Online ISSN : 2249-4626
Print ISSN : 0975-5896
DOI : 10.17406/GJSFR

Global Journal

of Science Frontier Research: H

Environment & Earth Science

Communnity in Niger Delta

Alterations of Ionic Regulations

Highlights

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Contamination Spatial Distribution

Discovering Thoughts, Inventing Future

VOLUME 18 ISSUE 2 VERSION 1.0

Global Journal of Science Frontier Research: H
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Volume 18 Issue 2 (Ver. 1.0)

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Contents of the Issue

Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 18 Issue 2 Version 1.0 Year 2018
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

A Proposal for an Accelerated Evaporation Treatment System for Alumina Industrial Soda Ash Wastes and Feasibility of the use Soda Ash and Sodium Percarbonate for CO_2 Capture and Phenol Oxidation in Water

By Pérez-Cisneros, M.A, Pernía, L, Barrios, M, Vasquez, P, Perozo, H & Quilice, A

Abstract- Increasing interest in CO_2 sequestration is linked to the need for cost-effective alternatives of In Situ Combustion Pilot Projects (ISCPP) which is an ongoing field testing effort aimed at assessing its efficacy in increasing the recovery factor of heavy oil reservoirs from Hugo Chávez Orinoco Oil Belt (Venezuela). A proposal is presented for an accelerated evaporation system for volume decreasing of caustic liquor in alumina industrial artificial lagoons, obtaining sodium carbonate (soda ash) and its later utilization in the synthesis of sodium percarbonate ($Na_2CO_3 \bullet 1.5H_2O_2$) (SPC). The caustic liquor evaporation rate was of 0.146 mm/h using only radiation in the evaporation system. When only artificial wind was used the evaporation rate was 0 .196 mm/h, which means an increase of 34% in the evaporation rate.

Keywords: by-products (caustic liquor "soda ash" and red mud); bayer process; in situ combustion; mineral carbonation; sodium percarbonate (SPC).

GJSFR-H Classification: FOR Code: 300899

Strictly as per the compliance and regulations of:

A Proposal for an Accelerated Evaporation Treatment System for Alumina Industrial Soda Ash Wastes and Feasibility of the use Soda Ash and Sodium Percarbonate for CO_2 Capture and Phenol Oxidation in Water

Pérez-Cisneros, M.A[α], Pernía, L[σ], Barrios, M[ρ], Vasquez, P[ω], Perozo, H[¥] & Quilice, A[§]

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Keywords: by-products (caustic liquor "soda ash" and red mud); bayer process; in situ combustion; mineral carbonation; sodium percarbonate (SPC).

I. Introduction

The Bayer process, developed by Karl Josef Bayer 130 years ago, is a widely applied commercial technology to obtain calcined alumina from bauxite ore (Habashi, 2004; Habashi, 2016). For alumina extraction, bauxite is crushed and subjected to alkaline digestion with a caustic soda (NaOH) solution at high temperature. Impurities generated from the extraction are separated in the form of a solid insoluble earthy brick red, called red mud; and a caustic liquor (soda ash about 13%) from spent alkaline solutions (Pérez et al., 2010). The process continues to obtain anhydrous alumina from the calcinations of aluminum trihydroxide as a final commercial product, leaving as environmental liabilities red mud and spent alkaline solutions (pH 10-13). Red mud is highly alkaline, corrosive and contains several oxides and salts, which are toxic to biota. Due to its particle-size distribution from fine powder to granular material sediment is highly mobile in aqueous environments and hazardous to human health, causing respiratory, cardiovascular and eczema-rosacea skin problems (Nagy, Szabó, and Vass 2013).

In Situ Combustion Pilot Project (ISCPP) is an enhanced oil recovery process which consists on burning a portion of the reservoir contained oil in order to generate thermal energy that allows an increased displacement and production of the rest oil.

The crude oil is mobilized by such thermal 'brooming' sweep/scavenge and pushed towards the drainage points located hundreds of meters from the air injection well (Figure 1) (Perozo et al., 2011). The ISCPP generates significant emissions of carbon dioxide (CO_2) contributing to global warming and harzarduos hydrogen sulfide gas (H_2S), during its operation (Perozo et al., 2011).

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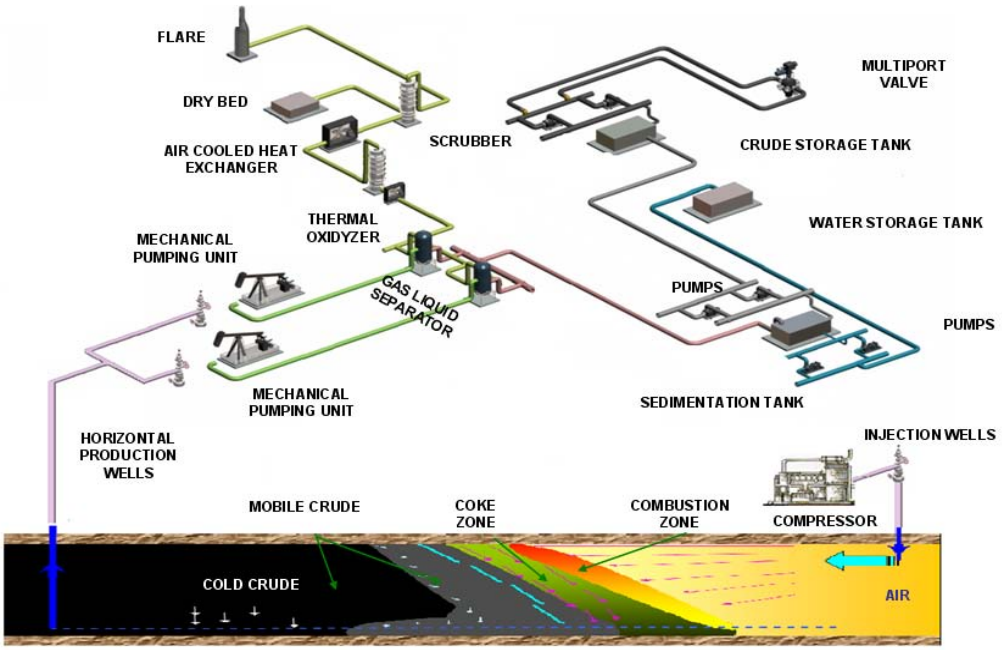

Figure 1: In situ combustion and surface facilities block diagram (Perozo et al., 2011)

Due to venezuelan environmental regulations, it is not allowed to release to the atmosphere this kind of gases. This causes the need to apply processes to treat the gas stream at the surface for the removal of these contaminants in order to satisfy environmental standards (Pérez et al., 2010; Perozo et al., 2011).

Present work shows results of laboratory scale studies using an accelerated evaporation system (intensive) of caustic liquor (waste) in alumina industrial artificial lagoons, to obtain sodium carbonate and its later utilization in the synthesis of sodium percarbonate (SPC); as an environmental cost-effective solution that could allow to minimize hazards and environmental liabilities by reducing alkalinity and volume of lagoons. Feasibility of the use sodium percarbonate from the reaction between Na_2CO_3 and hydrogen peroxide (H_2O_2), with a performance similar to advanced oxidation process for the treatment of waters contaminated with phenols (Bonenfant 2008, AOP's for Effluent Treatment 2009).

II. Materials and Methods

a) Caustic liquor samples used in the experiments

Two caustic liquor samples, CLL2 and CLL3 as well as a sample of red mud, were evaluated. Caustic liquor samples were analyzed for pH, NaOH concentration, Na_2CO_3 concentration and total alkalinity as $CaCO_3$ (Table 1). Caustic liquor was analyzed for determine pH, mineral phases via X-ray diffraction (X'Pert Pro equipment, mark PANAlytical) and thermogravimetric analysis (TG, mark SETARAM, KGP technologies) (Pérez et al., 2010). Evaporation rate was evaluated, starting from 4,500mL of caustic liquor samples in three experiments: one with CLL2, second with CLL3 and a third with both CLL2 and CLL3 caustic liquor samples.

Table 1: Caustic liquor average composition in samples

Composition	unit	L2	L3
NaOH	mg/L	6,157	3,870
Na_2CO_3	mg/L	132,900	75,800
NaCl	mg/L	12,380	12,110

b) Accelerated (intensive) evaporation system of caustic liquor to obtain sodium carbonate

Components

i. *Tray and evaporation panel*

A stainless steel tray (56.0 cm long by 46.0 cm wide and 4.0 cm deep) was used as caustic liquor reservoir. Some steel barriers were incorporated to increase the liquor retention time in order to help incidence of simulated meteorological variables (wind and radiation). Likewise, evaporation panel was made of stainless steel in a hexagonal grid form (honeycomb) to increase the surface area and therefore liquids retention in its weft. Dimensions of each individual panel were: 21.5 cm wide, 28.0 cm long and 1.3 cm deep, giving a total approximately 57.0 m^2 surface area.

ii. *Sprinkler and peristaltic pump*

The sprinkler used to recirculate caustic liquor from the reservoir tank and the tray to the evaporation

pads was Monarch F-80 type. The sprinkler transforms a pressurized liquid fluid into spray, which is called a water curtain, whose shape will depend on the nozzle of the sprinkler and the pressure capacity of the outlet. A peristaltic pump with a regulated flow rate of 120 mL/min was used. Masterflex L/S. Coputerized Prive. Model 77250-62. Hoses: Masterflex 6409-24 TYGON®. Mfg by Norton.

iii. *Wind speed meter*

Therno - Anemomether: EXTECH Instruments.

iv. *Radiation meter*

Radiometer Light Meter. LI-COR (Quantum radiometer/photometer). Model LI-189.

v. *Relative humidity/temperature meter and devices to simulate meteorological factors*

Brand Hanna, model HT-9218. A 100W/120V incandescent lamp was used for the simulation of radiation, and a two-speed, 120V, 6 inches fan for wind.

vi. *Evaporation capacity*

Three experiments were carried out in which different meteorological factors were simulated. The Penman equation (Equations 1, 2 and 3) describes evaporation (E) from an open water surface. Penman's equation requires daily mean temperature, wind speed, air pressure and solar radiation to predict evaporation rate.

$$Eto = k.\ [R_n + (1\text{-}W)f(u).\ (e^0 - e)] \quad \text{(Eq.1)}$$

$$\kappa = 10/\lambda_v \quad \text{(Eq.2)}$$

$$\lambda_v = (595\text{-}t_m) * 0{,}51 \quad \text{(Eq.3)}$$

$$(1\text{-}W) = \gamma/(\Delta+\gamma) \quad \text{(Eq.4)}$$

$$\Delta = 33.8693\ [0.05904\ (0.0078t_m + 0.8072)^7 - 0.0000342] \quad \text{(Eq.5)}$$

$$\gamma = (C_p.P)/(0.62198.\lambda_v) \quad \text{(Eq.6)}$$

Where

Et_o = reference evaporation rate (mm/day); k = adjustment factor; R_n = net radiation (mm/day); (1-W) = radiation weighting factor; $f(u)$ = wind function; e^o = saturated vapor pressure in air (mbar); e = vapor pressure of free flowing air (mbar), λ_v = heat vaporization of water at mean temperature; t_m = annual mean temperature; Δ = slope of the steam saturation curve; γ = psychrometric constant; C_p = specific heat capacity; P = atmospheric pressure.

Experiment 1: Control, no radiation, no winds. *Experiment 2:* Conditions of a cloudy day and nights. *Experiment 3:* Conditions of a clear sunny day. Images of experiments are shown in Figure 2.

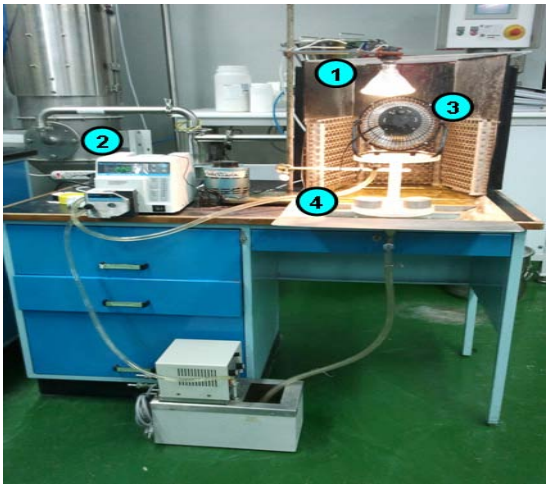

Figure 2: Experimental assembly: 1) lamp; 2) peristaltic pump; 3) fan; 4) tray and evaporation panel

Table 2 shows temperature and wind conditions applied in each experiment, positive (+) and negative (-) symbols respectively indicate whether or not the corresponding environmental condition were applied.

Table 2: Experimental design of wind and radiation application

Experiment	Radiation	Wind
1	-	-
2	-	+
3	+	+

Each experiment was monitored at two-hour intervals when it was determined:relative humidity, temperature and caustic liquor volume.

c) Saturated caustic liquor sample with CO_2 (g)

Impure salts of sodium carbonate were obtained after saturation of caustic liquor with CO_2 and water evaporation

d) Feasibility of SPC synthesis as alternative for final disposition caustic liquor

SPC is an additional compound produced in the reaction of sodium carbonate with hydrogen peroxide, which can be done via dry, spray granulation,

crystallization and electrochemical processes (Gerd et al., 1975; Ruiz et al., 2009). During the crystallization process, sodium carbonate is formed by reacting solutions of sodium carbonate and hydrogen peroxide in a crystallizer, possibly in combination with salting out additives (HERA, 2008). SPC is a moderately strong oxidizer, widely used in detergent formulations and cleaning products. SPC was prepared by mixing impure sodium carbonate (25 g) and hydrogen peroxide at 30 wt/vol % (34 mL). After 20 min, 20 mL of denaturalized ethanol was added. The SPC adduct formed as white granule-shaped crystals and were dried for 4 hours at room temperature (Equation 7).

$$Na_2CO_3 + 1{,}5\ H_2O_2 = Na_2CO_3 \bullet 1.5H_2O_2 \qquad \text{(Eq. 7)}$$

Sodium percarbonate was evaluated in base to the availability of active oxygen and its oxidation capacity of phenol in aqueous solutions (Vesper et al., 1994; Kabalka et al., 1990).

$$Na_2CO_3 \bullet 1.5H_2O_2 = Na_2CO_3 + 1{,}5\ H_2O + 1{,}5/2\ O_2 + \text{heat} \qquad \text{(Eq. 8)}$$

III. Results and Discussion

a) Experiment 1

Results of evaporation rate in Experiment 1 (control experiment), in which no meteorological factors were simulated (Table 2), have been taken as reference for estimation of evaporation rate increase to compare with following experiments. Figure 3, shows average evaporation rate for experimental and theoretical results and accumulation of the caustic liquor evaporation as a function of time. Relative humidity is inversely related to temperature. With increase of temperature, saturation pressure (maximum pressure before condensation occurs) increases resulting in a decrease of relative humidity (Rolle 2006). Observed maximums in saturation pressure are caused by both properties and depends on the time of the day at which each mean is measured; in the morning lower temperatures and therefore higher relative humidity values were registered. This trend varied with the time of the day. The variation of the evaporation rates among different performed assays is caused by aspersion loses generated during the impact of the aspersed liquor and the evaporation panel, which in turn caused a significant difference between experimental and theoretical results. The latter do not cover the observed loses (Frost 1955). The gradual evaporation of the water contained in the caustic liquor caused an increase in the carbonate concentration. For that reason, the liquid turned denser and more difficult to asperse. With an increase in the aspersion there is also an increase in the surface area of the panel that is covered causing a thinner liquid film which favors the action of the meteorological factors. This phenomenon was also observed in Experiments 2 and 3.

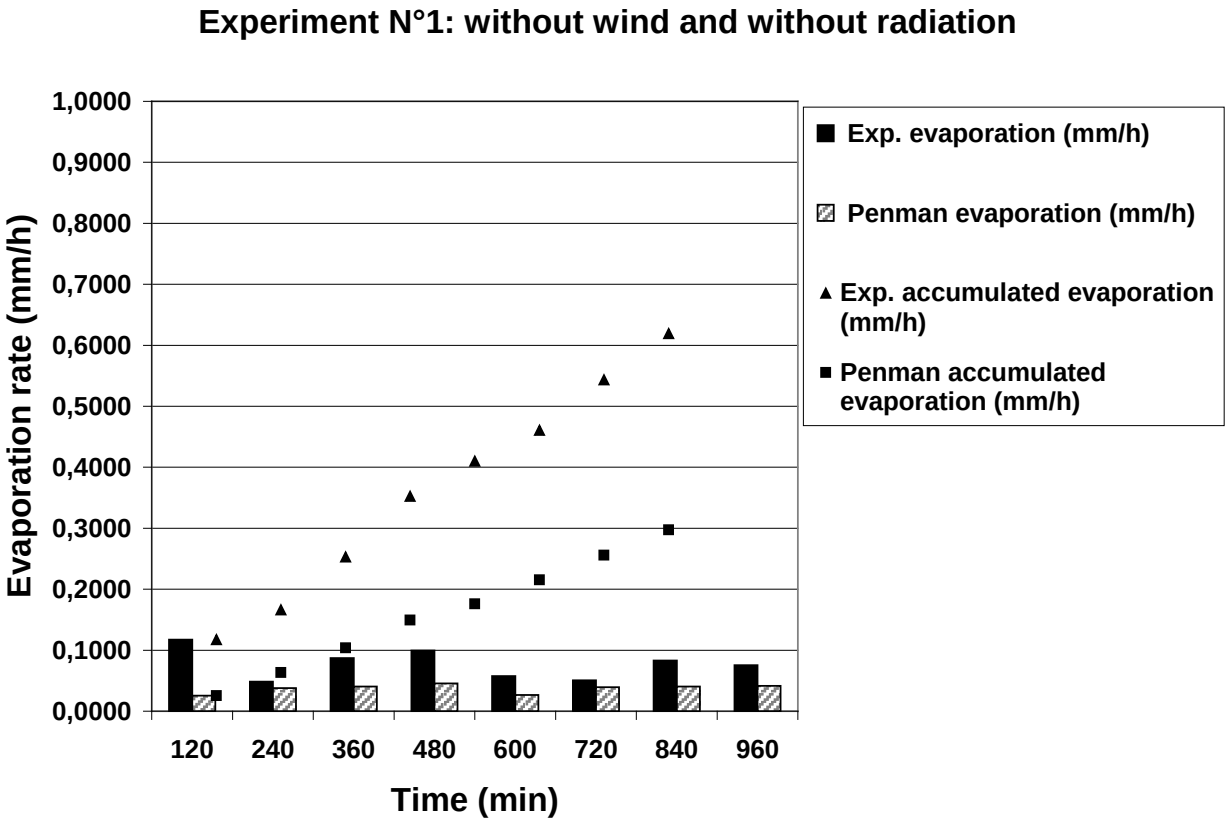

Figure 3: Evaporation rate: without wind and without radiation

b) Experiment 2

To simulate one-day weather conditions without solar radiation and only with wind (cloudy day: nights), a fan with regulated speed of 0.5 km/h was used. This is illustrated in Figure 4. An increase of 38% with respect to the control was obtained in the evaporation rate. The result was theoretically very approximate since wind spped is the variable that influences the evaporation rate in the Penman equation in tropical conditions. This variable was in a great extend below actual data for wind speed on tropical conditions. The decrease in the wind speed was so to avoid the caustic liquor loss that it generates and to obtain the evaporation yielded by the system. Drag-out losses are favored by decreases in the drop size; an increase in wind speed and temperature increases evaporation processes. Moreover, the provided wind speed kept a constant renewal of vapor saturated air layers. This trend was also observed in Experiment 3.

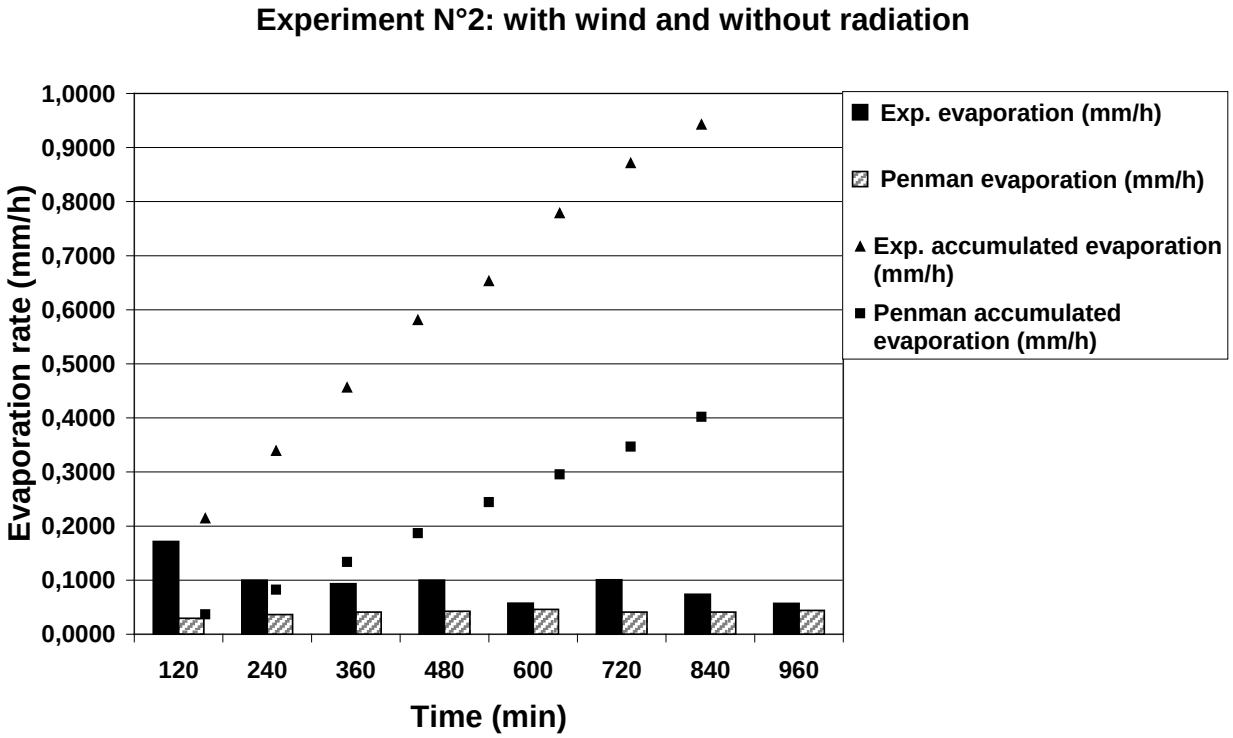

Figure 4: Evaporation rate: with wind and without radiation

c) Experiment 3

For the simulation of the meteorological conditions of a clear sunny day a speed-regulated fan (0.5 km/h) and a lamp 15.3 W/m^2 were employed. Figure 5 shows the rates of caustic liquor reduction through evaporation. An increase in evaporation rate of 107% with respect to Experiment 1 and of 34% respect to Experiment 2 was obtained. Aspersion on the panel favored evaporation since a thinner layer of liquid covered the surface area. This is explained by the fact that more thermal energy form radiation is adsorbed increasing temperature and the kinetic energy of the molecules. This acceleration in turn provides the energy required to overcome intermolecular energy of attraction. The evaporation process increase of the superficial area given by the panels was observed in Experiments 1 and 2. Similarly, wind accelerated evaporation by the renewal of water vapor saturated boundary layers as observed in the Experiment 2.

