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# Soils and Water Interplay in Sokoto-Rima Floodplain

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**Abstract:** The aim of this research is to assess the soils and water quality along Sokoto-Rima Floodplain; the correlation analysis was used to find out the degree of relationship between pollutants in soils and water. Seven sample points was selected systematically from the map at 6.13km interval, and in each sample point, three samples were taken each of soils and water from the river at hundred meters interval. A total of 21 samples of each soils and water were taken. The samples were taken to the laboratory for analysis. The results from the analysis show that: Positive correlations exist between soils and river in P and $PO_4$, Mg, Ca, and Fe. $R^2$ (co-efficient of determination) values are .124, .013, .053, and .445 respectively. While, negative correlations exist between soils and river in pH, N and $NO_3$, K, and OC and $CO_3$. $R^2$ values are .015, .224, .075, and .027 respectively. The correlation is statistically significant between N and $NO_3$ at 0.05 and also, it is significant in Fe at 0.01 levels.

**Keywords:** Soils, Water, Interplay, Sokoto-Rima, Floodplain

## INTRODUCTION

Soils and water are important natural resources on the earth surface. The major pathway of water quality properties is an inter-change between the earth surface and the atmosphere through precipitation and evapotranspiration [1].

Delince [2] cited in Abubakar *et al.,* [3] reported that the quality of waters depend on the kind of soils they flow over in addition to physical, chemical and biological factors. The soils and water bodies of Sokoto-Rima Floodplain are often subjected to intensive human and industrial activities (like the Cement Company of Northern Nigeria, CCNN) which influence their quality. Sewages from domestic, agricultural and industrial activities pollute fresh water and adversely affect the quality of water [3].

Soil is the link between the air, water, rocks, and organisms, and is responsible for many different functions in the natural world that we call ecosystem services. These soil functions include: air quality and decomposition, temperature regulation, carbon and nutrient cycling, water cycling and quality, natural "waste" (decomposition) treatment and cycling, and habitat for most living things and their food [4].

Land, soil, water, vegetation, fish and livestock, rocks, minerals, and different forms of energy with which our environment is endowed by nature are referred to as natural resources [5]. Among the natural resources, soil and water are responsive to human influence, and constitute the resource base for our sustainable future [6, 7]. The soil is the most important factor in agricultural production being the main medium for plant growth. The manipulation or management of this resource base has significant influence on the environment or ecosystems because of its effects on water resource, human settlement, atmospheric quality, water and land pollution, vegetation type and distribution, fishery and wildlife [5].

## MATERIALS AND METHODS

### Study Area

The Sokoto-Rima basin is located in the northwest of Nigeria between latitudes 10˚04'-13˚57'N and longitudes 3˚35'-8˚14'E. The basin covers catchment area of about 131,600km$^2$, which is about 14% of Nigeria's landmass [8]. Three physiographic units are found in the basin, namely: the uplands or high plains of the east and south east, the Sokoto plains of the north and the center, and lastly the lowlands of the Rima Valley and the Niger River [9]. Urban Sokoto is located on the Sokoto plains which are a monotonous lowlands derived from softer sedimentary rocks with an average height of 300m. The raining season is from June to October, rainfall start late and ends early with mean annual rainfall ranging between 500mm to 900mm [10]. Sokoto is located in the Sudan Savannah bioclimatic zone, with daily mean temperature of 36˚C [11].

This is an area were the basement complex is overlain by the Illumidan Sedimentary Basin which

consist of many groups including the Wurno, Kalambaina and Gundumi formations. The Sokoto Rima Floodplain is situated to the north of the town, and it effectively prevents growth of the city in that direction. The confluence of the Sokoto-Rima is found close to Kalambaina area where the Rima river catches the Sokoto river, the letter being its major tributary [12].

Wamakko town which is 16km from Sokoto city is located at latitude 13°2′16″N and longitude 05°5′37″E. It is about 226 meters above the sea level and covers an area of 697km² with a population of 179,619; NPC, 2006.

