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Effect of Rice Cultivation Activities on Inorganic Ions Content of Ini River in Southern Nigeria

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ABSTRACT: This research work assesses the effect of rice cultivation activities on the nutrient status of Ini River in Akwa Ibom State. Surface water was collected from three stations in the river and its nutrient status was analyzed using spectrophotometric method. The nutrient component viz: Phosphate ($P0_4$), Nitrate (NO_3) and Sulphate (SO_4) varied significantly $p<0.05$ across the Stations. Phosphate ranged from (0.96 mg/L – 1.89 mg/L), Nitrate (1.49 mg/L – 3.79 mg/L) and sulphate (2.10mg/L –5.90 mg/L). The trend observed in nutrient variation in the river followed the order Station A > Station C >Station B. The result obtained for nutrients are low and are within the WHO standard for clean water. However, the values obtained shows significant impact of rice cultivation activities on the nutrient status of the river. The result of this study shows that cultivation activities can contribute significantly to nutrient enrichment in water bodies. This can be of significance in management of water bodies around heavily cultivated areas.

Keywords: Rice cultivation, Inorganic ions, Nutrients ion, Run-off, Eutrophication,

Introduction

Water is the most essential and prime necessity of life. It is an important requirement for all living organisms, ecological systems, food production, human health and economic development. Though water is important to life, it is one of the most poorly managed resources in the world (Fakayode, 2005). Inorganic anions present in water bodies include sulphates, nitrates and phosphates. These anions play a vital role in the health of an aquatic ecosystem. The runoff of these nutrients into water bodies is becoming a problem that affects millions (Biggs, 2000). Industrialization and agriculture are among the leading causes of water pollution in the world (WHO, 1995). Many agricultural activities increases nutrient levels of water due to runoff of large inorganic and organic materials into rivers and thus are transported over long distances.

Nutrients are chemical elements that are essential to plant and animal nutrition. They occur in a variety of forms. Generally, they are reported in milligrams per litre (mg/l). Nutrients such as nitrate, phosphate and sulphate are essential for the growth of aquatic plants. However it has been established that their higher levels can cause a number of health and ecological effects (Michaud, 1994). These inorganic ions occur in small amounts naturally in all aquatic environments and are required to maintain the growth and metabolism of plants and animals (Ansar and Khad, 2005).

Through the process of eutrophication, dissolved minerals and nutrients flow into streams, lakes, rivers and other water bodies.A good portion of these dissolved minerals consist of phosphate, nitrates and sulphates. High levels of these nutrients are intolerable to indigenous organisms and have been known to deplete oxygen levels by causing algae blooms (Ansar and Khad, 2005). As such, eutrophication is one of the main causes of destruction of aquatic ecosystem around the world.

Recent evaluations of surface water quality have identified a number of rivers, lakes, streams and ponds that are impaired for one or more of their designated uses due to pollution from agricultural activities. Increased amount of nutrients cause algal and bacterial growth. Eutrophication, from past

studies is known to be associated with anthropogenic sources of nutrients (Jones, 1998). Improper disposal of biowaste from agricultural activities may elevate concentrations of nutrients, fecal coliforms and sediment loads in water bodies. Agricultural practices such as tillage, mulching, thinning fertilization and residue management increases nutrient ionic content of surface runoff, erosion which in turn affects the quality of water in aquatic ecosystems (Fakayode, 2005). This paper is aimed at determining the effect of rice cultivation activities on the nutrient status of Ini River.

Materials and Methods

Fig 1: Map of Ini local government Area of Akwa Ibom State showing Sampling Stations.

Description of Study Area

The study was conducted in three stations on a river in Ini Local Government Area of Akwa Ibom State.

Station A: Water at this station was brownish in colour owing to the presence of silt as a result of runoff. This station is dominated by *Nymphae lotus* and *Pistiastratiotes*. It was the closest to the rice paddy (1.2km away from the rice paddy).