Saturated caustic liquor sample with CO_2 (g) and feasibility of sodium percarbonate synthesis ($Na_2CO_3 \bullet 1.5H_2O_2$) as alternative for final disposition of caustic liquor

Total alkalinity determination: caustic liquor sample Caustic liquor samples have a low concentration of caustic soda (NaOH) compared to high content of soda ash (Na_2CO_3). As indicated in Table 3, on the initial composition of both samples (caustic soda concentration was between 3,870 and 6,157mg/L; and soda ash was between 75,800 mg/L to 132,900 mg/L). Table 3 shows alkalinity values obtained by acid-base titration of caustic liquor samples (Pérez et al., 2010).

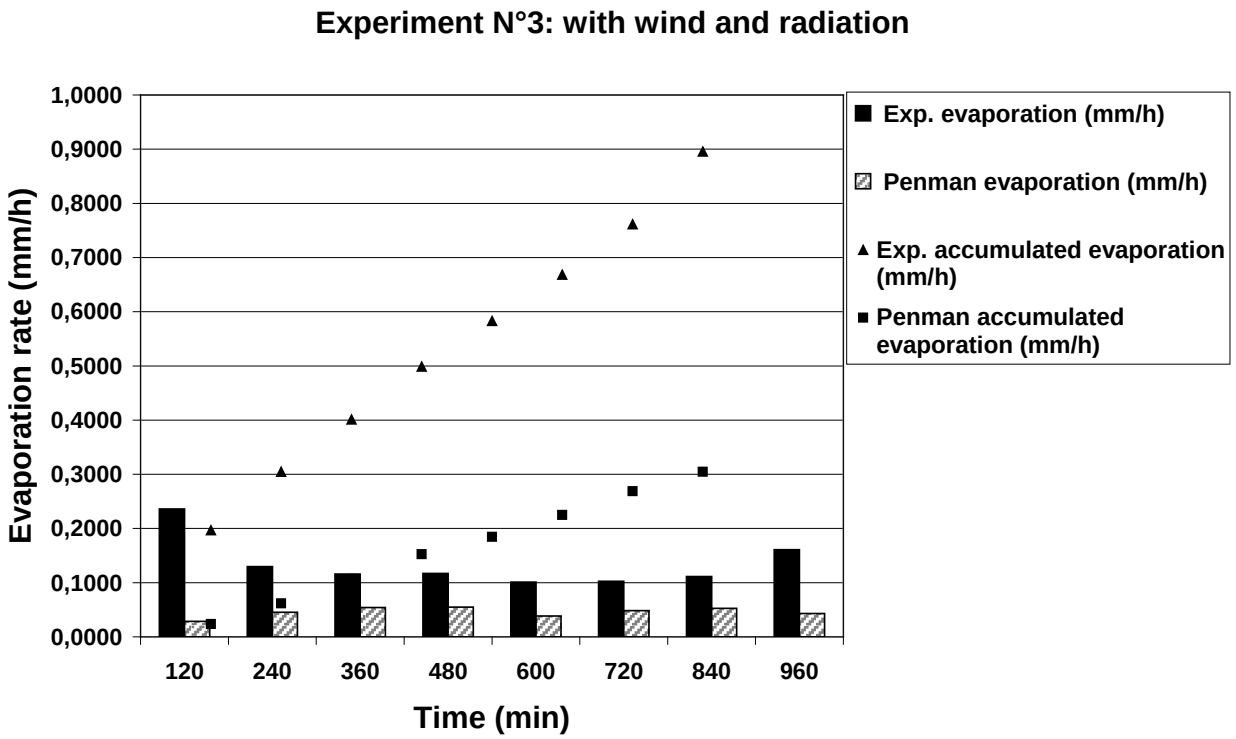

Figure 5: Evaporation rate: with wind and radiation

Table 3: Average initial values of alkalinity of the caustic liquor in samples

Total alkalinity as	CLL2 (mg/L)	CLL3) (mg/L)
Na_2CO_3 (soda ash)	150,343	93,538
$CaCO_3$	139,516	87,737

d) CO_2 (g) capture capacity

Determinations of total alkalinity, pH, carbonate and hydroxide, showed that liquor sample CLL2 has an absorption capacity of 7.9 kg CO_2 (g) /m^3 and total alkalinity, as carbonate, of 1,359,865 ± 15,149 mg/L (Potenciometric method). Sodium carbonate precipitation in liquor sample CLL2 using pure CO_2 (g), for maximum precipitation of carbonate and hence the maximum capture of CO_2 (g) is presented in Table 4. Maximum neutralization values will reach a pH 8.3, which is the value of pH given atmospheric gas carbon dioxide when dissolved in water (carbonate equilibrium) (Kaneko and Okura 2002; Pérez et al., 2010).

Table 4: Amount of precipitated Na_2CO_3 caustic liquor samples

Test	Na_2CO_3 (g)
Sample LL2-1 250 mL	4.7639
Sample LL2-2 250 mL	4.7519
Average	4.7579

e) Identification of precipitated soda ash

Precipitated salt after saturation of caustic liquor samples with CO_2 (g) was identified by X-ray diffraction as sodium carbonate heptahydrate ($Na_2CO_3.7H_2O$).

Feasibility of sodium percarbonate synthesis ($Na_2CO_3 \bullet 1.5H_2O_2$) as alternative for final disposition of caustic liquor

Precipitated $Na_2CO_3.7H_2O$ from the saturated caustic liquor samples was used to obtain SPC with a yield of 46.7% and a concentration of 68.0% SPC is produced from caustic liquor with impurities of ferric oxide and sodium salts from bauxite-goethite-hematite digestion process. Table 5 shows, the production of dissolved oxygen (DO) of reference bleacher with a content of SPC 33% and the SPC synthesized in distilled water.

Table 5: Dissolved oxygen (DO) from synthesized SPC and a reference bleacher

SPC synthesized (*) (g ± 0.0001)	DO (mg/L)	Bleacher reference (*) (g ± 0.0001)	DO (mg/L)
10.1752	33.44	10.0878	17.52
10.0549	36.77	10.3142	18.08
10.0822	35.64	10.2276	18.01
10.0480	34.81	10.0145	17.09

(*)*Distilled water: 2.84 mg/L DO*

The effect of SPC on the oxidation of standardized phenol aqueous solutions was investigated.Table 6 shows, the oxidation of phenol by synthesized SPC at ambient temperature. The high amount of phenol oxidized (82.47 %), indicates that synthesized SPC is an efficient oxygen source for phenol oxidation to hydroquinone (McKillop and Sanderson 1995).

Table 6: Capacity of SPC on the oxidation of standardized phenol aqueous solutions

Test	Check	SPC synthesized (g ± 0.0001)	$[Phenol]_0$ (mg/L)	[Phenol] (mg/L) After the oxidation	Oxidized phenol (%)	Reaction Time (min)	Oxidized phenol average (%)
1	a	0.9003	3.9740	1.2632	68.20	13	66.70
	b	0.9009		1.3816	65.20		
2	a	1.8002	4.1485	0.8819	78.70	28	79.06
	b	1.8005		0.8554	79.40		
3	a	2.7012		0.7194	82.60	39	82.47
	b	2.7014		0.7345	82.30		

IV. Conclusion

1. The maximum rate of evaporation achieved in Experiment 3 corresponded to 2,646 mm/year, which is alike to the annualized average rate of an industrial lagoon system for alumina production of 2,182 mm/year. Results indicate that a combination of the natural evaporation and forced evaporation in a lagoon, is able to increase evaporation rate at 4,828 mm/year; minimizing the risk of overflow of the caustic liquor.
2. The feasibility of synthesis of SPC from impure sodium carbonate heptahydrate salt is possible, with a yield of 46.7 % and SPC with a purity of 68%. SPC synthesis looks as a treatment option that adds value to environmental liabilities of alumina industry.
3. The SPC purity obtained was sufficient to promote the oxidation of low concentration phenol aqueous solutions with a reaction time between 13 and 39 min.

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Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 18 Issue 2 Version 1.0 Year 2018
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Geotechnical Indications of Bille Communnity in Niger Delta

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Abstract- The study area which is situated Morphologically within the Salt Water / Mangrove swamp Zone, is underlain by thick volume of clay with low C_u value of 14kpa and high Coefficient of Compressibility value. This results in large settlement observation and foundation failures of structures with high columns loads. Thus, Deep foundation is recommended for such structures. Soil Lithology reveals a medium dense Sandy layer (phi=>30) at an average depth >15m and Uniformity Coefficient indicating the sand as well graded. Pile load calculations indicates working loads < 300KN within diameter of 0.3m-0.45m at depths of 15m. Settlement calculations reveals expected settlement values of individual piles lower the allowable values.

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GJSFR-H Classification: *FOR Code: 040699*

Strictly as per the compliance and regulations of:

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I. Introduction

The area which is within the southern –most part of the Niger Delta, is located in the Transition or mangrove zone of the Niger Delta. 'Transition' Or Mangrove (Middle Delta) Zone coincides with the Mangrove brackish water zone with its numerous inter-tidal flats and mangrove vegetation. Sub-soils here are characterized by a typical fibrous, pervious clayey mud (that exhibits large values of compressibility and consolidation), underlain by silty sands which most often grade into poorly graded Sands and further downwards into well-graded sands and gravels. (Teme *et al* 2008).

Due to this characteristics, intolerable settlement (Total and Differential) of building is being observed within the area. Thereby making it unsafe for usage and results in the construction of building with low column loads. The study is about proposing bearing capacity for shallow foundation and work load for pile foundation within this area.

II. Site Description and Geology

Geologically, the site is underlain by the Coastal Plain sands of the Benin formation (short and stauble, 1967), which in this area is overlain by soft-firm silty clay sediments belonging to the Pleistocenic Formation (Nwankwoala, *et al*. 2014.) Morphologically the site is situated within the Salt water / Mangrove swamp zone of the Niger Delta. These are portions of the delta that are characterized by large saline-brackish water mangrove swamps. In these areas, there is less discharge of freshwater and there is a dominance of tidal influences. The zone which is rich in organic matter, consist of very soft peaty and bog soil, dark gray organic clay overlying fine sandy sequence. Water table is shallow in this zone as a result of the diurnal flooding and poor drainage. The elevation above mean sea level in this region ranges from 1 – 2m (Alaminiokuma, *et al 2016 ,* Nwankwoala, *et al*. 2014)

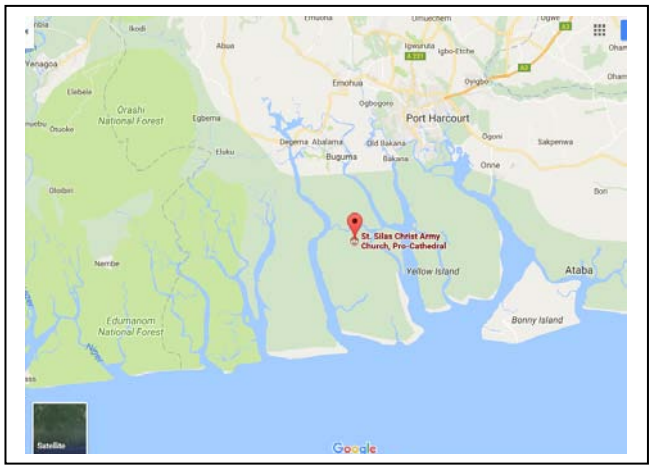

Fig. 1: Showing Location of Area

III. Methods Of Investigation

a) A Soil Borings

Conventional boring method which consists of the use of the light shell and auger hand rig was used in the boring operation. During the boring operations, disturbed samples were regularly collected at depths of 0.75m intervals and also when change of soil type is noticed. Undisturbed cohesive soil samples was retrieved from the boreholes with conventional open-tube sampler 100mm in diameter and 450mm in length. All samples recovered from the boreholes were examined, identified and roughly classified in the field.

Standard Penetration Tests (SPT) was performed every 1.5m advance through cohesionless soils. The main objective of this test is to assess the relative densities of the cohesionless soils penetrated.

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b) Bearing Capacity for Shallow Foundation

The conventional method of foundation design is based on the concept of bearing capacity or allowable bearing pressure of the soil. The bearing capacity is defined as the load or pressure developed under the foundation without introducing damaging movements in the foundation and in the superstructure supported on the foundation.

Damaging movements may result from foundation failure or excessive settlement. The two criteria used in the design of foundation are therefore:

i. Determination of bearing capacity of soil and the selection of adequate factor of safety, usually not less than 2.5
ii. Estimating the settlement under the expected load and comparison with the permissible settlement

Modified Terrzerghi Bearing Capacity equation (Murthy, 2007) was used in the calculation of the ultimate bearing capacity of the soil for rectangular foundations.

$$\mathbf{qu = CNc\,[1 + 0.3BL] + \gamma Df\,Nq + 12\gamma BN\gamma\,[1 - 0.2BL]} \quad (1)$$

Working Load for Pile (Bore) Foundation Tomlinson (1995), stated the carrying capacity of single pile using the Standard Penetrometer method. The Carry capacity in this study is obtained from the Skin friction and the End bearing. The Ultimate Bearing Capacity is as follows

$$Q_P = Q_S + Q_b + W_P \quad (2)$$

Where;

Q_P = *Ultimate Bearing Capacity of pile*

$W_P = weight\ \ of\ \ pile$

IV. Results and Discussion

a) Soil Stratigraphy

The data from the soil sampling and laboratory tests were carefully evaluated for the determination of the stratification of the underlying soils. The evaluation uncovered two primary zones.

Table 1: Showing Litholgy, bh1

Layers	Depth(m)	Thickness(m)	Lithology
1	0-12.0	12	Clay, soft Layer
2	12.0-13.5	13.5	Sand, gravelly
3	13.5- 14.5	1	Clay
4	14.5-20	5.5	Sand, Medium Dense Layer

Table 2: Showing Litholgy, bh2

Layers	Depth(m)	Thickness(m)	Lithology
1	0-10.5	10.5	Clay, soft-Layer
2	10.5-20	9.5	Sandy Medium Dense layer

Classification Test was done within Procedure Prescribe by BS 1377, Part 2, 1990 for Classification Test.

b) Engineering Properties of The Soils

The investigation disclosed that the soil deposits within the depths explored are characterized by a near-surface deposit of Soft Clay layer with high compressibility. Beneath is a Medium Densed sandy layer. The thickness of the most compressible zone is roughly 14.5m. The water table was encountered at 0.3m

Classification, strength and compressibility characteristics of the soils were determined from the laboratory and in-situ tests. The relevant index and engineering parameters of the soils are summarized below. Details of these are presented in tables at the end of this report.

i. *Soft Clay*

The thickness of this deposit, as confirmed by the borings varies within 12m. The clay is mainly of high compressibilty and *grayish* in colour. The ranges of variations in the relevant index and engineering parameters of the clay are summarized below:-

	Min	Max
Natural moisture content (%)	38	47
Liquid limit (%)	33	33
Plastic limit (%)	7	9
Plasticity index (%)	24	26
Unit weight (kN/m^3)	18	
Undrained cohesion (kPa)	14	
Angle of internal friction (^{o})	0.5	0.7
Modulus of Elasticity (KN/m^2)		

For design purposes, undrained cohesion of 14kPa, angle of internal friction of zero and Saturated unit weight of 18kN/m^3 are suggested for this layer

ii. *Medium densed Sandy Layer*

Underlying the clay layer is a layer of predominantly Well graded, Medium densed sand. About 6m of the sand deposit was proved. The uniformity Coefficient reveals the sand as a well graded sand with cu>4.0 The ranges of variations in the relevant engineering parameters of the sand are given below:-

	(BH1, 20m)
Effective particle size d_{10} (mm)	0.3
Mean particle size d_{50} (mm)	1.5
Coefficient of uniformity Cu,	5.6
Coefficient of curvature Cc,	2.7
SPT (N-value)	11
Elastic Modulus ((Kpa)	22000

For design purposes, mean angle of internal friction of 31 ^{o} and cohesion zero are suggested for the sand layer. Unit weight of 20kN/m^3 are suggested for this layer

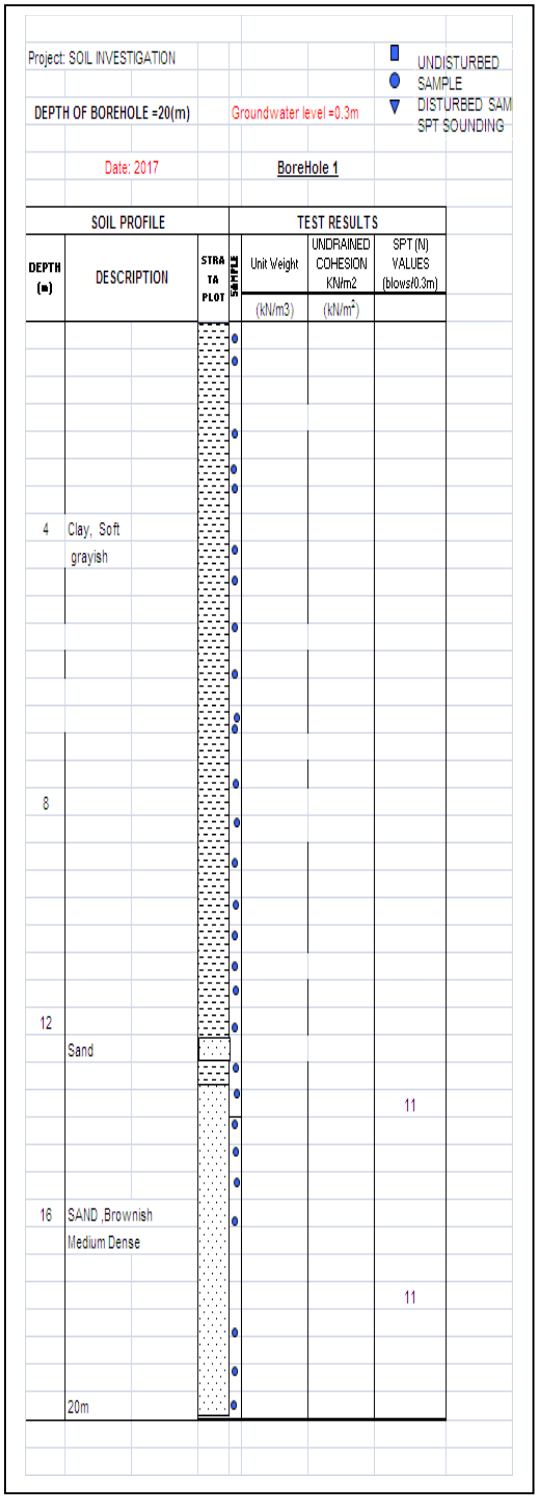

Fig. 2: CPT Profile

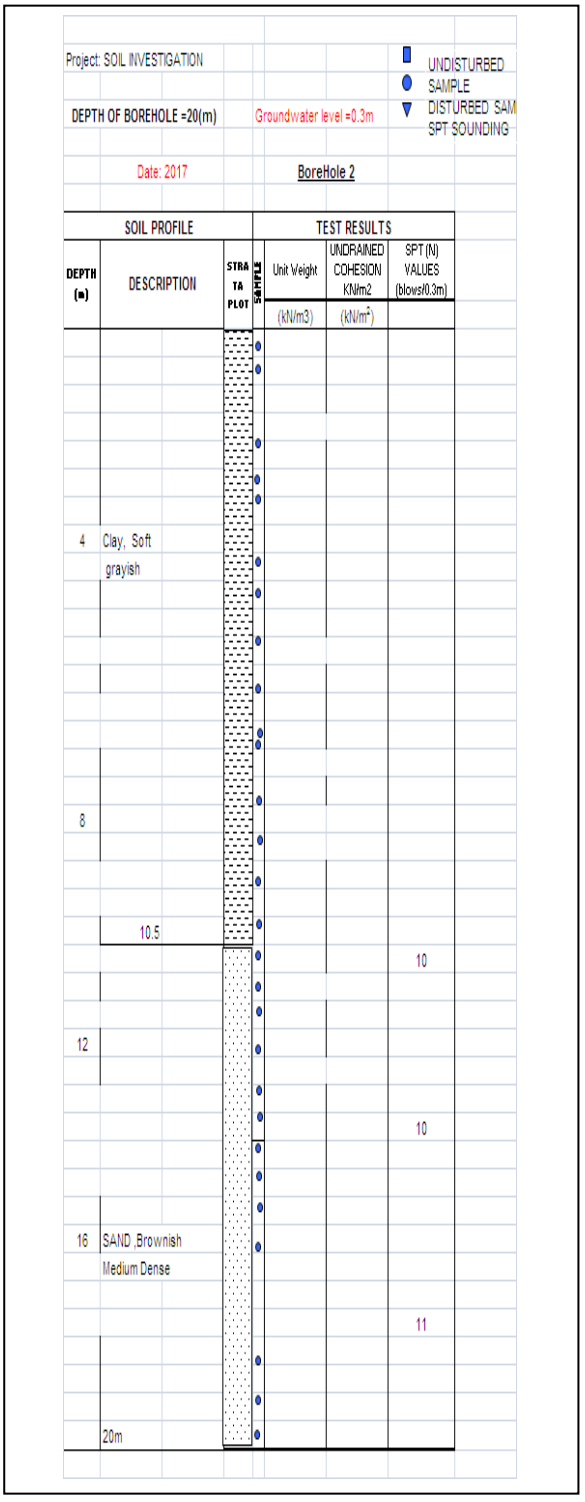

Fig. 3: Soil Lithology

Table 3: Showing Bearing Capacity for Both Areas

Foundation Depth (m)	Width (m)	Undrained Shear Strength (KN/m²)	Ultimate Bearing Pressure (KN/m²)			Allowable Bearing Pressure (KN/m²)		
			L/B =1	L/B= 1.5	L/B = 5	L/B=1	L/B=1.5	L/B=5
1	1	14	121.812	113.838	102.6744	40.60	37.95	34.22
1	1.5	14	121.848	113.877	102.7176	40.62	37.96	34.24
1	2	14	121.884	113.916	102.7608	40.63	37.97	34.25
1	2.5	14	121.92	113.955	102.804	40.64	37.99	34.27
1	5	14	122.1	114.15	103.02	40.70	38.05	34.34
1	10	14	122.46	114.54	103.452	40.82	38.18	34.48
1.5	1	14	130.812	122.838	111.6744	43.60	40.95	37.22
1.5	1.5	14	130.848	122.877	111.7176	43.62	40.96	37.24
1.5	2	14	130.884	122.916	111.7608	43.63	40.97	37.25
1.5	2.5	14	130.92	122.955	111.804	43.64	40.99	37.27
1.5	5	14	131.1	123.15	112.02	43.70	41.05	37.34
1.5	10	14	131.46	123.54	112.452	43.82	41.18	37.48
2	1	14	139.812	131.838	120.6744	46.60	43.95	40.22
2	1.5	14	139.848	131.877	120.7176	46.62	43.96	40.24
2	2	14	139.884	131.916	120.7608	46.63	43.97	40.25
2	2.5	14	139.92	131.955	120.804	46.64	43.99	40.27
2	5	14	140.1	132.15	121.02	46.70	44.05	40.34
2	10	14	140.46	132.54	121.452	46.82	44.18	40.48