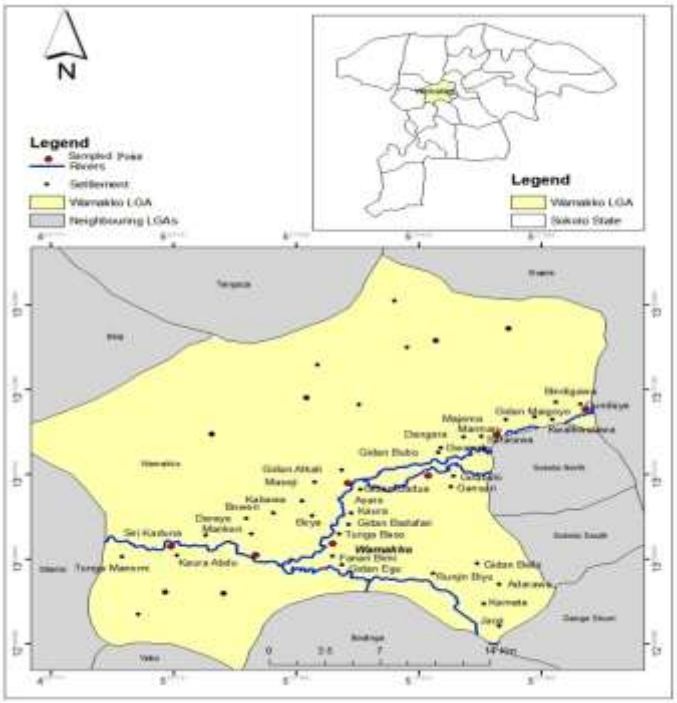


**Fig-1: Map of Wamakko L.G.A. showing study area**
Source: UDUS GIS Lab, 2015

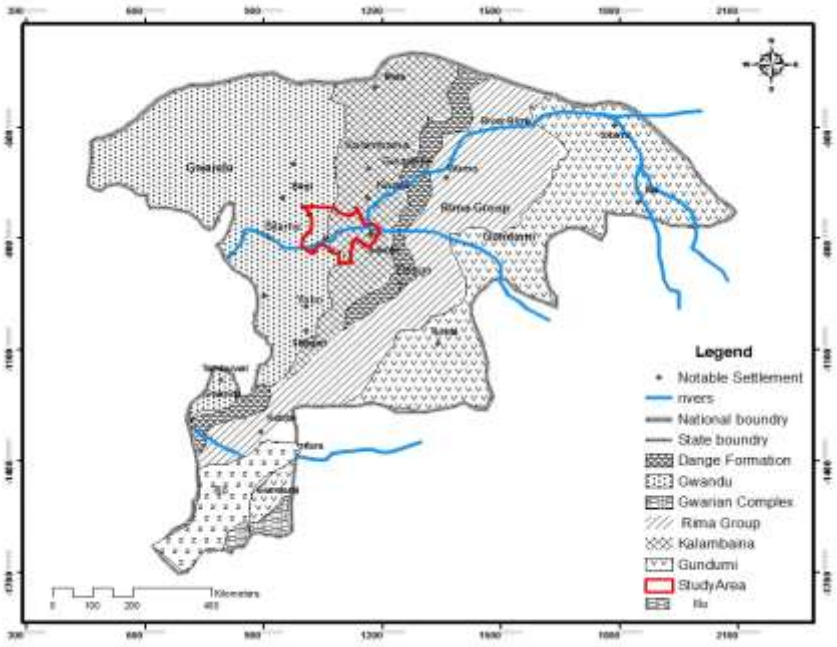


**Fig-2: Geological Map of Sokoto State showing the study area**
Source: UDUS GIS LAB, 2015

**Table 1: Shows the Location of Sample Points in the Study Area**

| Sample point | latitude | Longitude |
|---|---|---|
| Dundaye | 13°7'4.568"E | 5°14'29.74"N |
| Safatawa | 13°5'56.847"E | 5°11'29.589"N |
| Gantsari | 13°4'11.033"E | 5°9'7.798"N |
| Gidan Alkali | 13°3'54.102"E | 5°6'22.727"N |
| Wamakko | 13°1'15.381"E | 5°5'53.099"N |
| Mankeri | 13°0'49.988"E | 5°3'14.347"N |
| Kaura Abdu | 13°1'6.915"E | 5°0'20.842"N |

