*, 3rd Edn. Vol. 1 Recommendation, Geneva. P 515.

Yurtsever, M.; Sengil, I.A. (2009) Biosorption of Pb (II) ions by modified quebracho tanin resin, J Hazard Mater, 163(1): 58 – 64.