Allowable Bearing Capacities for shallow foundations (Water depth > foundation Depth)

Table 4: Pile Load Calculations for Deep Foundation for 15m

Pile work Load Calculation														
					Unit	Over burde	Effective	cum. Effect					Pile shaft	End
	0			Cohesion	weight	stress	stress	stress	bearing	factors	Ka	α	load,kpa	load,kpa
Layers	Bottom	Thickness(m)	phi	kpa	KN/cu.m	KN/cu.m	KN/cu.m	KN/cu.m	Nc	Nq				
1-CH	13.5	13.5		14	18	243	108	108	9			0.5	7	
2-SP	15	1.5	31		20	30	15	123	0		0.7		18.4957397	
	Total	15					123					Total		
					Diameter(m)								0.3	0.35
					Nq								17.24	18.84
					shaft Load (KN)		1						89.019	103.8555
					shaft Load (KN)		2						26.1344801	30.4902268
					Total shaft Load (KN)								115.15348	134.345727
					End Load (KN)								150.005585	223.123156
					Total Load (KN)								265.159065	357.468883
					Safe Load, SF		3						88.386355	119.156294
					Safe Load, SF		2.5						106.063626	142.987553
					Safe Load, SF		2						132.579532	178.734442
		k= earth pressure												
		α=Adhesion Factor												
		Qs=∑Af +∑Acuα												
		f= frictional resistance												
		Qb=∑cNc+qNq												

Table 5: Pile Load Calculations for Deep Foundation for 15m

						Pile work Load Calculation								
					Unit	Over burde	Effective	cum. Effect					Pile shaft	End
	0			Cohesion	weight	stress	stress	stress	bearing	factors	Ka	α	load,kpa	load,kpa
Layers	Bottom	Thickness(m)	phi	kpa	KN/cu.m	KN/cu.m	KN/cu.m	KN/cu.m	Nc	Nq				
1-CH	13.5	13.5		13	18	243	108	108	9			0.5	6.5	
2-SP	15	1.5	31		20	30	15	123	0		0.7		18.4957397	
	Total	15					123					Total		
					Diameter(m)								0.4	0.45
					Nq								19.86	20.53
					shaft Load (KN)		1						110.214	123.99075
					shaft Load (KN)		2						34.8459735	39.2017202
					Total shaft Load (KN)								145.059974	163.19247
					End Load (KN)								307.204013	401.921866
					Total Load (KN)								452.263986	565.114337
					Safe Load, SF		3						150.754662	188.371446
					Safe Load, SF		2.5						180.905595	226.045735
					Safe Load, SF		2						226.131993	282.557168
		k= earth pressure												
		α=Adhesion Factor												
		Qs=∑Af +∑Acuα												
		f= frictional resistance												
		Qb=∑cNc+qNq												

iii. *Settlement Characteristics for Shallow Foundation*

Table 6: Consolidation (One –Dimensional) Compressibility Parameter

Bore-Hole Nos	Depth (m)	Pressure Range (Kpa)	Coefficient of Consolidation Cv(m^2/yr)	Coefficient of Volume Compressibility Mv (M^2/MN)	Coefficient of Permeabilty K 10^{-8}cm/s
	1.5m				
		0-12.5	1.314	6.712000	2.74E-7
		12.5-50	1.441161	0.925663	4.15E-8
		25-50	1.441161	4.262838	1.91E-7
		50-100	1.441161	1.199011	5.37E-8
		100-200	1.441161	0.928337	4.16E-8
		200-400	1.540551	0.355124	1.7E-08

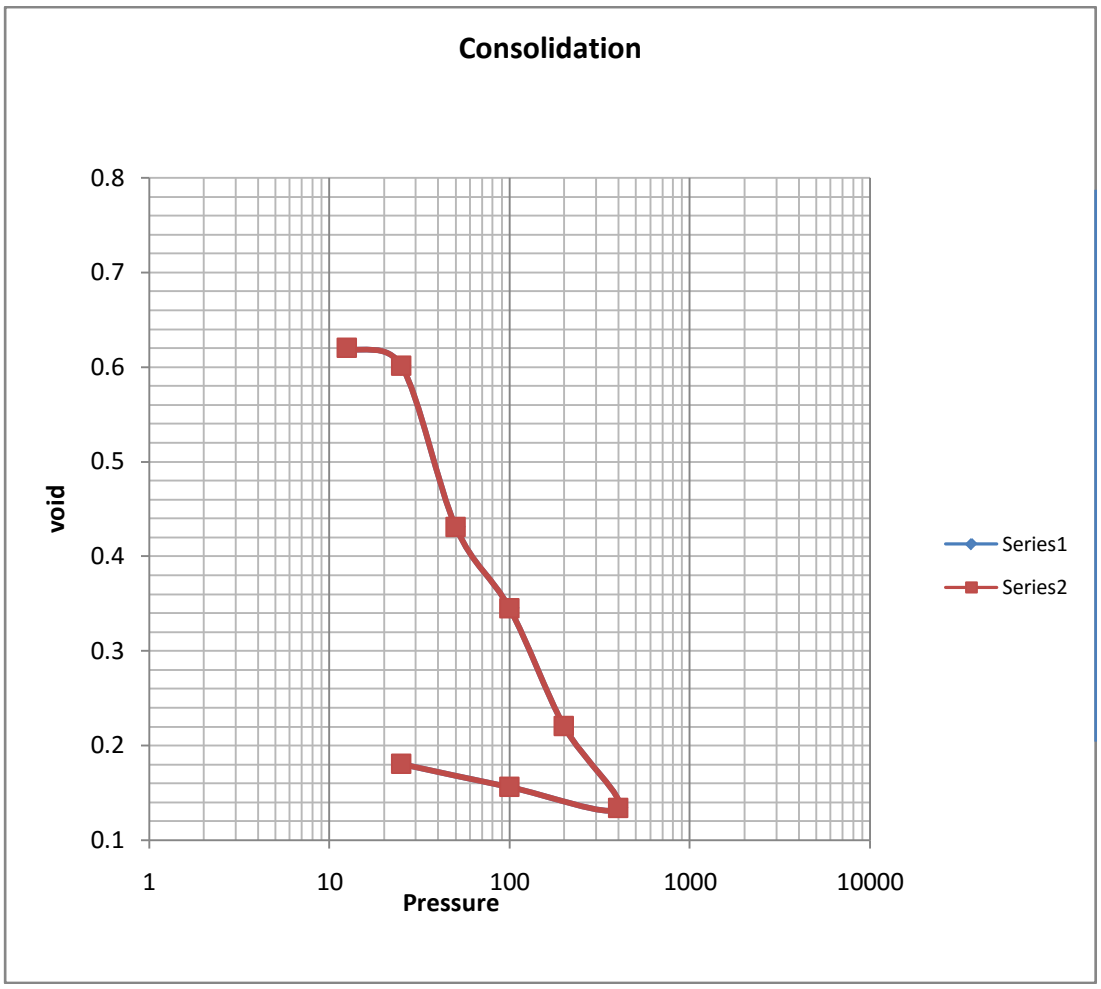

Fig. 3: Void Ratio / Pressure Plot

Table 7: Settlements Parameter, Bh 1 depth =1.5m

Clay	Normally consolidated OCR <1
e_o	0.62
Preconsolidation Pressure	20
Cc	0.35
Soil Compressibility based on CC and e_o	0.1
P_i (elastic)	
Pc (Primary)	

Computed Rate of Settlements (Pressure Range : 200-400 KPa)

Rate of Settlements	Years
T50	
T90	

Table 8: Showing Settlement variation for shallow foundation For Bh 1

Pressure (KPA)	50	100	150	200	250	400	600
Settlement (mm)	57.4	103.6	142.1	175.2	204.2	274.4	343.9

Table 9: Showing Pile Settlement variation

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13	Column14	Column15
Pile Settlement Calculations														
											Expected	Allowable		
			shaft	base	shaft	base			influence		Settlement (P)	Settlement (P)		
s/n	depth (B)m	diameter (m)	area (As)m2	area(Ab) m2	load (Ws)KN	load(Wb)KN	Ep(kpa)	Es(kpa)	factor " I"	F.S	mm	mm		
1	15	0.3	14.148	0.07074	57.5	75	17000000	22000	0.5	2	4.734854955	30		
2	15	0.3	14.148	0.07074	46	60	17000000	22000	0.5	2.5	3.030308207	30		
2	15	0.3	14.148	0.07074	38.3333333	50	17000000	22000	0.5	3	2.104381418	30		
P (settlement) =(Ws+2Wb)L/2AsEp +3.144Wb/4Ab *0.5Wb/BEs														
Ep (Elastic Modulus for Pile)=17 000,000Kpa														
Es (Elastic Modulus for base soil)														
FS (factor of Safty)														
Poisson Ratio , v, =0.25														

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13	Column14	Column15
Pile Settlement Calculations														
											Expected	Allowable		
			shaft	base	shaft	base			influence		Settlement (P)	Settlement (P)		
s/n	depth (B)m	diameter (m)	area (As)m2	area(Ab) m2	load (Ws)KN	load(Wb)KN	Ep(kpa)	Es(kpa)	factor " I"	F.S	mm	mm		
1	15	0.35	16.506	0.096285	67	111.5	17000000	22000	0.5	2	6.590121719	35		
2	15	0.35	16.506	0.096285	53.6	89.2	17000000	22000	0.5	2.5	4.21767914	35		
2	15	0.35	16.506	0.096285	44.6666667	74.3333333	17000000	22000	0.5	3	2.928944709	35		
*P (settlement) =(Ws+2Wb)L/2AsEp +3.144Wb/4Ab *0.5Wb/BEs*														
Ep (Elastic Modulus for Pile)=17 000,000Kpa														
Es (Elastic Modulus for base soil)														
FS (factor of Safty)														
Poisson Ratio , v, =0.25														

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13	Column14	Column15
Pile Settlement Calculations														
											Expected	Allowable		
			shaft	base	shaft	base			influence		Settlement (P)	Settlement (P)		
s/n	depth (B)m	diameter (m)	area (As)m2	area(Ab) m2	load (Ws)KN	load(Wb)KN	Ep(kpa)	Es(kpa)	factor " I"	F.S	mm	mm		
1	15	0.4	18.864	0.12576	72.5	153.5	17000000	22000	0.5	2	8.367285154	40		
2	15	0.4	18.864	0.12576	58	122.8	17000000	22000	0.5	2.5	5.355063919	40		
2	15	0.4	18.864	0.12576	48.3333333	102.333333	17000000	22000	0.5	3	3.718795374	40		
*P (settlement) =(Ws+2Wb)L/2AsEp +3.144Wb/4Ab *0.5Wb/BEs*														
Ep (Elastic Modulus for Pile)=17 000,000Kpa														
Es (Elastic Modulus for base soil)														
FS (factor of Safty)														
Poisson Ratio , v, =0.25														

Pile Settlement Calculations

s/n	depth (B)m	diameter (m)	shaft area (As)m2	base area(Ab) m2	shaft load (Ws)KN	base load(Wb)KN	Ep(kpa)	Es(kpa)	influence factor " I"	F.S	Expected Settlement (P) mm	Allowable Settlement (P) mm
1	15	0.45	21.222	0.159165	81.5	201	17000000	22000	0.5	2	10.07632879	45
2	15	0.45	21.222	0.159165	65.2	160.8	17000000	22000	0.5	2.5	6.448852037	45
2	15	0.45	21.222	0.159165	54.3333333	134	17000000	22000	0.5	3	4.478370587	45

*P (settlement) =(Ws+2Wb)L/2AsEp +3.144Wb/4Ab *0.5Wb/BEs*

Ep (Elastic Modulus for Pile)=17 000,000Kpa

Es (Elastic Modulus for base soil)

FS (factor of Safty)

Poisson Ratio , v, =0.25

Table 10: Particle Size Distribution

Borehole No	Depth(m)	Effective particle	d_{30}	Mean particle size d_{50}(mm)	d_{60}	Coefficient of uniformity	Coefficient of curvature
1	15	0.3	1.2	1.5	1.7	5.66666667	2.823529412
1	20	0.22	0.6	1.2	1.5	6.81818182	1.090909091
1	18	0.23	0.7	1.2	1.6	6.95652174	1.331521739

c) *Bearing Capacity Calculations for Shallow Foundation*

Undrained cohesion of 18 kPa, Unit weight of 18kN/m^3 and angle of internal friction of 0 were adopted for the bearing capacity analysis, adopting methods from BS 1377, Part 7 1990: 8. Table 2., indicates low values of allowable bearing capacities with different L/B ratios.

d) *Settlement of Shallow Foundation*

Laboratory Consolidation Test was performed on selected Cohesive sample to determine the compressibility Parameter. The Test was carried out in accordance with Procedure Recommended in BS 1377, Part 5, 1990:3. Method proposed by Pacheco Silva (1970) was used to determine the Preconsolidation Pressure graphically. Settlement Analysis based on Normally consolidated soils are stated as follows (Coduto D.P, 2007)

$$\boldsymbol{s = \Sigma cc1 + eoHlog\ [\sigma zf/\sigma zo\ ]} \qquad (3)$$

Where:
s= settlement
eo= void ratio
H= height of Clay
σzf =final vertical effective stress
σzo= Initial vertical effective stress
cc= compression index

V. Conclusion

The Study Reveals that the surface within these area is underlain by a Normally Consolidated soft clay of High compressibility (about 14.5m thick) . Beneath this layer is a medium dense, well graded Sandy Layer(with Phi value > 30^0). Moisture Content, Liquid Limit, compessional Index and Plasticity Index Shows high Values, indicating high Compressibility. Drainage Characteristics is expected to be low at the site as indicated by the K values.

An average Cu=18KN/m^2 and Phi =0 was considered within depth of 1m-2m The allowable bearing capacity profile of the sub-surface shows Low bearing Capacities characteristics (1.5m: 43KN/m^2,). Settlement predictions based on a loading of 250KN/m^2 indicated a settlement > 200 mm within the clay layer. The differential and total settlement is expected to be within intolerable limits. Due to the highly anticipated settlement values, Due to this layer, which depicts low allowable bearing capacities, Deep (Pile) foundation with depth greater than 15m is recommended for higher column loads. Pile calculations on table 4 and 5, shows working load of different diameter between 0.3m-0.45m . Working load for 0.3m diameter bored pile with depth of 15m, shows values 132.1KN and 106.1 KN for F.S values of 2 and 2.5 respectively . Also, Working load for 0.35m diameter bored pile with depth of 15m, shows values 179KN and 143 KN for F.S values of 2 and 2.5 respectively . 0.4m diameter by 15m Depth Pile shows working load of 226KN and 180KN for F.S values of 2 and 2.5 respectively, while 282KN and 226KN with F.S 2 and 2.5 respectively are working loads for 0.45m by 15m depth pile.

Settlement calculations on table 9 for deep foundation shows expected settlement lower the Allowable settlement, this imp[lies calculated work load for the different pile diameter is adequate and will not result in foundation failures.

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Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 18 Issue 2 Version 1.0 Year 2018
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Spatial Distribution of Heavy Metals Contamination of Groundwater in Neighborhood Communities of Shagamu Industrial Layout, Nigeria

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Abstract- Heavy metals contamination of groundwater has been of public health concern in recent years because of their implication in human health and environment. This study therefore assesses heavy metals contamination in groundwater from selected communities in Sagamu, Ogun State, Nigeria. Fifty groundwater samples were purposively collected for Physicochemical and heavy metals determination, and also spatial distribution maps of selected heavy metals were produced using Arc GIS software. Data were analyzed using descriptive statistics. Physicochemical results of groundwater revealed that the water was acidic with low conductivity and total dissolved solids (TDS). The levels of arsenic and chromium were found to be within the Maximum Contaminant Levels (MCL) while that of Pb and Cd were above MCL. The spatial distribution showed that there was predominantly high concentration of lead across the study area and cadmium was predominantly high especially in area close to industries.

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GJSFR-H Classification: FOR Code: 059999p

Strictly as per the compliance and regulations of:

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Keywords: groundwater sources, physicochemical properties, heavy metals toxicity, spatial distribution, safe water, maximum contaminant levels.

I. Introduction

It had been reported that one of the most important environmental issues is groundwater contamination (Vodela *et al.,* 1997). Water sources have been put under great pressure by population increases in developed and developing countries, through pollution by agricultural, domestic and industrial waste, and by environmental change (WHO, 2000). A primary concern of people living in developing countries is that of obtaining clean drinking water. In Africa and Asia, most of the largest cities utilize surface water but many millions of people in peri-urban communities and rural areas are dependent on groundwater (Obiri-Danso *et al.,* 2009).

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Water pollution problem both in the rural and mostly in the urban cities with teaming population have been observed to be the major cause of diseases and death. As a measure to the daily shortage of water, especially in most of our urban centers, attention has been shifted to open dug wells for groundwater resources (Gbadebo and Akinhanmi, 2010). Water sources, including groundwater, contain heavy or trace metals in concentrations depending on geology and contamination from varying anthropogenic sources. Although many heavy metals are necessary in small amounts for the normal development of the biological cycles, most of them become toxic at high concentrations. Heavy metals are introduced into the environment through natural phenomena and human activities, such as agricultural practices, transport, industrial activities and waste disposal (Kamarudin *et al.,* 2009).

Marcovecchio *et al.,* (2007) observed that between the wide diversity of contaminants affecting water resources, heavy metals received particular concern considering their strong toxicity even at low concentrations. Metals like calcium, magnesium, potassium and sodium had been known as essential metals in order to sustain life while cobalt, copper, iron, manganese, molybdenum and zinc had been needed at low levels as catalyst for enzyme activities (David and Joel, 2004). Excess exposure to heavy metals had been, however, reported to result in toxicity. Heavy metals had been known to produce their toxicity by forming complexes with proteins, in which carboxylic acid (-COOH), amine ($-NH_2$), and thiol (-SH) groups are involved; and these modified biological molecules had also been known to lose their ability to function properly, which resulted in the malfunction or death of the cells (Momodu and Anyakora, 2010).

Water resources containing contaminants, such as heavy metals and toxic metalloids, that pose a threat to health, had been reported to increase worldwide (Anazawa *et al.,* 2004). It had been observed that the presence of metals in water resulted from two independent factors: the first involving the weathering of soils and rocks (Bozkurtoglu *et al.,* 2006; White *et al.,* 2005) with its products being transported by air, (Rubio *et al.,* 2006) and water (Das and Krishnaswami, 2007),

and the second involving a variety of anthropogenic activities that have created a societal health risk in rivers that received a substantial amount of waste from such activities (Espino *et al.,* 2007; Rubio *et al.,* 2004). Different studies have revealed that the presence of toxic heavy metals iron, lead, mercury reduce soil fertility and agricultural output (Lokhonde *et al.,* 1999). Also Cd, Cr, As, and Pb are proved detrimental beyond a certain limit (Bruin *et al.,* 2000).

In most town and cities in Nigeria, groundwater in form of shallow or deep wells, borehole and springs are significant sources of drinking water supplies to a large proportion of the communities. The qualities of these groundwater sources are affected by the characteristic of the media through which the water passes on its way to the groundwater zone of saturation (Shittu *et al.,* 2008). Thus, the heavy metals discharged by industries, municipal wastes, hazardous waste sites, as well as from fertilizer for agricultural purposes and accidental oil spillage from tankers can result in a steady rise in contamination of groundwater. (Igwilo *et al.,* 2006). Garba *et al.,* (2010) reported a mean Arsenic concentration of 0.34mg in drinking water from hand dug wells, boreholes and tap of Karaye Local Government Area, Kano State. The Zamfara State lead poisoning epidemic occurred in Nigeria in 2010. At least, 400 children died from the effect of lead poisoning due to the acute lead (Pb) poisoning from illegal processing of lead rich ore for gold extraction taking place inside houses and compounds in these areas.

The health problem of heavy metals poison is believed to be a global one. While some countries have been able to identify the magnitude of the problem and are already making efforts at putting it under control, Nigeria and most other African countries (particularly the under developed ones) are yet to identify the extent of the health problem associated with groundwater contamination by heavy metals and provide information for policymakers. Hence the objective of this study was to assess heavy metals in groundwater from selected communities in Sagamu Local Government Area, Ogun State, Nigeria.