**Soils and Water Sampling**

Seven sample points was selected systematically from the map at 6.13km, GPS was used to locate the sample points, and in each sample point, three samples were taken each of soils and water from the river site at hundred meters interval. A total of 21 samples of each soils and water were taken. The soils and water samples collected were placed into polythene bags and clean rubber battles respectively, labeled for easy identification and then taken to the laboratory.

**Soils analyses**

The collected soil samples were air-dried, passed through a 2 mm sieve and analyzed for the following parameters. Soil pH was measured using a pH meter. Organic carbon, total nitrogen and available phosphorus were determined by the Walkley-Black Method, Macro-Kjeldahl Method and the Bray No-1 Method, respectively. Calcium and magnesium by EDTA titration, while, potassium and sodium by flame photometry and iron by AAS.

**Water analyses**

The water samples collected were taken to the laboratory and tested for the following parameters: River pH was measured using pH meter, nitrate by kjeldhler method, phosphate by spectrophotometer, magnesium and calcium by EDTA titrant solution, iron by AAS, potassium by flame photometer and carbonate by titration method.

**RESULTS AND DISCUSSIONS**

**Correlation Analysis**

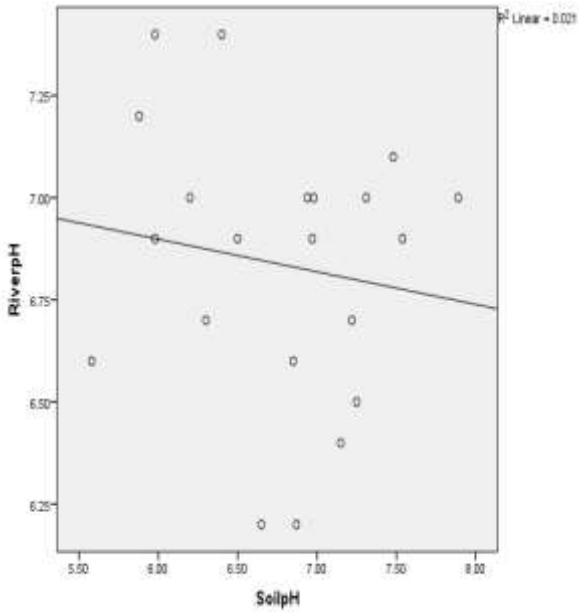


**Fig-1: Soil and River pH**

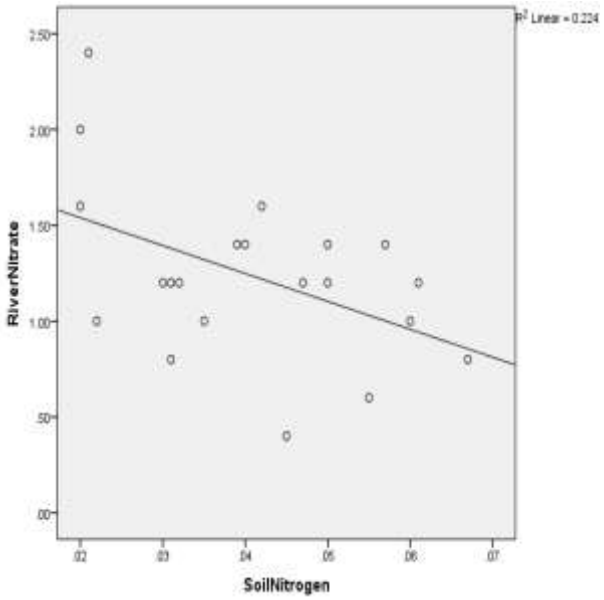


**Fig-2: Soil Nitrogen and River Nitrate**

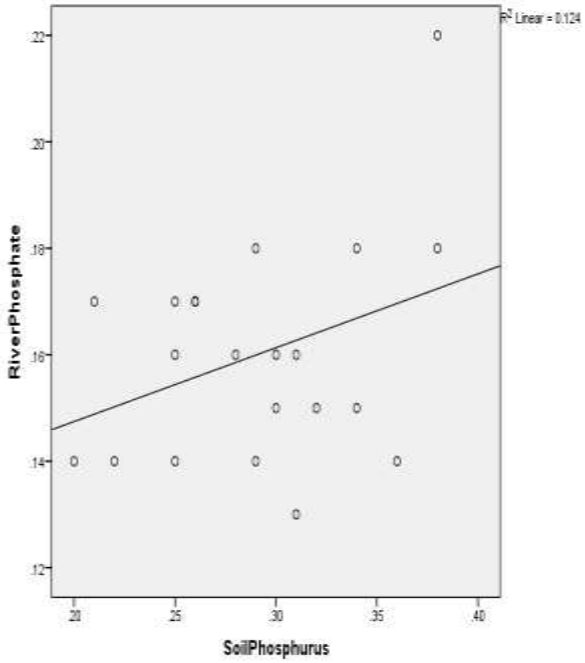


**Fig-3: Soil Phosphorus and River Phosphate**

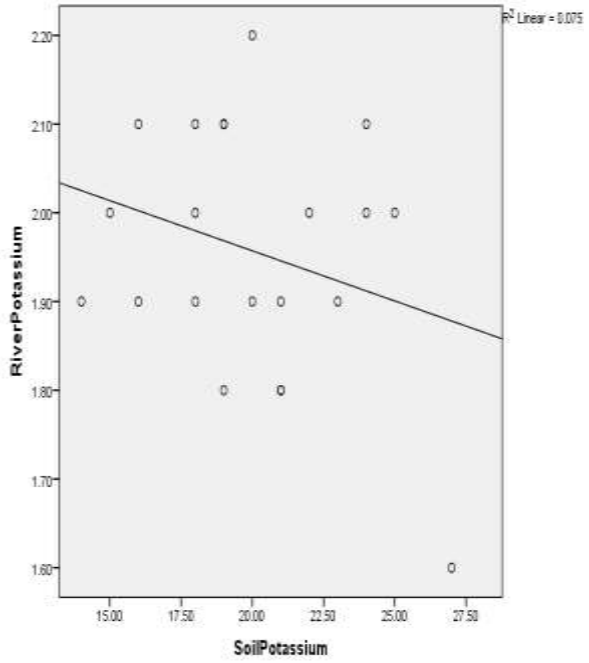


**Fig-4: Soil and River Potassium**

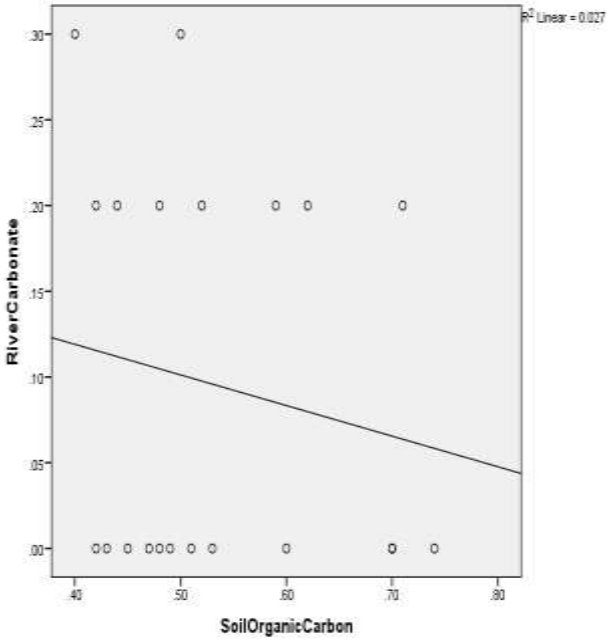


**Fig-5: Soil Organic Carbon and River Carbonate**

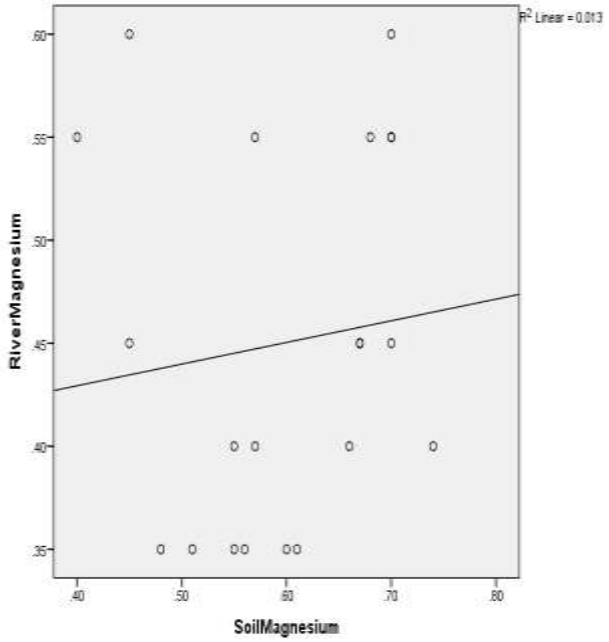