Station B: Station B is located at 1.2km away from station A. Water at this station was clearer than that of station A. Grasses, ferns and various emergent macrophytes were found here.

Station C: Water at this station was not as clear as that of station B. Distance away from station B was 1.5km. The station is dominated with large number of trees fringing the edges of the water and providing a shade over the water. Shrubs and grasses were also present in this station. Some common plants species found include *Costusafer, Commelinabenghalensis* and a host of other tree plants.

Sampling Location

The study was carried out in Ibamukot of Ini Local Government Area, Akwa Ibom State. Ini is located in the south-south of Nigeria. It has coordinates of $5^0$24'0"N, $7^0$44'0"E. It is geographically bounded by Ikono Local Government Area and ObotAkara Local Government Area all in Akwa Ibom State and also by Abia State. It has a landmass of 320,451 sqkm. The area is rich in both natural and mineral resources and houses one of the largest rice farms in Akwa Ibom State.

Sampling Method

Water samples were collected in the month of April, 2013 from three stations and were collected just below the water surface in pre-cleaned polyethylene bottles. The samples were then stored pending analysis. The samples were preserved with 2ml of Lugos iodine and 60% formaldehyde in accordance with APHA (1994).

Sampling Analysis

The water samples collected were analyzed for major inorganic chemical water quality parameters such as phosphate, nitrate and sulphate in accordance with APHA (1994).

Statistical Analysis

Analysis of variance (ANOVA) was used to determine significant effect and variability (Ubom, 2004).

Results

The results of the analysis of nutrient properties of water collected from Ini River in Akwa Ibom State are shown below in Figures 2-4.

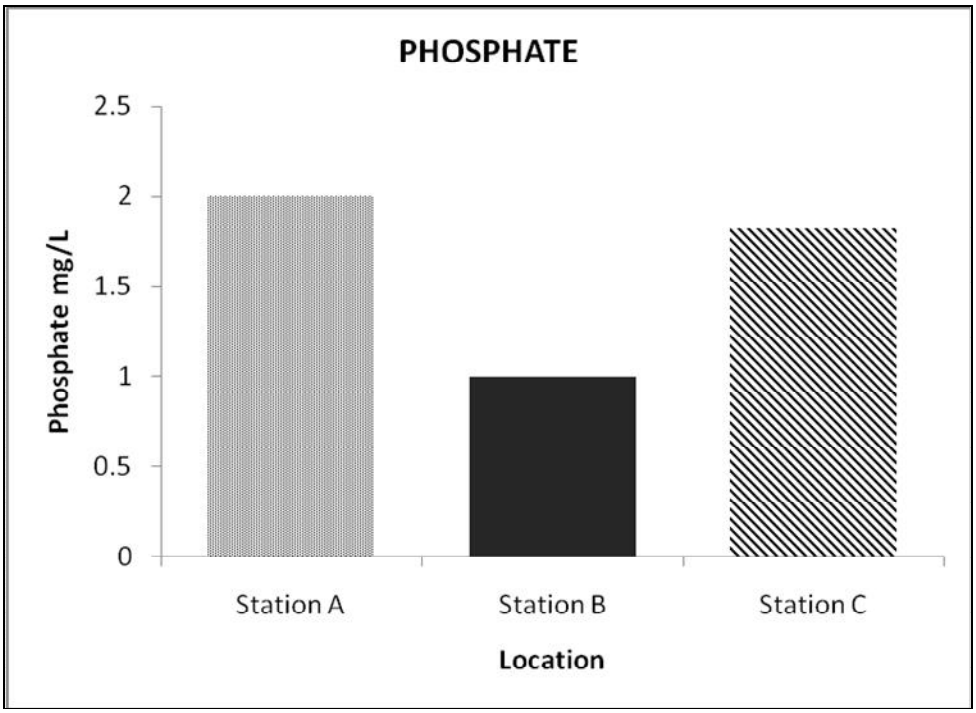

Figure 2: Variation of phosphate Concentration in stations A, B & C

Figure 2: shows variation of phosphate concentration in the three stations. Station A recorded the highest concentration of phosphate (1.89 mg/L) than stations B and C. Phosphate concentration of 1.88 mg/L was recorded in station C while station B had the lowest concentration (0.96 mg/L). There was a

significant difference in the phosphate concentration between station C and the other two stations (A & B).