II. Materials and Methods

a) Study design

The study involved a cross-sectional descriptive survey and laboratory analytical procedures. The experiment employed a complete randomized design with three (3) replicates of each of the samples.

b) Study location and population

The study was carried out in Sagamu Local Government Area, Ogun State, located within Southwestern Nigeria. It is bounded by Odogbolu Local Government to the East, Ikenne Local Government to the North, Obafemi-Owode Local Government to the West and Lagos State to the South respectively. It farthest point on the top left is 6 50 42.59N/ 3 28 20.67E, farthest point top right is 6 57 26.83N/ 3 36 36.09E. Lower left 6 38 57.35N/ 3 26 37.56E and lower right 6 41 05.34N/ 3 40 55.18E. The Local Government has an area of 614km^2 and a total population figure of 253,421 people, comprising of Yoruba, Hausa and Igbo background according to the National Population Census conducted in 2006. Sagamu Local Government Area is a Cosmopolitan Area that is divided into fifteen political wards. These include ward 1 – Oko, Epe & Itunle 1, ward 2 – Oko, Epe and Itunla II, ward 3 Aiyegbami Ijoku, ward 4 – Sabo 1, ward 5 – Sabo II wards 6 – Itunsoku Oyebayo, ward 7 Ijagba, ward 8 – Latawa, ward 9 – Odelemo ward 10 – Ogijo/Likosi, ward 11 – Surulere, ward 12 – Isote, ward 13 – Simawa ward 14- Agbowa, ward 15-Ibido/Itun-alara.

The purposively selected wards of interest for this study included Sabo 1, Sabo II and Ogijo/Likosi. They were chosen because of the indiscriminate waste disposal practices and high industrial activities in these communities. The industries in the study area are oil and gas depot and mostly metal, iron steel and battery lead recycling companies etc.

c) Sampling procedure

A three stage multi-sampling procedure was carried out. Fifteen wards were identified from the local government area, out of the fifteen wards, 3 wards were purposively selected based on the high industrial activities and indiscriminate waste disposal practice. From the three wards selected, seven communities were purposively selected based on high industrial activities and indiscriminate waste disposal practices, a practice predisposing heavy metal contamination in soil and water. From the seven communities, households were selected using systematic sampling method. This involves sampling of every 3rd houses in each locality and their groundwater source.

d) Sample location (coordinates acquisition)

Fifty groundwater samples were purposively collected for analysis in the laboratory. Samples locations were collected using a Global positioning system (GPS) Garmin 60 on site at groundwater source location. The GPS was put on and allowed to receive signals from the navigational satellite. Once full signals were received, the coordinates of the groundwater source was marked and saved on the GPS unit to be downloaded and inserted into data base to generate map showing samples location across the study area. In order to keep track of each unique location, the way points were saved to correspond to the names of each groundwater source site.

e) Sample collection and transport

The water samples were collected in a 500ml sterilized bottles. The pH, TDS and conductivity of the groundwater samples were determined immediately

using pH meter. Concentrated hydrogen trioxonitrate (V) (HNO_3) was added to water samples for preservation and transported to the laboratory for analysis of Heavy metals [Arsenic (As), Cadmium (Cd), Chromium (Cr), and Lead (Pb)].

f) Procedure for laboratory sample

i. *Physicochemical analysis*

The Physicochemical parameters of the groundwater such as the temperature, conductivity, Ph and Total Dissolved Solids (TDS) were determined using a combined conductivity, TDS, temperature, pH meter (Hanna HI 9811-5 model). The already switched on meter was inserted into 500ml sterilized bottle with the tip containing the electrode touching the water. The result was read when a constant reading was attained. The procedure was repeated for each of the fifty water samples.

ii. *Heavy metals analysis (As, Cd, Cr and Pb)*

The concentration of heavy metals in the groundwater samples was determined following the methods described by the Association of Analytical Chemists (A.O.A.C). The samples were digested in concentrated nitric acid (HNO_3). After digestion, the samples were analysed using Perking 3300 AAS at different wavelengths (As – 193.7, Cd – 228.8, Cr – 357. 9, Pb – 283.3). Perkin Elmer MHS-10 hydride generator was used with the system for the determination of As. Blank and Standard for each of the metals were also analysed under the same analytical conditions. The concentration of metals in each sample was calculated using the read out from the AAS, volume of sample taken for analysis and volume of extract viz;

$$\text{Metal (mg/L)} = \frac{\text{The result – Blank) x Vol. of extract}}{\text{Vol. of Sample taken}}$$

g) Data management and analysis

The results obtained from the physicochemical and heavy metals analysis were summarized using descriptive statistics such as proportions, percentage, mean and standard deviation.

III. Results

a) Physicochemical analysis of water samples

Table 1 shows the mean values of physicochemical parameters analysed as compared with World Health Organization (WHO) and Standard Organization of Nigeria (SON) standards. The pH value of sample analysed ranged from 3.8 – 7.9 with a mean value of 4.79±1.6. The temperature value ranged from 27.7 – 34.5°C with a mean value of 30.09±3.6°C. The conductivity value ranged from 010-750 μ^2/ cm with a mean value of 81.25±5.8 μ^2/ cm. TDS value ranged from 0010-0360 mg/L with a mean value of 50±3.9 mg/L.

Table 1: Shows the physicochemical analysis on water samples

Parameter	Range	Means / SD	WHO 2011 / SON 2008
Ph	3.8 – 7.9	4.794 ± 1.6	6.5 – 8.5
Temperature (°C)	27.7 – 34.5	30.093 ± 3.6	Ambient
Conductivity (μ^2/ cm)	010 – 750	81.25 ± 5.8	500
Total Dissolved solids (mg/L)	0010 - 0360	50 ± 3.9	1000

b) Level of arsenic concentration in groundwater samples

Table 2 shows the levels of arsenic concentration in groundwater samples. A total number of 50 samples were analysed. The Arsenic (As) value ranged from <0.0001 – 0.0089 mg/L with the mean concentration of 0.002±0.002 mg/L. One hundred percent (100%) of As detected are within the WHO/SON maximum containment level.

Table 2: Levels of arsenic concentration in groundwater samples

Parameters	Borehole water	well water	Both
Number of total samples	41	9	50
Number of arsenic detected groundwater within WHO/SON limit (MCL)	43	7	50
Percentage of arsenic detected groundwater within WHO/SON limit (MCL)	86%	14%	100%
Number of arsenic detected groundwater above WHO/SON limit (MCL)	0	0	0
Percentage of arsenic detected groundwater above WHO/SON limit (MCL)	0	0	0
Minimum concentration detected in the groundwater (mg/L)	<0.0001	<0.0001	<0.0001
Maximum concentration detected groundwater (mg/L)	0.0089	0.00061	0.0089
WHO/SON Maximum Contaminant Level (MCL) (mg/L)	0.01	0.01	0.01
Mean	0.002	0.002	0.002

c) *Level of cadmium concentration in groundwater samples*

Table 3 shows the levels of cadmium concentration in groundwater samples. The cadmium value ranged from <0.01-0.43 mg/L with the mean concentration of 0.08±0.11 mg/L. 48% are above the WHO/SON MCL, while 52% are within the MCL. The minimum concentration detected is <0.01 while the maximum concentration detected is 0.43 mg/L.

Table 3: Shows Level of Cadmium Concentration in Groundwater Samples

Parameters	Borehole water	well water	Both
Number of cadmium detected groundwater within WHO/SON limit (MCL)	19	7	26
Percentage of cadmium detected groundwater within WHO/SON limit (MCL)	38%	14%	52%
Number of cadmium detected groundwater above WHO/SON limit (MCL)	23	1	24
Percentage of cadmium detected groundwater above WHO/SON limit (MCL)	46%	2%	48%
Minimum concentration of cadmium detected groundwater (mg/L)	<0.01	0.12	<0.01
Maximum concentration of cadmium detected in the groundwater (mg/L)	0.43	0.12	0.43
WHO / SON MCL (mg/L)	0.003	0.003	0.003
Mean	0.08	0.08	0.08

d) *Level of Chromium Concentration in Groundwater Samples*

Table 4 shows the levels of chromium concentration in groundwater samples. The chromium value ranged from <0.001-0.215 mg/L with the mean concentration of 0.03±0.05. 22% are above the WHO/SON MCL while 78% are within WHO/SON MCL. The minimum concentration detected is <0.001 mg/L and the maximum concentration detected is 0.215 mg/L.

Table 4: Shows Level of Chromium Concentration in Groundwater Samples

Parameters	Borehole water	well water	Both
Number of chromium d detected groundwater within WHO/SON limit (MCL)	32	7	39
Percentage of chromium detected groundwater within WHO/SON limit (MCL)	64%	14%	78%
Number of chromium detected groundwater above WHO/SON limit (MCL)	11	-	11
Percentage of chromium detected groundwater above WHO/SON limit (MCL)	22%	-	22%
Minimum concentration detected groundwater (mg/L)	<0.001	-	<0.001
Maximum concentration detected groundwater (mg/L)	0.215	-	0.215
WHO/SON MCL (mg/L)	0.05	0.05	0.05
Mean	0.03	0.03	0.03

e) *Level of Lead Concentration in Groundwater Samples*

Table 5 shows the levels of lead concentration in groundwater samples. The lead value ranged from <0.01-3.26 mg/L with the mean concentration 0.51±0.71. 12% are within the WHO/SON MCL while 88% are above the WHO/SON MCL. The minimum concentration detected is <0.01 mg/L while the maximum concentration detected is 3.26 mg/L.

Table 5: Shows Level of Lead Concentration in Groundwater Samples

Parameters	Borehole water	well water	Both
Number of lead detected groundwater within WHO/SON limit (MCL)	6	-	-
Percentage of lead detected groundwater within WHO/SON limit (MCL)	12%	-	12%
Number of lead detected groundwater above WHO/SON limit (MCL)	37	7	44
Percentage of lead detected groundwater above WHO/SON limit (MCL)	74%	14%	88%
Minimum concentration detected groundwater (mg/L)	<0.01	0.13	0.01
Maximum concentration detected groundwater (mg/L)	3.26	3.12	3.26
WHO/SON MCL (mg/L)	0.01	0.01	0.01
Mean	0.51	0.51	0.51

Distribution of Heavy Metals in Groundwater of Ogijo/Likosi and Sabo 1 and 2 Using Geographical Information System (GIS)

There is low concentration of arsenic across the study area both in Ogijo/Likosi and sabo 1 and 2. There is low concentration of chromium across the study area with one or two occurrence of high concentration in the northern part of the map close to NNPC depot, Monarch and steel companies. There is a general trend of low concentration of chromium in the southwest part of the study area whereas there appears to be high concentration of chromium in the north east part.

In Ogijo/Likosi cadmium is predominantly low with spars occurrence of high concentration of cadmium in the southern part of the study area. In the upper northern part, there is a significant high concentration of cadmium especially the areas closed to industries. In Sabo, there is a significant occurrence of high concentration of cadmium across the area with only spars occurrence of low concentration of cadmium in the southwest area, but the northwest region shows a significant level of high concentration of cadmium. A map showing lead concentration distribution in Ogijo/Likosi shows that there is predominantly high concentration of lead across the study area with just spars appearance of low concentration in the southern area and also in Sabo lead concentration is predominantly high across the area.

Table 6: Distribution of Heavy Metals in Groundwater Using GIS

1. Describe the distributions of heavy metals in groundwater (GIS)	Pb (mg/L)	Cd (mg/L)	Cr (mg/L)	As (mg/L)
Presence of heavy metals	44	24	11	0
Absence of heavy metals	6	26	39	50