**Fig-6: Soil and River Magnesium**

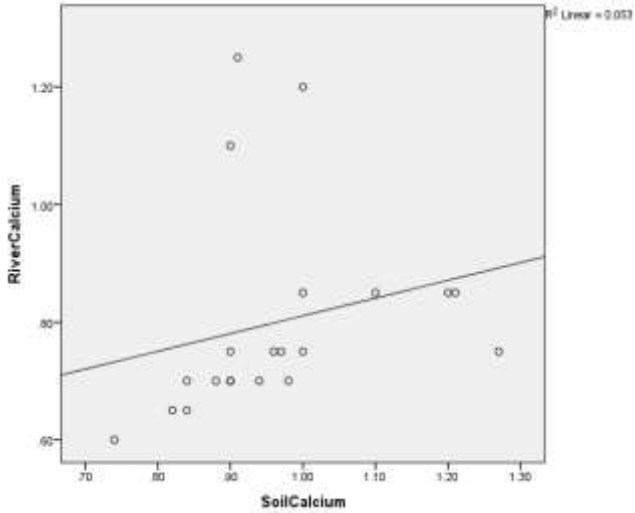


**Fig-7: Soil and River Calcium**

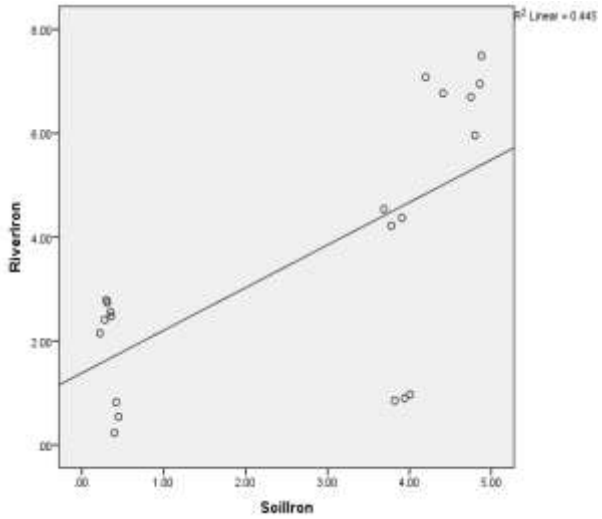


**Fig-8: Soil and River Iron**

From the above figure 8 show a strong positive correlations of iron between soil and river (.667) and is significant at p< 0.01(2-tailed), with $R^2$ value of .445, which means 45% of the variability in river iron is explained by the variability in soil iron. This may be as a result of heavy metals in the area because of industrial activities, and agricultural sources (insecticide, pesticide, misapplication of fertilizer etc.). While, figure 3, 6, and 7 shows a weak positive correlations between soils phosphorus and river phosphate (.353), soil and river magnesium (.114), soil and river calcium (.230), with $R^2$ (co-efficient of determination) value of .124, which means 12% of the differences in river phosphate is explained by the differences in soil potassium.