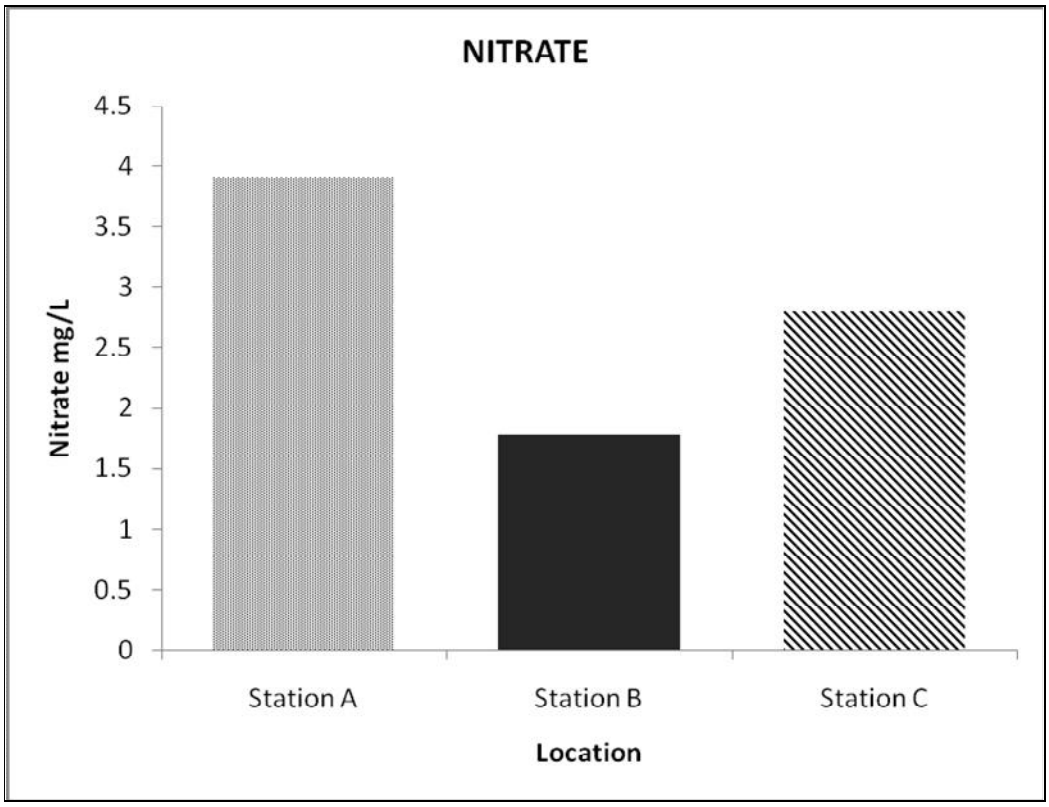

Figure 3: Nitrate composition in station A, B & C

Figure 3: Highest value of nitrate composition in the three study locations (Figure 3) was also recorded in station A (3.79 mg/L). Station B had a value of 1.49 mg/L while Station C had 2.98 mg/L. There was a significant difference ($p<0.05$) in the nitrate concentration across the three stations.