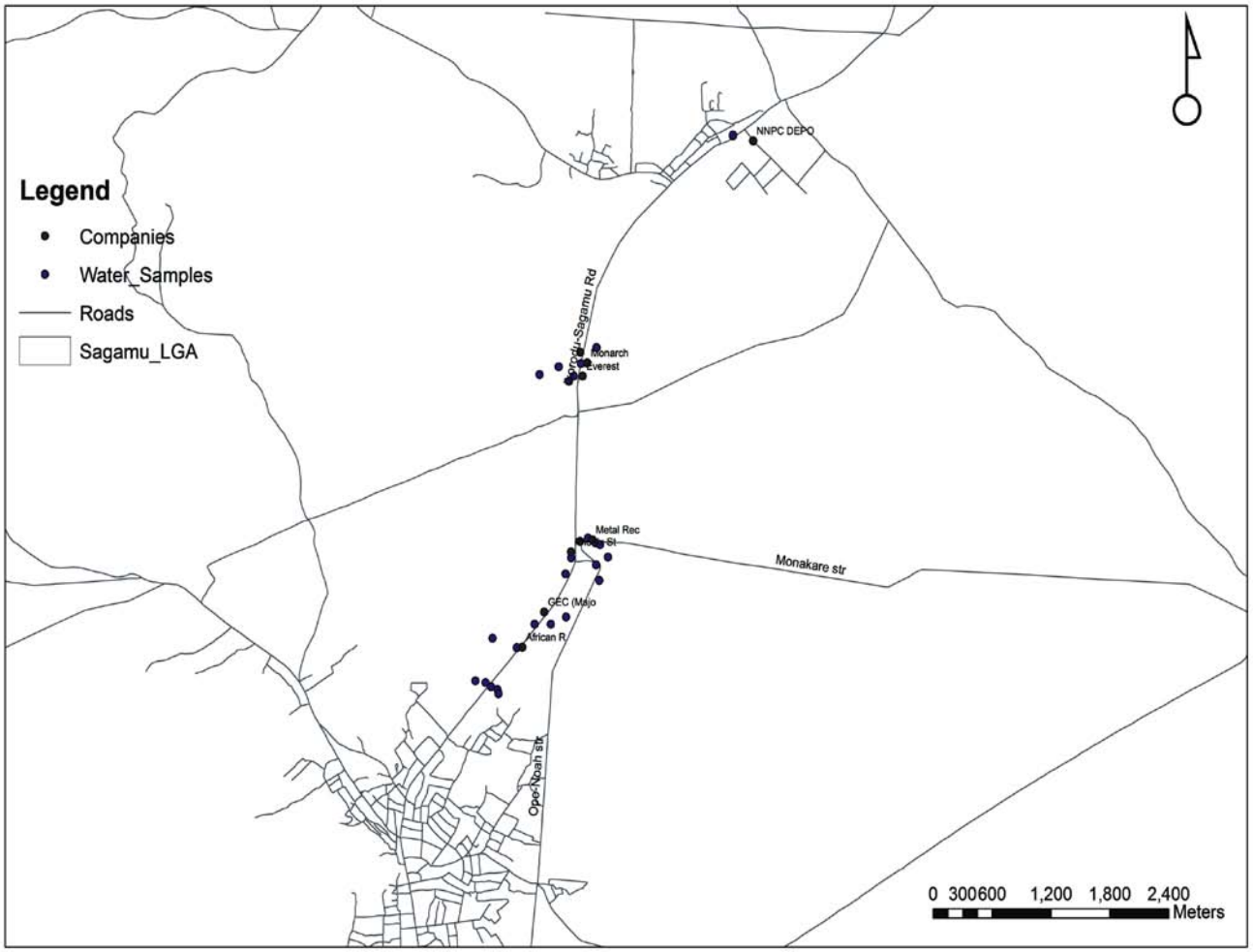

Fig. 1: Map Showing Sample Locations In Ogijo/Likosi Ward 10

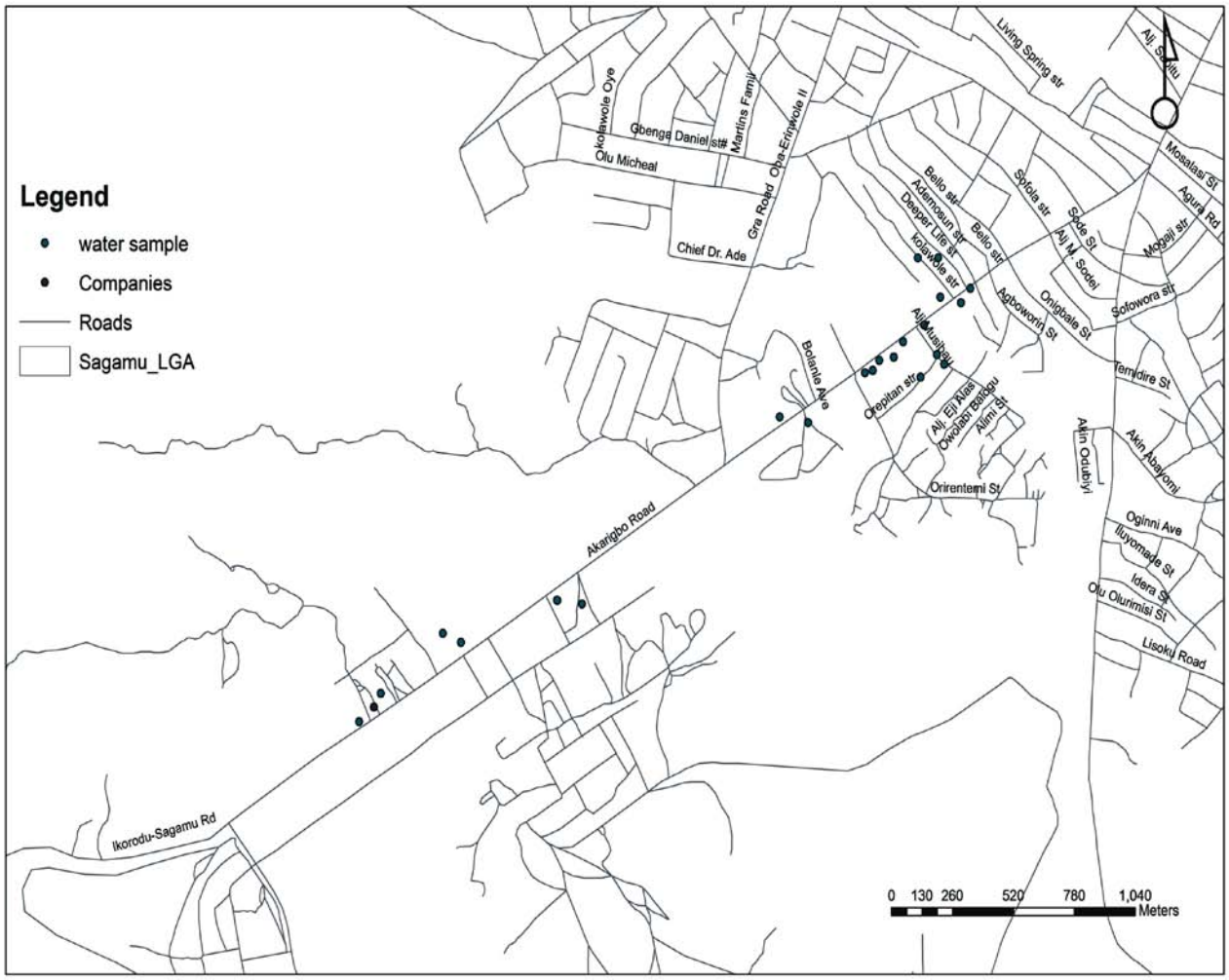

Fig. 2: MAP Showing Sample Locations In Sabo Ward 4 & 5

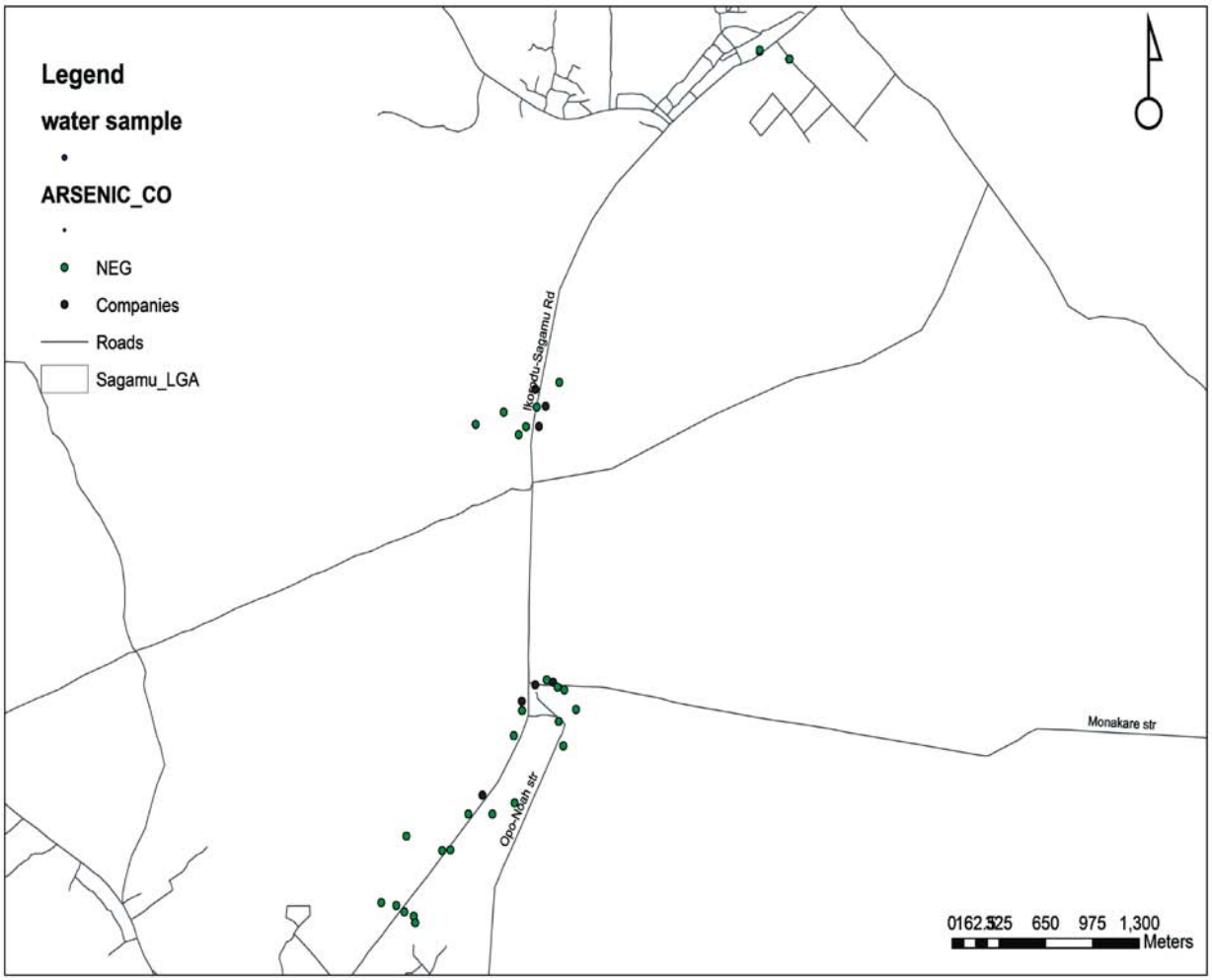

Fig. 3: MAP Showing Arsenic Concentration Distribution in Ogijo Likosi Ward 10

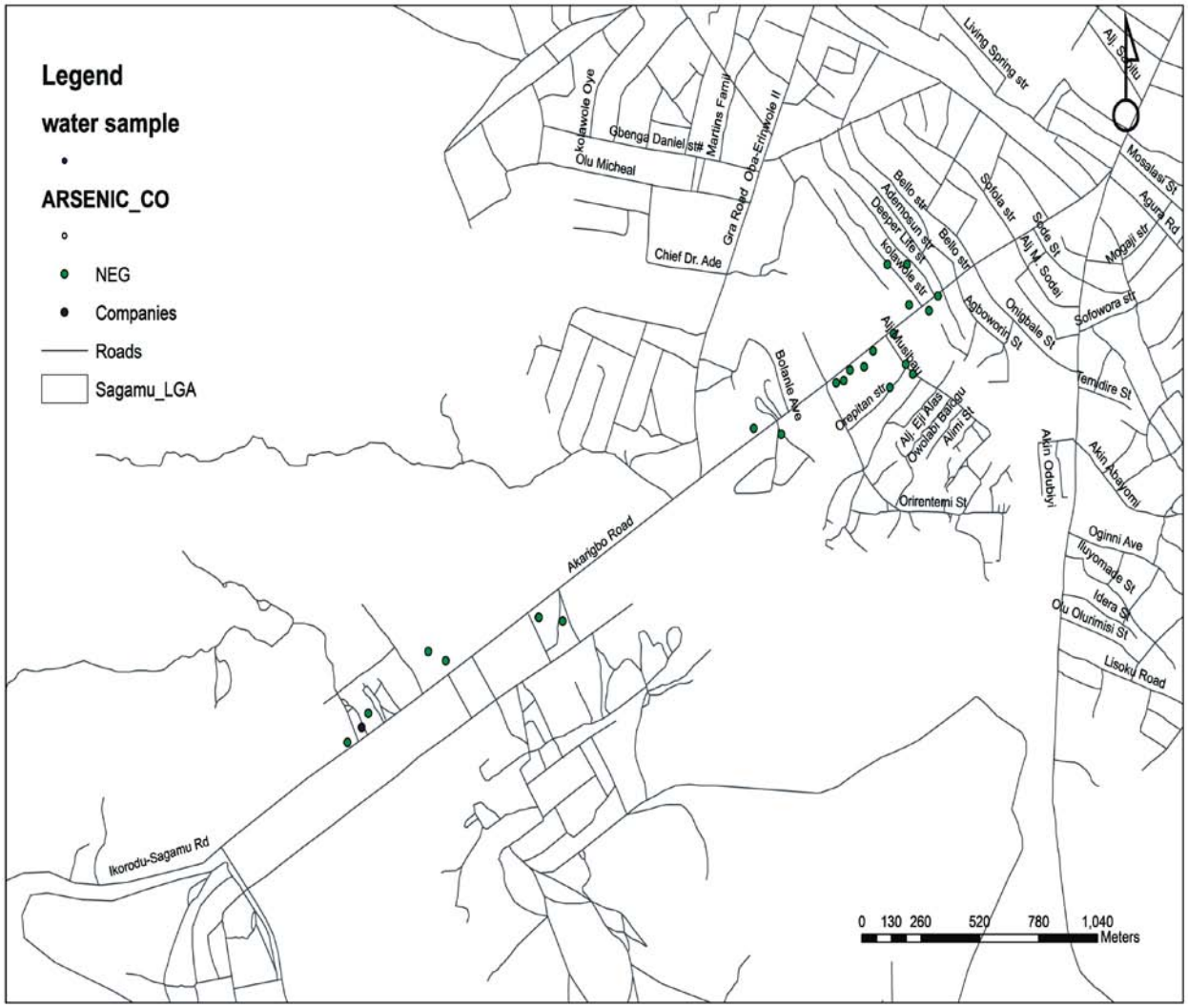

Fig. 4: MAP Showing Arsenic Concentration Distribution In Sabo Ward 4 & 5

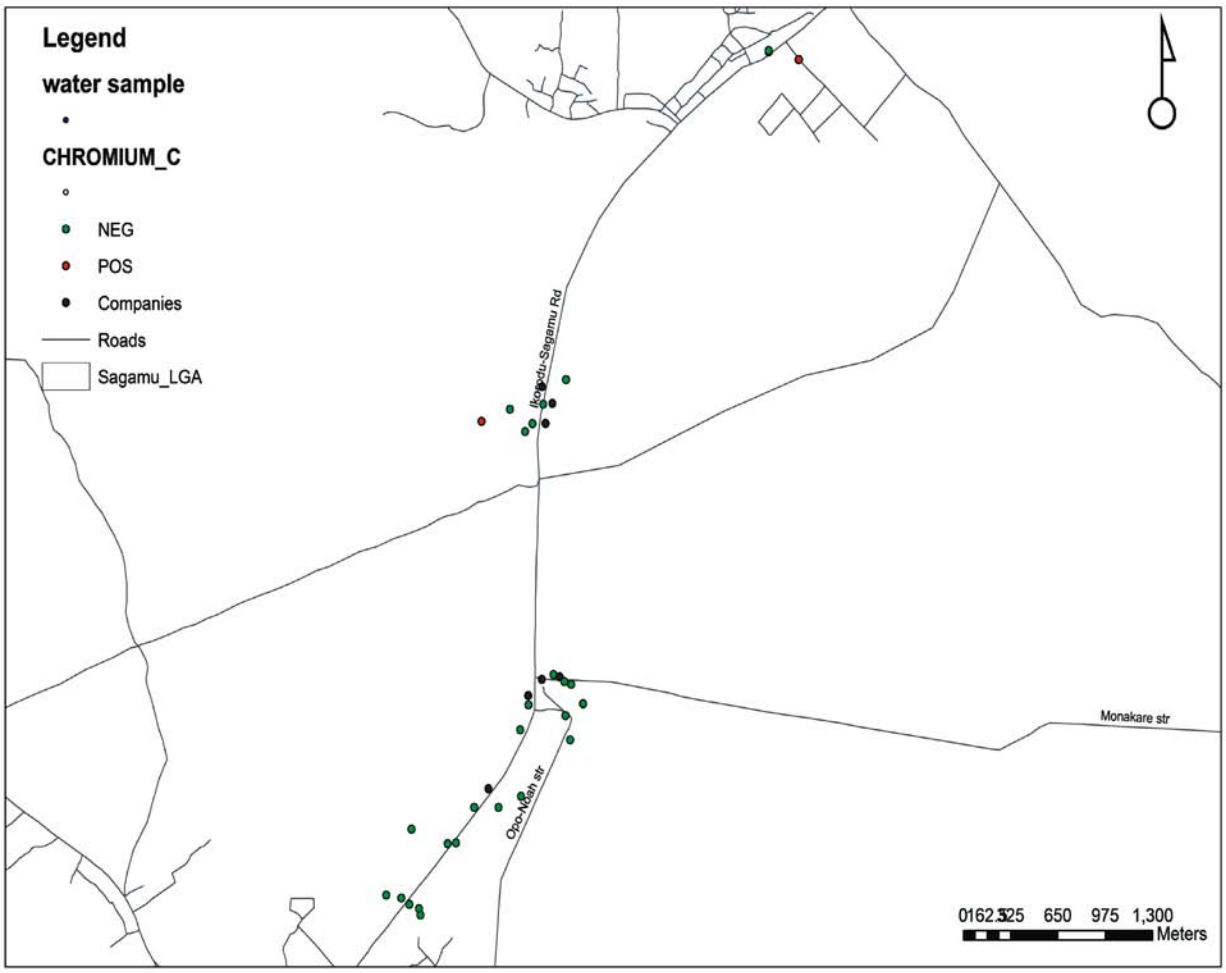

Fig. 5: MAP Showing Chromium Concentration Distribution In Ogijo/Likosi Ward 10

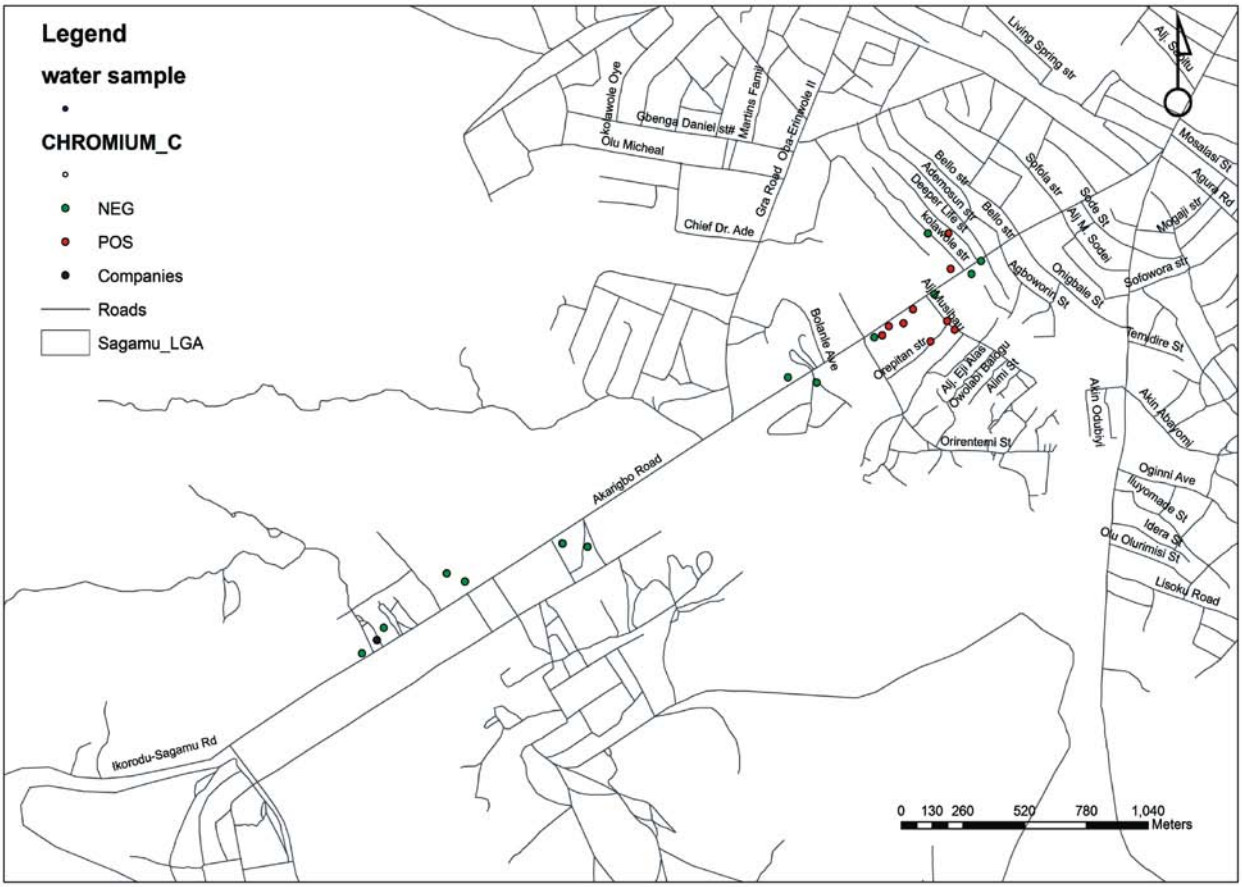

Fig. 6: MAP Showing Chromium Concentration Distribution In Sabo Ward 4 & 5

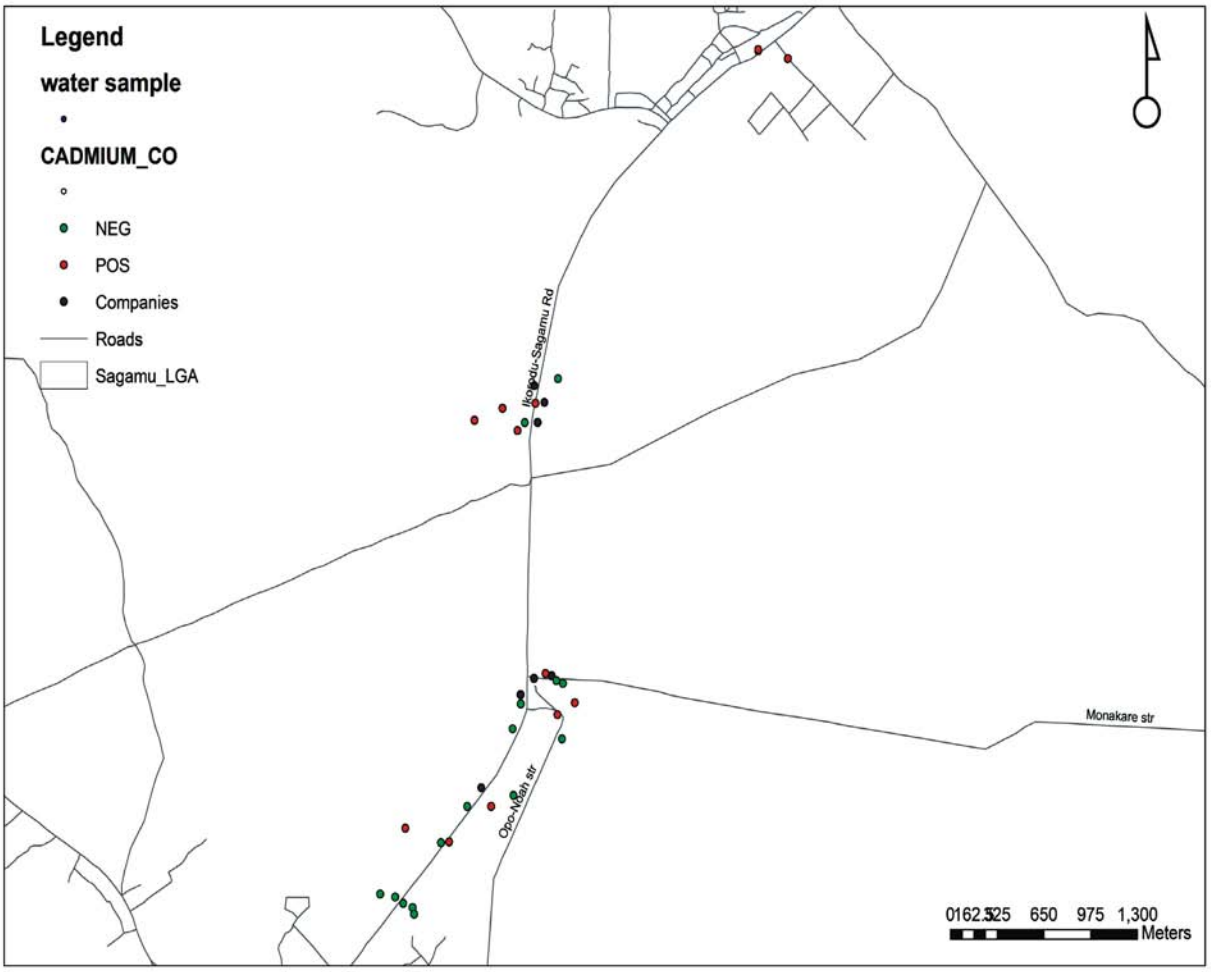

Fig. 7: MAP Showing Cadmium Concentration Distribution In Ogijo/Likosi Ward 10

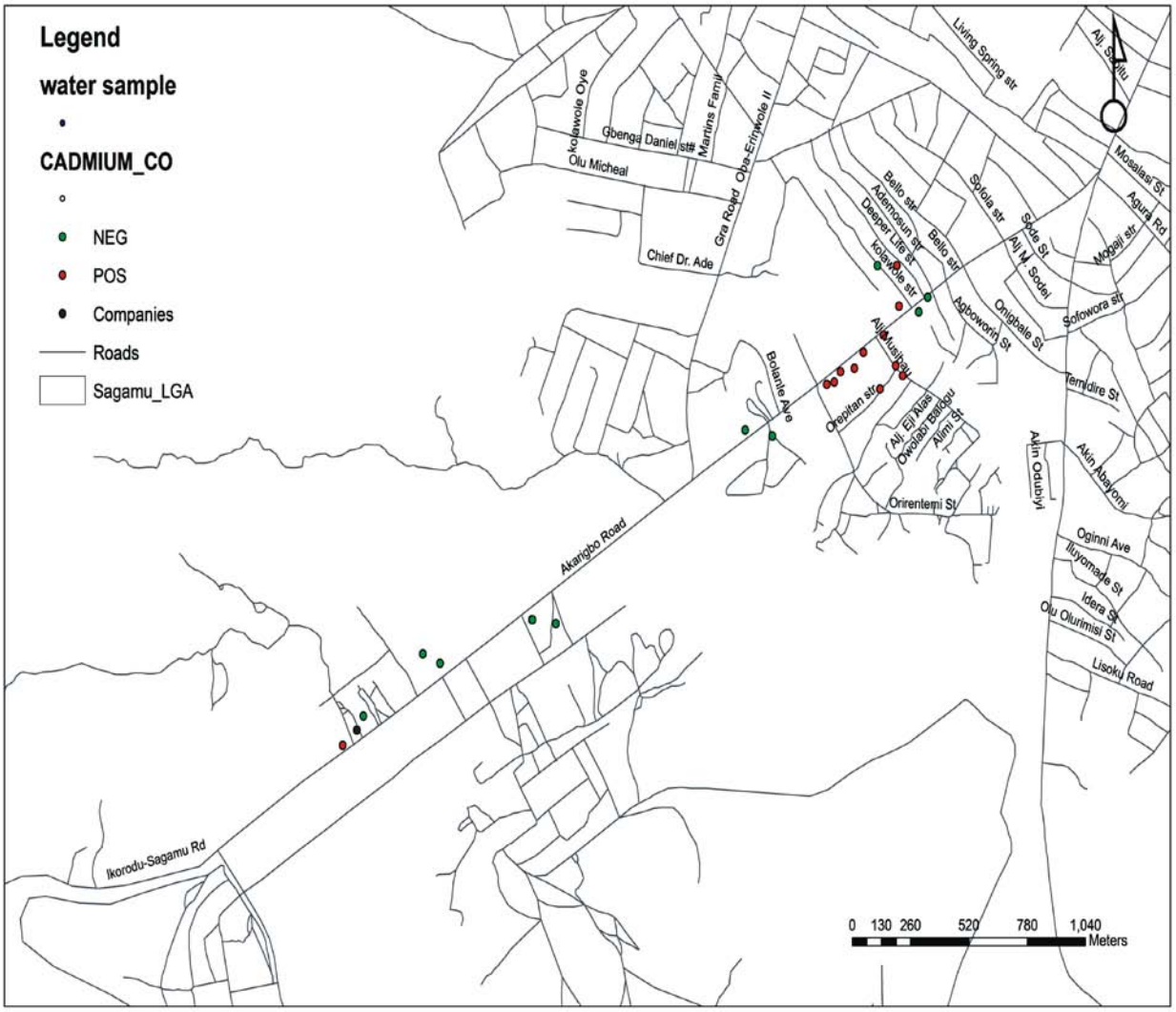

Fig. 8: MAP Showing Cadmium Concentration Distribution In Ward 10

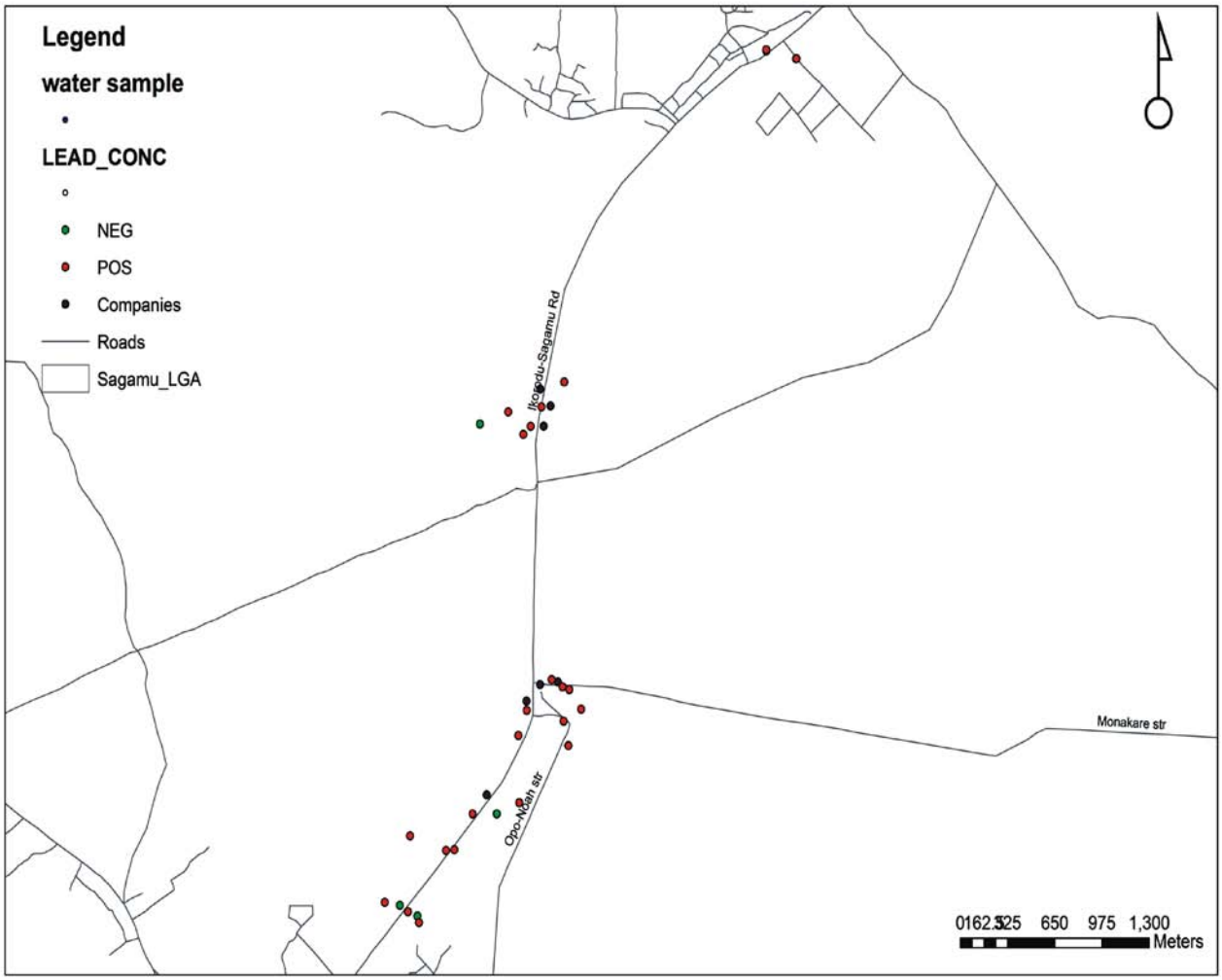

Fig. 9: MAP Showing Lead Concentration Distribution In Ogijo/Likosi Ward 10

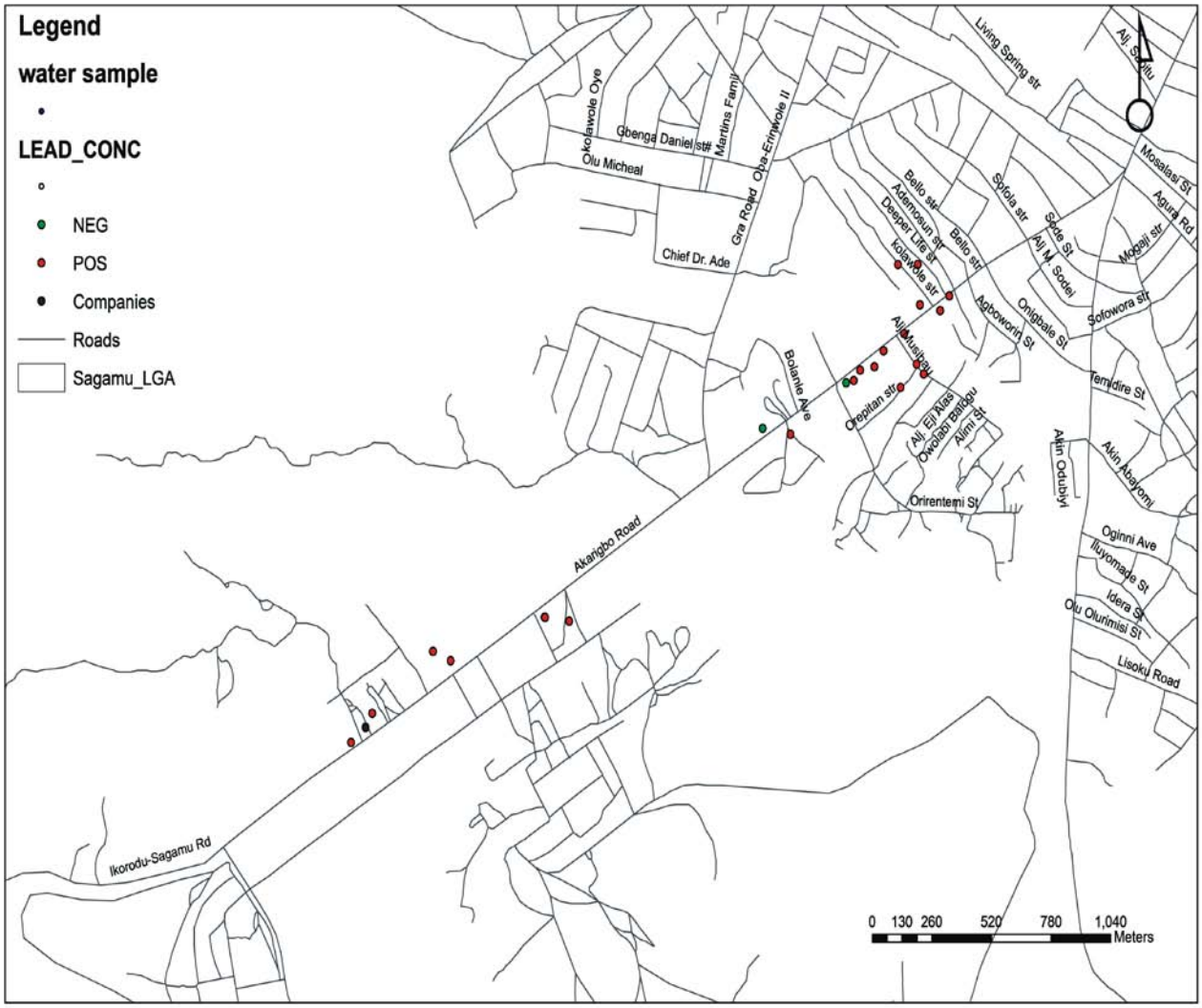

Fig. 10: Map Showing Lead Concentration Distribution In Sabo Ward 4 & 5

IV. Discussion

Ground water had been reported to be the most important source of domestic, industrial and agricultural water supply in the world (Adeyeye and Abulude, 2004). It had also been observed that rock weathering, atmospheric precipitation, evaporation and crystallization control the chemistry of water (Kayode *et al.,* 2011). The influence of geology on chemical water quality had been widely recognized (Lester and Brikett, 1999). The influence of soils in water quality had been known to be very complex and had been ascribed to the processes controlling the exchange of chemicals between the soil and water (Hesterberg, 1998). It had also been reported that the water chemistry of the groundwater consist of inorganic chemicals and suspended solids as a result of urban run-off (McGregor *et al.,* 2000).

In this study, the mean pH value of the sample water is below the recommended value by WHO/SON in drinking water, indicating that the groundwater from the study area is acidic. Past studies had reported the acidic nature of Lagos and Ogun groundwater. Longe and Balogun (2010) reported the mean pH value of 6.134 ±0.67 in Lagos groundwater and Ayedun *et al.,* (2010) also reported pH value of 5.90±0.32 in Ibeshe Ogun State. The acidity is probably as a result of the industrial activities and indiscriminate waste disposal practices in the study area. The acidic water can cause corrosion of water pipes and affect gastro intestinal tract when consumed leading to perforation of intestinal tissues. In a study conducted by Anjorin (2010), to assess the physicochemical parameters of twenty (20) sample wells from three Local Government Areas in Abeokuta Metropolis, Ogun state, Nigeria. He reported that the well water in this area was almost neutral with pH (6.464± 0.568), electrical conductivity (539.6±339.07 μscm^{-1}) and total dissolved solids (274.55±175.35 mg/L).

Four heavy metals As, Cd, Cr and Pb were analysed in groundwater of the study area. The mean value of arsenic and chromium are within the limits prescribed by WHO/SON for drinking water quality.

However, a study conducted by Garba *et al.,* (2010), reported a high mean concentration of arsenic of 0.34mglL in drinking water from hand-dug wells, boreholes and tap of Karaye Local Government Area, Kano State. Even though the arsenic levels in the study area are within the MCL of WHO/SON, there is the possibility of bioaccumulation of arsenic in biological systems. This is important in food chain and ecosystem health. It is known that the first visible symptoms caused by exposure to low arsenic concentration in drinking water are abnormal black-brown skin pigmentation known as melanosis and hardening of palms and soles known as keratosis, further thickening (hyperkeratosis) and can lead to skin cancer (WHO 2001).

Chromium is an essential trace element, required for the metabolism of lipids and protein and to maintain a normal glucose tolerance factor. High doses of chromium cause liver and kidney damage and chromate dust is carcinogenic (SEIGH, 2001; Mugica *et al.,* 2002). Arsenic has become increasing important in environmental geochemistry because of its significance to human health. Long-term exposure to arsenic through drinking contaminated water can result in a chronic arsenic poisoning; known symptoms are: cancer of the skin, lungs, urinary blades, and kidney as well as other skin changes such as pigmentation and thickening (WHO, 2010). The concentration of arsenic in most ground waters is lower than 10g/L and often below the detection limit of routine analytical methods. The physicochemical conditions favoring arsenic mobilisation in aquifers are variable, complex and poorly understood, although some of the key factors leading to high groundwater arsenic concentrations are known (Plant *et al.,* 2004). Reducing conditions favourable for arsenic mobilisation have been reported most frequently from young (Quaternary) alluvial, deltaic sediments (Alaerts and Khouri, 2004). Recent groundwater extraction, either for public supply or for irrigation, has induced increased groundwater flow. This could induce further transport of arsenic (Harvey *et al.,* 2002).

The mean concentration of cadmium and lead found in the sample areas were above the WHO/SON recommended standards. High levels of cadmium and lead in groundwater analysed are probably the result of discharge from industrial waste or by leaching from solid waste dumped (Naik *et al.,* 2007; Singh, 2003), particularly from the iron steel and metal industries in the study area. Similar observation was reported by Eruola *et al.,* (2011) that showed high concentration of Cd (0.017±0.016) in Ilaro and high concentration of Pb (0.23±0.06) in Aiyetoro all in Ogun State. Cadmium is highly toxic, producing symptoms such as nausea, vomiting, respiratory difficulties and loss of consciousness at high doses. Chronic exposure to cadmium can lead to anaemia, cardiovascular diseases, renal problems and hypertension. (Robert and Worsfold, 1991). Waakles (2000), reported the co-existence of renal and lung damage among workers of alkali storage plant. Cadmium effects on cardiovascular system were explained by linking dietary cadmium to hypertension (Schroeder, 1965). Cadmium is released to the environment in wastewater, and diffuse pollution is caused by contamination from fertilizers and local air pollution. Contamination in drinking water may also be caused by impurities in the zinc of galvanized pipes and solders and some metal fittings (Kayode *et al.,* 2011). Food is the main source of daily exposure to cadmium and the daily oral intake is 10 to 35mg. Smoking is a significant additional source of cadmium exposure (WHO, 2010).

Lead is a cumulative poison, initiating hypertension, irritability, behavioural changes and impairment of intellectual functions in affected patients (Tebbutt, 1983). Long – term exposure to lead or its salt (especially soluble salts or the strong oxidant PbO_2) can affect adversely the nervous system and kidneys (Mugica *et al.,* 2002). The spatial distribution showed that there was predominantly high concentration of lead across the study area. In the upper northern part of Ogijo/Likosi and across Sabo 1 and 2, lead was predominantly high especially the areas close to industries. Lead from atmosphere or soil can end up in groundwater (Yu, 2005). Lead gets into drinking water from the corrosion of lead solder that connects the pipes or brass faucets. In US, 14-20% of total lead exposure is attributed to drinking water (Mass *et al.,* 2005). Studies have linked lead exposure even at low concentration and increases blood pressure (Zietz *et al.,* 2007), as well as encephalopathy and inability to learn fast in children (Needleman, 1985). Therefore, the presence of these heavy metals in groundwater sources for domestic use should be managed with appropriate technology that will be suitable for rural and urban dwellers. This should be geared towards improved public health status of the communities.

V. Conclusions

The purpose of this study was to assess heavy metals contamination in groundwater in some selected communities in Sagamu Local Government Area, Ogun State, Nigeria. The results show that the mean pH of the water from the borehole and hand dug wells are slightly acidic which makes the water a good medium for dissolution of heavy metals. High concentration of the heavy metals may be attributed to industrial release of hazardous waste and untreated effluents in soil leaching into groundwater. In the light of the parameters assessed, the drinking water sources may not presently have any adverse effect as far as arsenic and chromium are concerned, since their mean concentrations fell within the regulatory bodies standards, contrary to the

mean concentrations of lead and cadmium. This suggests a risk of the population to heavy metals toxicity and acidic water, thereby making the groundwater sources (borehole and hand dug well) unsafe for drinking, which is raising a warning sign to the health of people settled in the communities.

Acknowledgements

The technical input of Mr. Femi Oyediran, Managing Director, Environmental Laboratories Limited and Mr. Toyin Bawala supports during the data collection stage and the laboratory analysis of the samples is highly appreciated.

Conflict of Interest

The authors declare no conflict of interest in the publication of this research paper.

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Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 18 Issue 2 Version 1.0 Year 2018
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Alterations of Ionic Regulations Due to the Toxicity of Endosulfan Result the Death of the Fish Mastacembelus Armatus

By Kasinatha Durai R, Nambu Mahalakshmi R & Amanullah Hameed S. V. S.