From figure 2 above show a strong negative correlation between soil nitrogen and river nitrate (-.473) and is significant at p< 0.05 (2-tailed), with $R^2$ value of .224,which means 22% of the variability in soil nitrogen is explained by the variability in river nitrate. This may be as a result of application of NPK fertilizer in the area. While, figure 1, 4, and 5 shows a weak negative correlations between soils and river pH (-.122), soils and river potassium (-.274) and soils organic carbon and river carbonate (-.164), with $R^2$ value of .015, .075 and .027 respectively.

## CONCLUSION

There is relationship between the quality of river Sokoto-Rima and Floodplain soils that the river flows over. These because, positive correlations exist between four out of eight parameters tested. While, negative correlation exists in the remaining parameters.

## REFERENCES

1. Beadle, L. C. (1974). The Inland Tropical Waters of Tropic Africa. An Introduction to Trop. *Limnology, Longman Group Limited, London. Britain.*, 365.
2. Delince, G. (1992). The Ecology of the Fish Pond Ecosystem with Special Reference to Africa, Developments in Hydrobiology 72. *Klumer Academic Publishers*, Dordrecht/ Boston/ London., 228 p.
3. Abubakar, M., Ipinjolu, J. K., Magawata, I., & Manga, B. (2013). Some Physical Parameters of the Sokoto-Rima River System in North Western Nigeria. *Scientific Journal of Environmental Sciences*, *2*(5), 93-100.
4. Soil Science Teacher. (2015). *A Program of Soil Science Society of America*. Retreaved on 7/12/2015 from www.soils4teachers.org
5. Ojeniyi, S. O. (2002). Soil Management Natural Resources and Environment. 1st publ. *Adeniran comm. Press, Dugbe, Ibadan.*
6. Adepetu, J. A. (1997). Soil and Nigerian Food Security. Inaugural Lecture Series 119. *Obafemi Awolowo University, Ile-Ife, Nigeria. 19pp.*
7. Joseph, T. U., Abraham, T. A., & Terry, I. U. (2014). Irrigation Soil Analysis in River Katsina-Ala Catchment Areas of North-Central Nigeria. *International Journal of Engineering and Technology*, *4*(6).
8. Adamu, I. A., & Fada, A. G. (2015). The Tripatite - *Complex of Human Induced Watershed Degradation, Changing Climate and the Incidence of Waterborne Diseases* - Towards a Management Proposal for the Sokoto-Rima Basin of Nigeria. International Conference of the Nigerian Association of Hydrological Science (NAHS), ABU Zaria 15th-18th September, 2015.
9. Ifabiyi, J. P., & Eniolorunda, N. B. (2012). Watershed Characteristics and Implication for Hydrologic Response in the Upper Sokoto Basin, Nigeria. *Journal of Geography and Geology* Vol. 4(2), Canadian Center of Science and Education.

10. Bala, G., Abdulqadir, A. U., Adamu, I., Kehinde, M. O., & Munir, A. (2015). Trend Analysis of Annual and Decadel Rainfall in Sokoto State. *International Conference Proceedings of the Nigerian Meteorological Society 23rd –26th November,* 2015, Sokoto, Nigeria
11. Umar, A. T. (2013). Evidence of Climate Change, in Iliya M.A. and Fada A.G. (eds*), the Impact on Climate Change on Sokoto State, Nigeria: Evidence and Challenges*; 1st Edition, UNDP/Sokoto State Government.
12. Adamu, I. A., & Umar, A. (2015). Biodiversity Degradation and Human Impact- *Climate Change Nexus in the Sokoto Rima Basin: A Case Study of Urban Sokoto*. International Conference Proceedings of the Nigerian Meteorological Society 23rd –26th November, 2015, Sokoto, Nigeria