Abstract- Fresh water fish has made a substantial contribution as food to the growing population. Fish proteins occupy an important place in human nutrition. They have high digestibility, besides biological and growth promoting value. However, indiscriminate use of pesticides in agricultural operations poses many problems to the aquatic environment and causes serious contamination. Continuous exposure of fish to these toxic chemicals is hazardous to their health and causing massive fish kills. In this investigations, Mastacembelus armatus a cauvery riverine fish was exposed to endosulfan an organochlorine pesticide widely used in agricultural areas in cauvery delta. It was found that the toxicity of this pesticide had caused a deleterious effects in the ionic regulations of the fish monovalent cations like Na+, K+ and divalent cations like Ca++and Mg++ play a significant role in the physiological functions of fishes. Prolonged exposure of the fish to the endosulfan toxicity had altered the ionic regulations and resulted to the morbidity of fish and finally lead to the mortality of the fish from the pesticide polluted water.

Keywords: *homeostasis-hypocalcemia-pesticide toxicity-hypocalcemia- metabolic fortification sodium and potassium pump.*

GJSFR-H Classification: *FOR Code: 059999p*

Strictly as per the compliance and regulations of:

Alterations of Ionic Regulations Due to the Toxicity of Endosulfan Result the Death of the Fish Mastacembelus Armatus

Kasinatha Durai R [α], Nambu Mahalakshmi R [σ] & Amanullah Hameed S. V. S. [ρ]

Abstract- Fresh water fish has made a substantial contribution as food to the growing population. Fish proteins occupy an important place in human nutrition. They have high digestibility, besides biological and growth promoting value. However, indiscriminate use of pesticides in agricultural operations poses many problems to the aquatic environment and causes serious contamination. Continuous exposure of fish to these toxic chemicals is hazardous to their health and causing massive fish kills. In this investigations, *Mastacembelus armatus* a cauvery riverine fish was exposed to endosulfan an organochlorine pesticide widely used in agricultural areas in cauvery delta. It was found that the toxicity of this pesticide had caused a deleterious effects in the ionic regulations of the fish monovalent cations like Na^+, K^+ and divalent cations like $Ca^{++}$and Mg^{++} play a significant role in the physiological functions of fishes. Prolonged exposure of the fish to the endosulfan toxicity had altered the ionic regulations and resulted to the morbidity of fish and finally lead to the mortality of the fish from the pesticide polluted water.

Keywords: homeostasis-hypocalcemia-pesticide toxicity -hypocalcemia- metabolic fortification sodium and potassium pump.

I. Introduction

Fresh water fish has made a substantial contribution as food to the growing population. Fish proteins occupy an important place in human nutrition. They have high digestibility, besides biological and growth promoting value (Idyl, 1972 and Tont 1977). However, indiscriminate use of pesticides in agricultural operations poses many problems to the aquatic environment and causes serious contamination (Cremlyn,1978). Continuous exposure of fish to these toxic chemicals is hazardous to their health and causing massive fish kills (Saunders, 1969). In this investigations, *Mastacembelus armatus* a cauvery riverine fish was exposed to Endosulfan an organochlorine pesticide widely used in agricultural areas in cauvery delta. It was found that the toxicity of this pesticide had caused a deleterious effects in the ionic regulations of the fish. Monovalent cations like Na^+, K^+ and divalent cations like Ca^{++} and Mg^{++} play a significant role in the physiological functions of tissues. Prolonged exposure of the fish to the endosulfan toxicity had altered the ionic regulations and resulted to the morbidity of fish and finally lead to the mortality of the fish from the pesticide polluted water.

Fresh water fishes maintain the internal homeostasis through the influx and efflux of ions, which exist in bound and free form and are essential for cell metabolism. Sodium and potassium pump mechanisms maintain the normal cell volume and pressure. They are also important in the regulation of water and electrolyte balance and acid-base balance in the body. Sodium ions concentration in the tissues depends primarily on the permeability of the membrane and also on the functional efficiency of the sodium pump, which regulates the ionic content of the tissues. Calcium has been recognized as an important factor in influencing the survival of fishes. Physiological functions including muscular contractions, hormonal release, maintaining cellular structure, membrane stability and cytoplasmic compositions are regulated by calcium ions in the tissues of fishes. Calcium homeostasis is achieved by a balance between absorption in the intestine and excretion by the kidney.

II. Materials and Methods

a) Collection of samples

Laboratory acclimatized female fishes *M. armatus* of 15-17.5 gm. weight were grouped into sets of 10 fish and was introduced into the sub lethal concentration of 1/30 Lc 50 of endosulfan. A control of 10 fish, not exposed to endosulfan pesticide was also maintained. Earth worms and fish feeds were provided throughout the experimental period, but feeding was stopped 24 hours prior to the sampling day. The total period of exposure was 30 days. Sampling was done on 96 hours.

i. Estimation of Calcium and Magnesium

The total calcium and magnesium ions in the samples were determined by titrating with disodium Ethylene Diamine Tetra Acetate (EDTA). Eriochrome black I was an indicator. Calcium was estimated by titrating with EDTA using Muroxide as indicator (Kacz *et al.,*1964)

200mg of tissue from liver, ovary, and muscle were taken for analysis. The tissues were digested in 2ml of concentrated HNO3, kept overnight and were

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diluted with 10 ml of distilled water. This solution was taken for the estimation of calcium and magnesium. 1 ml of the sample was taken in a China dish and 9 ml of distilled water was added. 5 ml of Ammonia buffer was added followed by 2 drops of Erichrome black I indicator and titrated against 0.01m EDTA. The end point was the appearance of Sky blue colour. Titre value was common for the Ca^{++} and Mg^{++}ions .

To 1ml of the same sample 9ml of distilled water was added in a China dish, 5ml of 10% NaOH solution was added and 2 drops of Muroxide indicator was added and titrated against 0.01m EDTA. The end point was the appearance of violet colour.

III. Calculation

Titre value of Mg^{++} = Titre value of Ca^{++} and Mg^{++} - Titre value of Ca^{++}

$$\% \text{ of Calcium} = \text{Titre value of Ca} \times \text{Molarity of EDTA} \times \frac{\text{Volume made} \times \text{dilution} \times 100}{\text{Weight of the sample (mg)}}$$

$$= \% \text{ of } Ca^{++} \times 10^4 / \text{Equivalent wt. of calcium}$$

$$= \text{Milli Equivalent } Ca^{++}/\text{ Kg}$$

Magnesium ions were also estimated employing the same calculation method after substituting, the appropriate titre value and equivalent weight of magnesium.

a) Estimation of Na^+ and K^+

200 mg of wet tissue from liver, ovary, and muscle were taken from the enosulfan treated and untreated fish. To each of the tissue 2 ml of concentrated HNO3 was added, followed by 10 ml of distilled water and filtered. The filtrate was used for the analysis of Na^+ and K^+ in an automatically controlled G.BC 906 (Australia). Atomic Absorption Spectro-photometer. Na^+ was estimated at 588.6 nm and K^+ was estimated at 766 nm. The ionic levels were calculated and expressed in meq/ kg of tissues.

IV. Results and Discussion

In this investigation, *Mastacembelus armatus* a Cauvery riverine fish was exposed to endosulfan an organochlorine pesticide which is widely used in agricultural areas of Cauvery Delta. It was found that the toxicity of this pesticide caused deleterious changes in the ionic regulations of the fish and the excretion by the kidney. Mg++ also plays a key role in the action of many enzymes, particularly those of glycolysis and ATP dependent reactions.

But the ionic regulations of the fresh water fishes are altered by the additions of metals and pesticide pollutants. These pollutants change the ionic concentration in the tissues which could result in physiological, behavioral and hormonal abnormalities. The disturbance in the ionic regulations has been established in the fresh water *Mastacembelus armatus.* These fishes were subjected to sub lethal concentration of endosulfan. The exposed fishes showed hypocalcemic condition in liver, ovary and muscles. This declining trend is due to the structural and functional changes of the mitochondrial membrane of the tissues.

Pesticide toxicity inhibits the binding of calcium to the phospholipid moiety of the ATPase enzyme, thus inhibiting the normal movement of Ca++ across the nerve membrane, resulting in hypocalcemic condition in the peripheral tissues such as liver, ovary and muscle (Table 1).

Table 1: Cation in M. armatus treated with endosulfan

M. armatus untreated	Organs of *M. armatus*	Concentration of cation in MEq/Kg			
		K^+	Na^+	Ca^{++}	Mg^{++}
	Liver	37.5	151.12	9.83	13.17
	Ovary	31.17	140.83	7.50	11.33
	Muscle	103.87	125.50	9.50	11.14
M. armatus treated with endosulfan	Liver	11.17	180.17	2.40	25.03
	Ovary	16.67	195.00	1.67	24.00
	Muscle	77.83	149.83	2.83	22.83

The muscle of the fishes showed a declining trend of Ca^{++} ions due to the inhibition of Ca^{++} ATP ase enzyme. This condition of the tissue results in vigorous muscular spasms and neuro muscular effects.

Endosulfan toxicity also increases the Mg^{++} concentration in the tissues. This alteration of Mg^{++} transport is due to the changes of the permeability of the membrane systems and damage of gills, intestinal mucosa and the failure of renal tubular reabsorption caused by the pesticide residues. The pesticide toxicity also inhibits Na and K, ATPase enzymes and disturbs osmoregulation, muscular activity and physiological functions. Prolonged changes in cationic regulations may result in the morbidity and extinction of these organisms from polluted waters.

Acknowledgements

It is indeed a great pleasure for me to express my deep sense of gratitude to my research advisor Dr. George John, Department of Zoology, A.A. Govt arts and College. Musiri, for suggesting this problem, providing able guidance and encouragement. I am deeply indebted to Dr. R.S. Jagadish Bose Principal and Prof. Mrs. S. Kanthamani HOD of the Department of Zoology, A.A. Govt. Arts College, Musiri.

I have great pleasure in expressing my heartfelt thanks to the Board of Management, the principal and Prof. Dr. S. Thangavelu, HOD. of PG. and Research Dept. of Zoology, Jamal Mohamed College, Trichirappalli. I am immensely thankful to Dr. K. Ramalingam, Lecturer Research Department of Zoology Govt. Arts College, Nandanam, Madras. I am also grateful to Dr. P. Subramanian (Doctoral Committee Member) Lecturer, Department of Animal Science, Bharathithasan University, Trichirappalli.

My sincere thanks are due to the Director, Central Electro Chemical Research Institute (CECRI) Karaikudi for granting permission to avail HPLC and Atomic Absorption Spectrophotometer facilities. I thank especially the university Grants Commission, New Delhi and the Bharathidasan University for selecting me under the F.I.P. for one year and the financial assistance provided during the research period. I also thank the commissioner of collegiate education, Madras for granting me permission to do this research project.

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Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 18 Issue 2 Version 1.0 Year 2018
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Potential Soil Loss Rates in Urualla, Nigeria using Rusle

By B.U. Dike, O.P. Alakwem, H.U. Nwoke & N.N., Nwakwasi
Federal University of Technology Owerri Imo State

Abstract- Soil erosion represents a natural risk which produces material and human losses annually. The assessment and mapping of erosion prone areas are essential for soil watershed management. The objective was to apply RUSLE model to determine the amount of soil loss in Urualla watershed of Imo, Nigeria. Land use and land cover map was obtained from Google earth satellite image; ground control point data was collected from GeoSmart Survey, Imo State, Nigeria; 25 year sannual rainfall data was obtained from NIMET; soil map was generated from Onyekanne et al. (2012) soil data. The various components of RUSLE were integrated into the ArcGIS 10.2.1 to estimate the annual soil loss in the area. The soil loss in the area ranged from6 to 1200 t/ha/year while the mean annual soil loss is 36 t/ha/yr. The erosion map obtained shows that in the study area, 25.9% has medium erosion rate of 10-15 t/ha/yr; 33.6% has moderately high erosion rate of 15-25 t/ha/yr; 16.4% has high rate of 25-50 t/ha/yr while 14.7% has a rate greater than 50 t/ha/yr. The study shows that GIS presents simple and low cost tools for assessing erosion potential and risk in a watershed.

Keywords: *soil erosion, GIS, RUSLE, urualla watershed, map, erosion factors.*

GJSFR-H Classification: *FOR Code: 050399*

Strictly as per the compliance and regulations of:

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B.U. Dike [α], O.P. Alakwem [σ], H.U. Nwoke [ρ] & N.N., Nwakwasi [ω]

Abstract- Soil erosion represents a natural risk which produces material and human losses annually. The assessment and mapping of erosion prone areas are essential for soil watershed management. The objective was to apply RUSLE model to determine the amount of soil loss in Urualla watershed of Imo, Nigeria. Land use and land cover map was obtained from Google earth satellite image; ground control point data was collected from GeoSmart Survey, Imo State, Nigeria; 25 years- annual rainfall data was obtained from NIMET; soil map was generated from Onyekanne et al. (2012) soil data. The various components of RUSLE were integrated into the ArcGIS 10.2.1 to estimate the annual soil loss in the area. The soil loss in the area ranged from6 to 1200 t/ha/year while the mean annual soil loss is 36 t/ha/yr. The erosion map obtained shows that in the study area, 25.9% has medium erosion rate of 10-15 t/ha/yr; 33.6% has moderately high erosion rate of 15-25 t/ha/yr; 16.4% has high rate of 25-50 t/ha/yr while 14.7% has a rate greater than 50 t/ha/yr. The study shows that GIS presents simple and low cost tools for assessing erosion potential and risk in a watershed.

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I. Introduction

Soil erosion is one of the most serious environmental problems in the world today because it threatens agriculture and also the natural environment [8].The factors which influence the rate of erosion are rainfall, runoff, soil, slope, plant cover and presence or absence of conservation measures, [6]. Erosion control requires a quantitative and qualitative evaluation of potential soil erosion considering these factors [9].

Urualla watershed has massive active erosions currently devastating the land. This has been attributed to several causes [16]. Assessing soil erosion rate is essential for the development of adequate erosion prevention measures for sustainable management of land and water resources [3].

Soil erosion modelling can be undertaken using deterministic, stochastic, or empirical approaches [1]. In an empirical model, theoretically-based procedures are employed using parameters like Universal Soil Loss Equation (USLE), Revised USLE or its modifications and derivatives ([17, [13] and[14]). Geographic Information System (GIS) technologies are valuable tools in developing environmental models through their advance features of data storage, management, analysis and display. There are several GIS-Based models used to estimate soil loss. RUSLE is frequently used due to its simplicity and suitability for integration with GIS. RUSLE has several improvements over USLE in estimation of factors and application to different conditions including forest, rangelands and disturbed areas [5]. Several studies has been carried out in recent years using RUSLE ([2],[10],[3],[4]etc.). With appropriate selection of factors, RUSLE computes average soil loss [13] as follows

$$A = R \times K \times LS \times C \times P \quad (1)$$

Where: A = Computed average annual soil loss in (tons/ha/year), R = Rainfall erosivity factor in (MJ.mm/(ha.h.year-1)); K = Soil erodibility factor in (t.ha.h/(ha.MJ.mm); LS = Surface characteristic factor comprising of L = Slope length factor and S = Slope steepness factor; C = Cover management factor; P = Conservation practice factor or support practice factor.LS, C, and Paredimensionless.

The runoff factor [7]is computed as

$$R = 38.5 + 0.35 \times \Pr \quad (2)$$

Where, Pr = annual average rainfall (mm/yr)

The LS factor is estimated [17] as

$$LS = \left(\frac{\text{Flow accumulation} \times \text{Cell value}}{22.1}\right)^{m} (0.065 + 0.045\,S + 0.0065\,S^2) \quad (3)$$

Where cell value = resolution of DEM, S = slope (%) generated from DEM, m is estimated from [17] table.

The support practice factor P classified according to cultivation and slope are obtained from [15]. The objective of the study therefore is to predict soil loss rate in Urualla watershed using RUSLE and compare results with physical site assessment.

a) Study Area

Urualla is located in the north-western region of Idea to North L.G.A of Imo State, Nigeria. It covers a total of approximately 19.570 sq km and is situated between latitude 5° 50´N and 5° 55´N; and longitudes 7° 00´E and 7° 05´E. The area is semi-urban consisting mainly of built up areas which is characterized by humid

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tropical wet and dry climate governed primarily by rainfall. The annual rainfall ranges from 1,990mm to 2,200mm with average annual temperature of 25.8 °C. The study area is shown in Fig. 1.

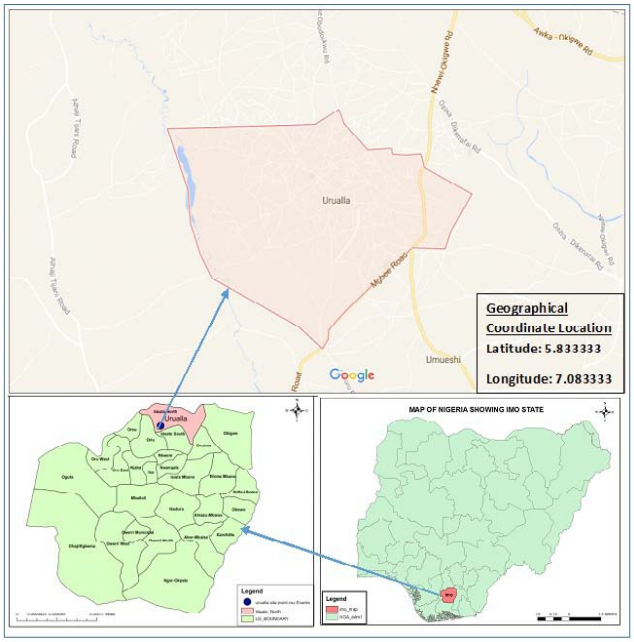

Fig. 1: Location map of the study area

II. Materials and Methods

The primarydata include DEM of Urualla, which was generated from ground control point (GCP) data collected from GeoSmart survey unit in Imo State. A high resolution Google earth satellite image used to obtain the land use and land cover map of the study area. The annual rainfall Owerri, Enugu and Onitsha stations were collected from the Nigerian Meteorological Agency (NIMET) for a period of 25years (1981-2005). The study area soil map was generated from soil data [12]. The various components of RUSLE namely rainfall erosivity(R), soil erodibility(K), topographic factor(LS), crop management factor(c) and conservation practice factor (P) were obtained using equations specified in literature and integrated in ArcGIS 10.2.1to estimate the amount of annual soil loss. A schematic presentation of the procedure as adopted from [11] is shown in Fig.2.

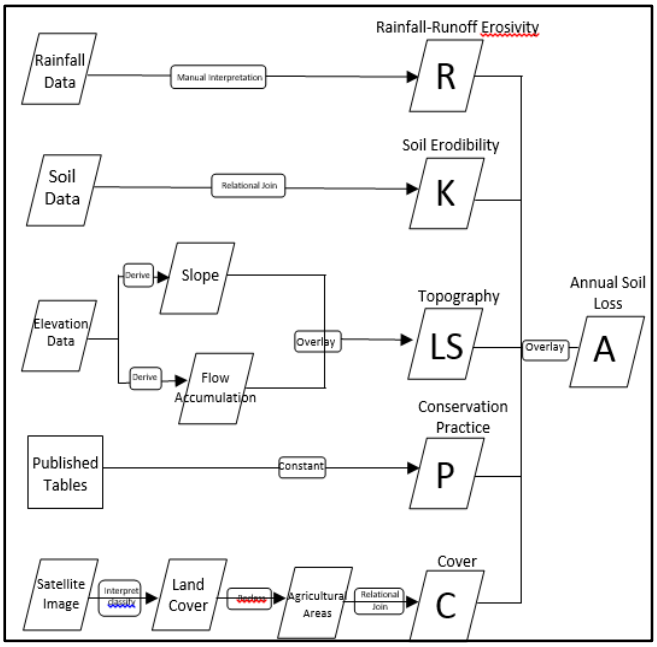

Fig. 2: Procedures of RUSLE integrated in ArcGIS
Source: Omar, (2010)

III. Results and Discussion

The rainfall erosivity factor (R) ranged from98.8939 to100.04 MJ.mm.ha^{-1}.hr^{-1}.year^{-1} (Fig. 3). Based on rainfall erosivity, the higher value which is 100.04 found in the lower part of the study area shows it'smore likely to cause erosion while the lower value in the upper part of the study area indicates less vulnerability to erosion when considering rainfall.

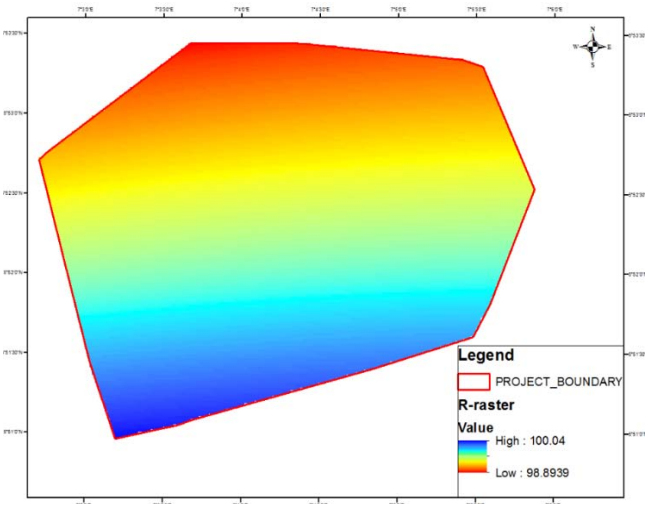

Fig. 3: R factor Map

The value of K-factor in the study area ranged from 0.131454 to 0.140551 ton. ha/MJ.mm (Fig.4). The high K-factor value found in the upper side of the watershed shows that the soil type is more likely to be eroded while the smaller value found in the south-

eastern part of the watershed shows the soil to be less vulnerable to erosion.

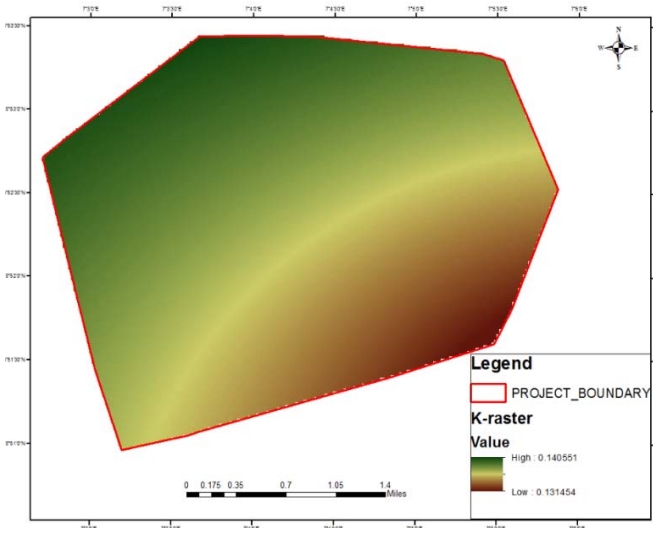

Fig. 4: K Factor Map

The topographic factor, LS increases in the range of 0.0-39.045 (Fig.5) as the slope and flow accumulation increases. The high LS values are associated with steep slopes between 15% - 50% and greater than 50%. Areas of high LS value are more likely to be eroded than other areas.

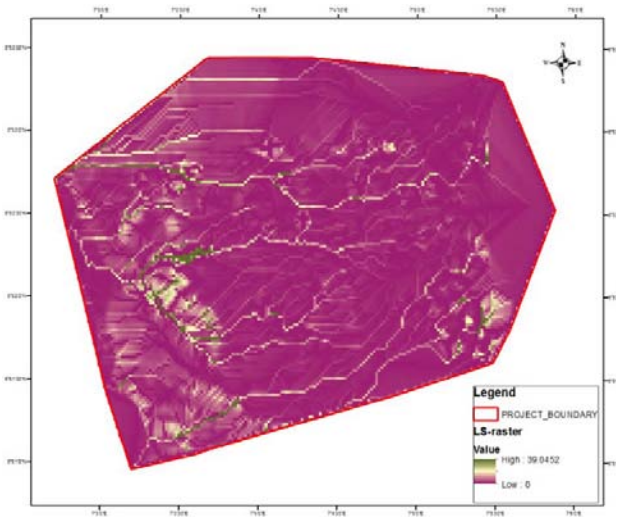

Fig. 5: LS Factor Map

Fig. 6 shows spatial distribution of crop management factor C which ranged from 0 to 0.5. Thus, based on C-factor the large value shows more vulnerable land use/land cover to erosion and on the other hand the lower value shows less vulnerable land use/land cover to erosion. From the result bare lands have a large value of C-factor of 0.5.

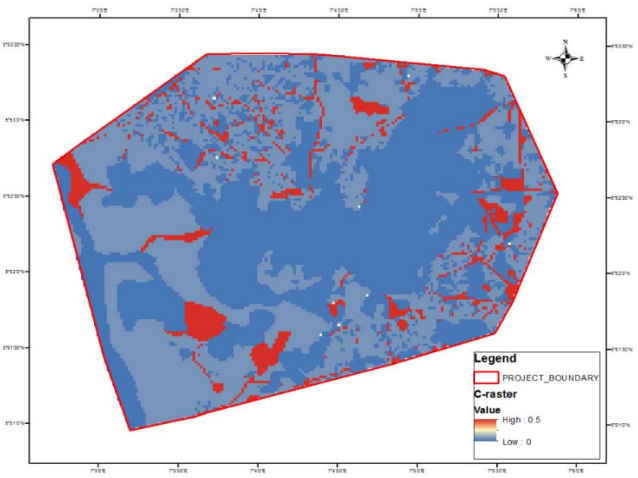

Fig. 6: C Factor Map

The P factor ranged from 0.55 to 1.0 (Fig.7). By contrast, maximum P values correspond exactly with areas of steep slopes while the minimum values corresponds with areas of gentle slope

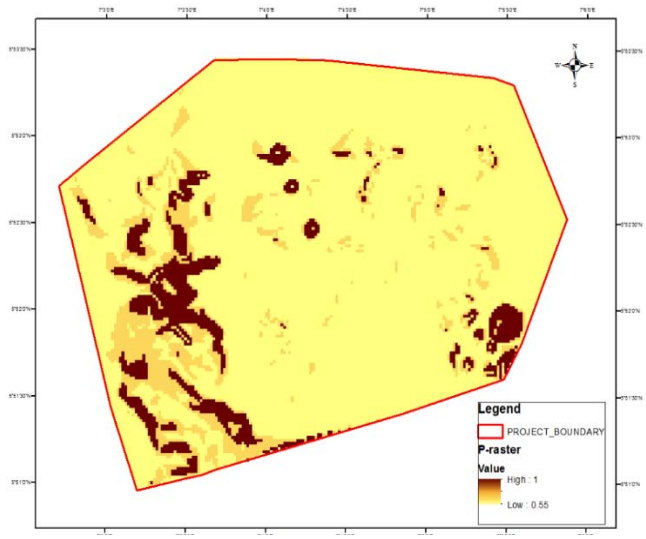

Fig. 7: P Factor Map

This five (R, K, LS, C and P)maps were multiplied interactively using raster calculator tool in ArcGIS 10.2.1. The output gives an erosion map which shows that the potential annual soil loss of Urualla watershed ranges from 6 to 1200 ton/ha/year (Fig. 8).

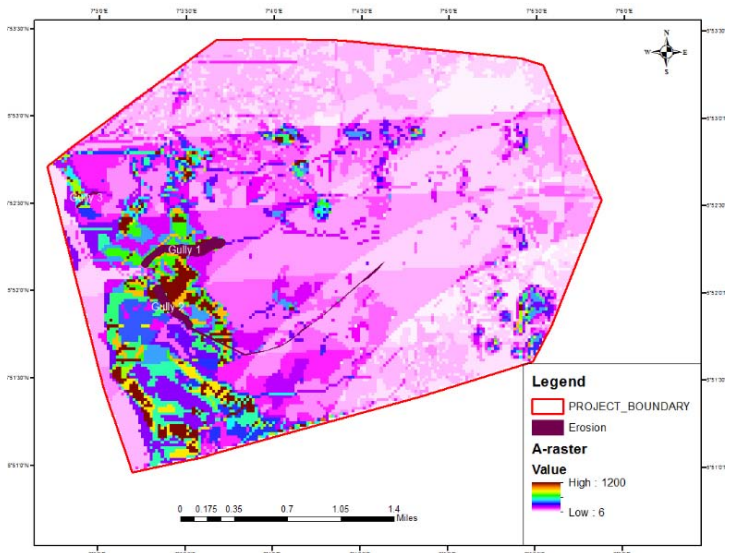

Fig. 8: A Map (Soil loss Map)

The lowest soil loss rate is 6 t/ha/yr while 1200 t/ha/yr shows highest soil loss rate in the study area. The mean annual soil loss rate is 36 ton/ha/year which is much greater than the tolerable level of 10 ton/ha/year (Hurni, 1983).

The result of reclassifying Urualla soil loss rate map into six soil erosion risk categories (Fig. 9) shows that the three identified gullies discovered during site visit falls on the areas having very high and high rate of soil loss. Thus, this accounts for the massive soil loss at the gullies more especially gully 1 to an estimated depth of about 20 m. The result of analyzing the soil loss map to estimate the area of coverage (Fig. 10) shows that 0.2% and 9.2% of the watershed area has very low and low rate of soil loss respectively while 25.9% and 33.6% of the area has medium and moderately high rate of soil loss. 16.4% and 14.7% of the watershed area has high and very high soil loss rate.

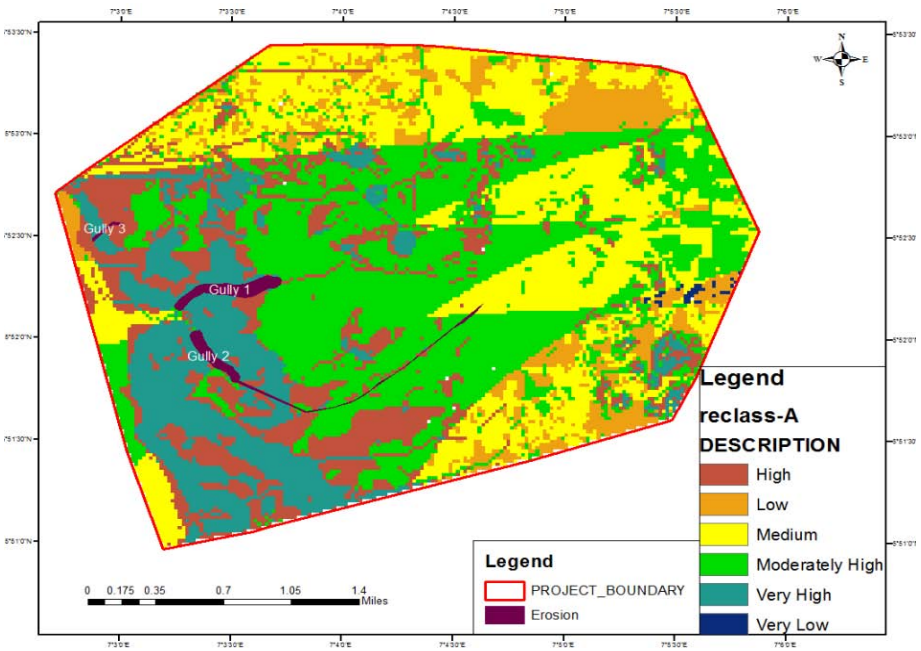

Fig. 9: Reclassified soil loss rate (A) Map

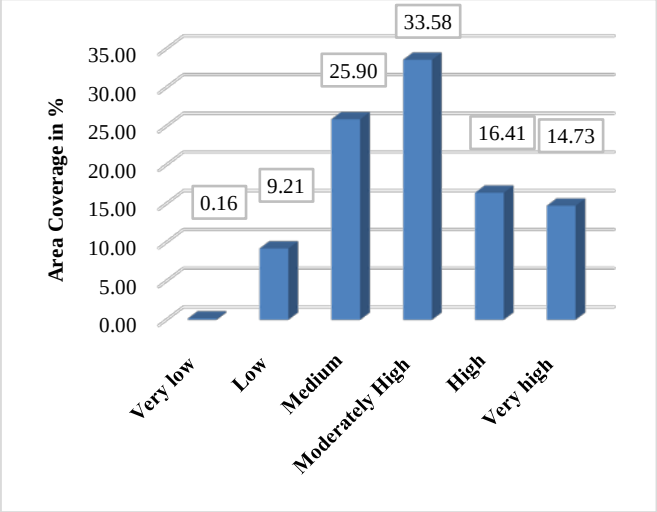

Fig.10: Classes of average annual soil loss and corresponding area

From the results shown in Figs.8,9 and 10, this study has however, clearly highlighted the spatial distribution of erosion hotspots in the region, thus providing a great insight of erosion impact trends in the study area. These results are expected to serve as a relevant guide to environmental and water resources managers involved in the mitigation of the impact of erosion in the study area. It is obvious that surface erosion can vary spatially due to rainfall variability, topographic changes, different soil types and characteristics, and human-induced disturbances. The C and P factors can be improved to reduce the soil erosion loss through afforestation and shifting community environmental practice. The LS factor also can be modified by shortening the length and steepness of slopes by the construction of contour walls and terraces. Construction of soil conservation measures like cistern to harness precipitation is vital to control runoff and soil erosion across different agro-ecological zones and under various land uses/land cover. Expected benefits of enhancing soil and water conservation in the studied area could be summarized in the following: reduction in sediment load of Urualla; and reducing the peak flows of the Urualla watershed. Also, the construction of check dams along gullies is an essential measure to minimize gully erosion.

IV. Conclusion

The extent of soil erosion occurring in the study area is still increasing and is now a major cause for concern. The present determination of RUSLE parameters for mapping potential soil loss rates in Urualla, Imo State has revealed the severity of soil erosion in the area and identified critical areas for soil conservation measures and sustainable environment. The approximate mean annual rate of soil loss in the watershed is 36 ton/ha/year, which is very large enough to degrade the area, with the six erosion risk classes, ranging from 6-1200 t/ha/year. 14.7%, 16.4% and 33.6% of the area experience very high, high and moderately high erosion rate which shows that greater part of the study area are highly at risk. This has also been proven to be correct from site visitation results. They study also revealed that high rainfall erosivity and soil erodibility combined with moderate to high slope and decreasing vegetal cover are the major factors driving soil loss in the area.

Finally, the present investigation has demonstrated that GIS techniques are simple and low-cost tools for modeling soil erosion, with the purpose of assessing erosion potential and risk for Urualla watershed.

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Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 18 Issue 2 Version 1.0 Year 2018
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Analysis of Vehicular and Pedestrian Flow in Metropolitan Area of Lagos

By Adekiya I S & Oyeniyi S O
Osun State College of Technology

Abstract- The crisis in transport is largely as a result of the growing concentration of population, rapid urbanization and economic activities of certain part of the world. Attempt to eliminate the traffic functional problem had led to gradual spatial restriction of pedestrian movement. This is a result of lack of consideration for pedestrian facilities in the road design and construction. Hence pedestrians compete for the use of road designed purely for vehicular use consideration and thereby creating conflicts and accidents on roads most especially within the central business district and other commercial areas. In the light of this, the research study examined the problems associated with pedestrian and vehicular traffic in an Urban Metropolitan Area. Questionnaires were used for data collection from respondents, in addition to secondary data extracted from documented information related to the research on causes, effect and solution to pedestrian and vehicular traffic conflict on Nigeria roads. Finding in this research work revealed that pedestrian and vehicular conflicts in the Urban Metropolitan Area led to traffic jam, delay and congestion. The conflict was found to be associated with roadside, road median and footbridge trading, on-street, parking of commercial transport operators, inadequate traffic and parking facilities.

Keywords: *population, pedestrian and vehiculartraffic, management.*

GJSFR-H Classification: *FOR Code: 059999*

Strictly as per the compliance and regulations of:

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Adekiya I S [α] & Oyeniyi S O [σ]

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Keywords: population, pedestrian and vehiculartraffic, management.

I. Introduction

One of the most serious problems in Nigeria cities today is that of traffic congestion. All over the major cities of Nigeria particularly in Lagos, large numbers of vehicles are seen crawling along the roads within the area. The amount of traffic generated by each land use is a reflection of its role in the social and economic circle of a particular environment (Adeniji 2000). This explains why commercial areas are always experiencing a high pedestrian and vehicular traffic.

The development of mechanical mode of transportation has contributed to changes in intra-urban movement pattern. People, goods and services need to move from home to office, market, schoolsetc. This movement pattern has been greatly aided by mechanized transport system. The fulfillment of those various needs of movements resulted in heavy traffic.

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Traffic is a function of land use and it is an object in motion. It has become a household word has come to be associated mainly with motor vehicles. The Buchman report (1963) stated that "Traffic is a function of activities". All activities however, involve people. Before and after movement of vehicles, pedestrian activities take place within and around area where vehicles are not accessible to or where they are restricted from; pedestrian like any other mode of transport deserves to be treated as traffic in his/her own right not as incidental to other mode of transport. Besides, with increase in population, vehicles ownership and general mobility, more pedestrian traffic is generated particularly at the trip ends. The pedestrian activity has caused great concern in that it has been observed to have a great influence on free flow of vehicle traffic (Kilasho, 2001). The effect rests on its volume that has been noticed to affect traffic flow considerably in areas of high commercial intensity and concentration (Ephiram 2000). This is because in such areas pedestrian traffic is considerably high and t results in competition between pedestrian and vehicles both in motion and at rest

a) Study Area

Oshodi Local Government is a popular commercial/industrial centre located at the core of Lagos. Apart from being the market where different kinds of food items are traded-in, it serves as a park/terminal for various intra and inter-state transport services for various routes in the state and country at large. The ease to it and convenience of getting vehicle to one's destination at any particular time makes Oshodi a very proponent commercial centre that forces people/shoppers from far and near to the centre

Oshodi, a local government at the core of Lagos stretching in the north to Agege motor road including the P & Twireless station, Matori industrial area, the refuse incinerator including Orile-Oshodi forming a common boundary between Ajamogun and Onimotun families of Ewu at Otulu Rivers, and from Badagry Express Road to the Isolo forming a common boundary with Amuwo-Odofin Local Government in the South and in the West with Ojuwoye at Oju-Olobun in the heart of Mushin Market Areas and in West, it stretches to Egbe-Riverine area including the Low Cost Housing Estate and forms a boundary with Isheri Village in Alimosho Local Government and extends to Okota

Palace way development area via Ire-Akari Estate (road), Badagry express road.

Oshodi Local Government shares boundary on the west with Ikeja Local Government. It stretches from Mafoluku and Murtala-Mohammed Airport in the south along to Agege Road sharing boundary with Mushin Local Government in the west; it extends to Oshodi Apapa Expessway to Amuwo-Odofin behind Festac '77 Hotel (Formally Durber hotel). It also shares boundary with communities like Ejigbo and NNPC depots.

The land use pattern of Oshodi local Government shows a dominant commercial and industrial use. The inner part serves as residential and industrial use. The movement in and out of this area is usually found very high throughout the day due to high traffic generated by the commercial activities and industrial operations. A very high traffic (both vehicular and pedestrian) generation throughout the hours of the day results to conflict due to inability of the road to accommodate the available traffic

The overall land use composition of the town is as shown below in table1, residential use accounted for 36% of the total built up area in Oshodi Local Government; public use accounted for 4.4% while transportation uses constituted 10.3%. The commercial land area which embraces the C.B.D. district commercial area, banks, supermarket, and other commercial establishment and industrial area constituted 31.6% and 16.9% respectively. This shows the intensity of commercial and industrial activities that accounted for nearly half (48.5%) of the land use pattern in most settlement where residential use mostly constitutes be dominant land use.

II. Methodology

Data for this article were collected though questionnaire survey in Oshodi. Questionnaire on road design and pedestrian facilities was used to collect information on the design characteristics and available facilities for easy and smooth movement of vehicle and pedestrians. The pedestrian questionnaire was used to collect information on the purpose of making trip to this commercial area, mode of transport, things that obstruct free movement of pedestrian in the business district and the attitude of vehicular drivers to the pedestrians. The vehicular driver questionnaire sought answers to issues such as the driver reason(s) for plying the routes of Oshodi Local Government, where they park, when they get to the area, the behaviours or attitudes of pedestrians to the vehicles on the routes as well as those things that were impeding their free movement.

A total of four hundred (400) samples were selected as a true representative of the population drawn from the drivers and passengers of private vehicle owners and commercial buses (light bus and molue), market men and women, shoppers, students and either road users.200 questionnaires each were for both pedestrian and vehicular drivers using simple random survey method such that the entire population was represented. To determine the distribution pattern of the 200 target population for questionnaire administration of vehicle drivers, the National Union of Road Transport Workers Association in the study area we as contacted for interview and in the process, the total number of commercial vehicle plying the routes were known through their registers to be 245 light buses and 115 trucks (molue). 20% samples each were taken using a random number table to elect from the union register.

a) The Research Findings

The traffic volume data were collected through enumeration exercise at various points in Oshodilocal government area. The pedestrian movements along with crossing the road are recorded on hourly traffic flow. The period of the survey is 12hours ranging from 7a.m to 7p.m as presented in the table 2; it was obtained that the pedestrian traffic volume during the weekday on Oshodi area is higher than that of the weekend. A total of 80780 traffic was obtained on weekday traffic volume while 68541 traffic was obtained in weekend traffic volume. This is because journey to work and school, which accounted for substantial part of weekend The heavy volume of pedestrian traffic here is due to the fact that Oshodi is a commercial centre and comprises of various intra and intercity bus terminal.

The peak hour traffic flow between 2-3p.m in the afternoon was 6240 when the school children are returning from school and this is followed by 5397 traffic flow between 4-5p.m in the evening time when the workers are returning home. The weekend pedestrian Peak hour was recorded between 5-6p.m as 5212. The evening peak period on weekend as due to this fact that majorly of the visitors to this area did so in afternoon, after having used the morning time to rest and attend to children, and returned home before 6.00p.m when the traffic holdup would have been at peak.

The total number of people crossing the road is relatively high. The weekday still recorded th highest number with 30129 and weekend being 25463. The peak hour of crossing for weekday was recorded to be 3324 between 2-3p.m. in the afternoon, while that of weekend was recorded to be 3417 between the hours of 5-6p.m. It was also recorded that only 146 (0.50%) and 128 (0.48%) pedestrians make use of footbridges to cross the road struggling with vehicles on the roadway.

This was attributed to the location of the footbridge that required pedestrian walking lengthy distance to reach because of distance to reach because of distance apart between bus stops and the footbridge From the survey data collected and presented in the table 3, vehicular traffic volume counts in Oshodi is

tremendously higher. This according to survey was due to the fact that the daily business activities in this place attract traffic from far and near. The weekday's traffic volume is higher with an average of 71,699 counted as against 66,012 traffic counted for the weekend traffic volume. The higher traffic volume was recorded on weekdays because journey to work and school, which counted for substantial part of weekday travel pattern, is not undertaken during the weekend.

The peak hour traffic flow between 7-8a.m in the morning was 6349 traffic during weekdays while that of the weekend was between 4-5p.m with 6857 traffic. The peak hour during the weekday accounted for high traffic rush in the morning when journey to work, schools and offices are undertaken. Afternoon peak period varies but mostly between 3-4p.m on weekdays with 6057 traffic counted and this is counted and this is influenced by school children returning from schools and evening peak hour was recorded between 5-6p.m on weekdays and 4-5p.m on weekend with an average of 5801 and 6857 traffic respectively. Morning peak hour traffics is often sharper and heavier than afternoon peak hour, which is often lighter because of extension over relatively long period of time.

Main purpose of visiting Oshodi: This is used to determine the cause of attraction of pedestrians to study area. From the table 4, the highest percentage (39.5) of pedestrians visiting the study area did so on other to enable them board vehicles to their various final destination. Pedestrian that came to buy one thing or the other accounted for 29percent while those that came to sell accounted for 23percenmt, other purpose accounted for the remaining 8.5 percent.

Mode of Transportation to the study area: According to table 5, 34,5 percent of the pedestrian came to the study area private transport. Those that came by public transports took the highest shire of 51 percent while the remaining 14.5 percent make their visit-on-foot. Therefore, it is easier to say that majority of the people of the found in this area came by public or commercial vehicles.

Reasons for buying and selling in Oshodi: From the survey data collected and presented in table 6, 33.5 percent of the pedestrians attributed their reasons to availability of variety of goods and services. 28 percent are for nearness/easy access to various commercial centres, while 36.5 percent of the pedestrians give reasons for cheap articles/many customers. 2 percent of pedestrians gave others different reasons for being in the study area such as availability of inter andintra city transport to others places in and outside the state

b) *Problems encountered in the Transportation system of the Study Area*

Congestion is the most common problem facing this study area, as vehicles hold up are seen everywhere and pedestrians finding it difficult to walk. 47 percent of the pedestrian interviewed complained seriously about this as major problem facing them. 32.5 percent of the people are also confronted with the problem of poor condition of roads. 16 percent of the people faced problem of unstable transport fare most especially on weekends and daily traffic peak hours while 45 percent of the people interviewed mentioned other problems encountered like theft. See table 7.

c) *Ways/method of solving the problems of pedestrian/vehicular conflicts in the study areas*

As can be seen in table 8, when the pedestrian were interviewed on ways of solving the problems of conflicts between them and the vehicular trafficsegregation; 24% accounted for those that support the provision of side walk while 8 percent sees the provision of the crossing facilities as a solution. The remaining 32 percent are those that recommend other ways such as organizing education seminal on the safety use of road to the pedestrian and enforcement of law and order prohibiting traders from displaying their goods on the road median and road side

III. Summary of Findings, Recommendation And Conclusion

a) *Summary Findings*

In the study area, it was observed that the volume of both pedestrians and vehicular traffic is higher on the weekday than weekend, and the traffic flow facilities are inadequate and those that are available were not properly enforced in order to ensure proper traffic management. The attitude of the pedestrian to footbridge as an option for road crossing varies from one area to the other and this is influenced by the type of road involved, that is, number of lanes and how busy such roads are. For instance, at Oshodi area, few people are found making use of this crossing facility instead they cross the road without making use of footbridge because the road is just two lanes with a wide median that allows for rest. Meanwhile most of these median have been taken over by the hawkers selling various good items that attract pedestrians in their hundreds, crossing the road and consequently causing obstruction to flow on traffic The use of road side and footbridge for commercial activities has been found to be a serious problem and a factor that contribute in no small measure to pedestrians and vehicular traffic conflict. The business activities on various footbridge is the study area have been found to have hindered its usage. Over half of the space that is meant for pedestrian traffic on the bridges are used up by traders who displayed goods on them, thereby causing congestion on them and consequently making them unattractive to pedestrians. Similarly, the use of roadside, walkway, sidewalk, road-median by traders and hawkers for commercial activities force the pedestrians to walk on the carriage way and thus

causing conflicts to traffic flow. This problem is found more pronounced at Oshodi area being a commercial centrewhere there is no adequate space for people that intend buying and selling goods and services It was observed that public transports as well as private car drivers usually engaged in on-street of vehicle which disturbs free flow of traffic. The commercial vehicle on-street parking are designation called bus/top. At Oshodi on the other hand, there is no slow lane. Hence, commercial buses are found paring along the road loading and unloading their vehicles thereby causing a reduction in the road width that is available to motorist, thus resulting in congestion, which also impacts free flow of traffic

IV. Recommendations

Provision of parking facilities: The space for parking vehicle is a basic requirements in a society where mechanical means of transport is of paramount sine the utility derivable from this means of transport diminished as working distance to point of final destination increases when parking is found missing. Thus, it will be a good thing, if parking facilities are made available in sufficient numbers to meet the parking needs of the motorist. Off street parking should be provided by the companies, industries and commercial enterprises/offices to meet the needs of their various visits that usually find parking on the roadside which in turn result to congestion

Parking Control: On-street parking should be prohibited totally on all roads within the study area to ensure a free flow of traffic. This should be done through the use of roadside sign which will be enforced by traffic wardens and staff of Lagos State Transport Management Authority (LASTMA).

Where on-street parking is inevitable like Oshodi, length of time permissible to stay should be controlled and the feasible methods recommended is introduction of parking pricing mechanism that discourages long time parking.

Traffic Control Device: Adequate provision should be made for road signs and carriage way marking for effective control.

These sign should show among others; NO PARKING, NO WAITING, NO HAWKING, direction and approaches to intersection. They should be in simple meaning. Conspicuously located easily recognizable, fulfill a need, command attention and also located at distance that give motorist sufficient time to take action (Hay, 1980)

Traffic warding should be placed at all intersection in the study area to ensure good conduct by motorists especially commercial transport operators and anyone found causing obstruction to traffic flow should be made to face all possible punishment so as to stop future occurrences.

Speed control: Speed limit should be introduced as part of traffic management measures. The main reason for this is to influence driver's behavior rather than to control traffic volume. With this, drivers will be conscious of pedestrians who partly own the right of way.

Road maintenance: Most roads in the study area are suffering from potholes. This is very serious because they forcer vehicle to crawl when approaching these roads and thus resulted to traffic hold up. Likewise, pedestrian with their two eyes widely open still sometimes miss their steps and consequently fall down on the roadway. As such, the authorities concerned should see to the regular maintenance of these roads. Effort should be made to ensure that potholes are patched as soon as when they are noticed before getting out of hand.

Pedestrian Traffic Management: The essence of this is to reduce the delay of pedestrian traffic and avoid lengthy delays. This will be achieved through frequent education by relevant agencies like Federal Road Safety Commission and Nigeria Police to the public especially the pedestrians on the needs to make use of pedestrian overhead bridge that segregate from vehicular traffic. Likewise, the law enforcement agent should assist to put right the use of pedestrian's walkway, as against what is presently on ground where pedestrians are forced to walk on the road, having been hijacked by traders and traders.

Enforcement of edicts and By-laws: The activities of the street traders, hawkers and refuse disposers have taken over roadside, road media and on-street parking area of commercial vehicles along most roads in the study area. The over spillages of commercial activities of street traders and refuse on the road is also a common phenomenon in Lagos, this to traffic congestions which disrupt free flow of traffic. As a result of these, edicts and byelaw should be enforced strictly by the Environmental Sanitation Task Force in order to yield the expected result.

V. Conclusion

Oshodi Local Government being an area that accommodated high level of commercial and industrial activities in Lagos is being faced with an apparent problem of vehicular and pedestrian traffic conflict and this is because the land-use is capable of attracting high vehicular and pedestrian traffic. The recommendations put forward have been in the light of findings from the field survey.

It is hoped that the successful, implementation of these recommendations will help to resolve a traffic conflict situation between the pedestrian and motorists in the study area thereby making the transportation in the area more efficient, functional and attractive to all road users.

Appendices

Table 1: Landuse Composition in Oshodi

Uses	Percentage (%)
Commercial	31.6
Residential	36.8
Industrial	16.9
Public	4.4
Transportation	10.3
Total	100.0

Source Akinlawon, O.A. 1992

Table 2: Hourly Pedestrian Traffic Flow in Oshodi

Time	Along the Road		Across the Road			
	Weekend	Weekdays	Weekday		Weekend	
			Road	Footbridge	Road	Foot Bridge
7-8am	2810	2854	2786	14	2543	16
8-9am	3196	3704	2614	18	2815	17
9-10am	2400	2654	2314	12	1986	11
10-11am	4671	3481	2276	16	1741	13
11-12am	2962	3128	2312	14	1853	14
12-1pm	2454	2396	2181	11	1747	15
1-2pm	3426	4547	2274	17	1668	8
2-3pm	3590	6240	3324	18	1717	6
3-4pm	4804	4668	2580	8	1316	9
4-5pm	3019	5397	2477	12	2114	11
5-6pm	5212	5014	2743	2	3417	5
6-7pm	7534	4668	2102	4	2418	5
Total	43,078	50,651	29,983	146	25,335	128

Source: Author's Field Survey, December, (2017)

Table 3: Hourly Vehicular Traffic Flow In Oshodi

Time	Weekdays	Weekends
7-8A.M	6349	5628
8-9	6298	6147
9-10	6241	6414
10-11	6005	5934
11-12	6025	5647
12-1	5664	5782
1-2	5981	6002
2-3	6003	6075
3-4	6057	6126
4-5	5696	6128
5-6	5801	5784
6-7	5579	5616
TOTAL	71,699	67,012

Source: Author's Field Survey, December, (2017)

Table 4: Main Purpose of Visiting Oshodi Local Government

Purpose	No. of Respondents	Percentage
To sell goods	46	23
To buy good	58	29
To board vehicles to other places	79	23
Site seeing	17	8
Total	200	100

Source: Author's Field Survey, December, (2017)

Table 5: Mode of Transportation of the Study Area

Mode	No. of Respondent	Percentage
Private means of Transport	69	34.5
Public means of Transport	102	51.0
On foot	29	14.5
Total	200	100

Source: AUTHOR'S field Survey, December, (2017)

Table 6: Reasons for Buying and Selling at Oshodi Local Government

Reasons	No. of Respondent	Percentage
Availability of variety of Goods and Services	57	33.5
Nearness/Easy Access to various centers	56	28.0
Cheap Articles/Many Customers	73	36.5
Others	4	2.0
Total	200	100

Source: Author's Field Survey, December, (2017)

Table 7: Problems Encountered in the Transportation System of the Study Area

Problems	No. of Respondents	Percentage
Congestion	94	47.0
Poor Road Condition	65	32.5
Unstable Transport Fare	32	16.0
Others	9	4.5
Total	200	100.0

Source: Author's Field Survey, (2017)

Table 8: Ways/Methods of Solving the Problems of Pedestrian/Vehicular Conflicts in the Study Area

Ways/Methods	No. of Respondents	Percentage
Vehicular/pedestrian	72	36
Provision of Sidewalk	48	24
Provision of Crossing Facilities	16	8
Others	64	32
Total	200	100

Source: Author's Field Survey, December, (2017)

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h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for Writing a Good Quality Science Frontier Research Paper

Techniques for writing a good quality Science Frontier Research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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Global Journal of Science Frontier Research

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ISSN 9755896