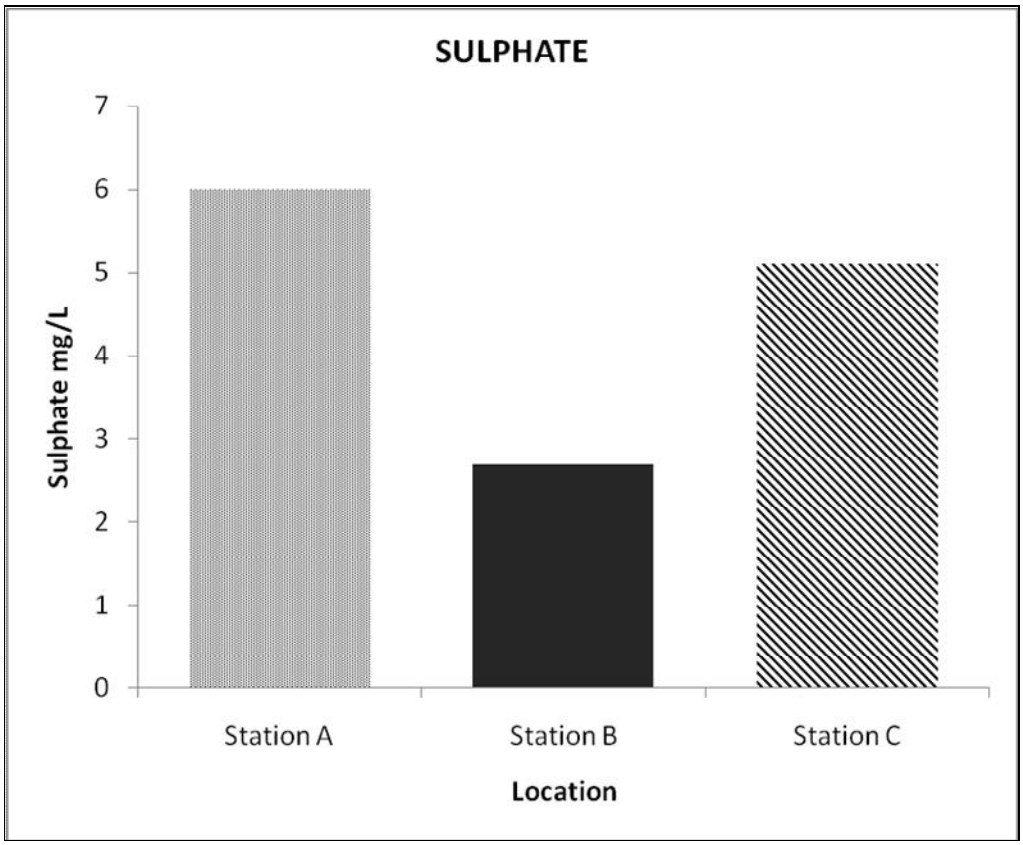

Figure 4: concentration of sulphate in Stations A, B and C

Figure 4: shows the concentration of sulphate in stations A, B and C. The value ranges from 2.10 mg/L at Station B to 5.90 mg/L at Station A. Station C had 4.89 mg/L. Highest value was recorded at Station A while Station B had the lowest concentration (2.10 mg/L). There was also significant difference $p<0.05$ in the sulphate concentration across the stations.

Discussion

Nutrients play a vital role in the health of any water ecosystem. They are essential for the growth of algae and macrophytes (Dwivedi and Pandey, 2002). Nutrient in water ways come in the form of inorganic nutrients (simple chemicals) called nitrogen (N) phosphorus (P) and sulphur (S). However, only small amount of each are required in natural ecosystem and any additional increase of these nutrients in waterways can quickly become a nuisance. Increases in nutrients are nearly always as a result of land use activities and the nutrient status of a water body often reflects the land use of the surrounding upstream catchment.

Phosphate is an important nutrient in water bodies. It is often the limiting factor in microalgal biomass production. While low levels of phosphate may lead to decreased production in water bodies (Jake and Serge, 2010), High levels have a similarly detrimental effect (Jensen, 2010). Phosphate values obtained in this study compare favourably with those reported by (Akoma, 1990), for river Osse. The values are low and this is probably due to net loss from the water columns to the sediments as has been reported for many water bodies (Jegbefume, 1993).This study shows trace amounts of phosphates in the three stations. According To WHO, its standard level in water is 3.5mg/L. Therefore it appears to be low in the three stations (Figure 2). However, values were higher in station A which was closest to point of higher agricultural activities. This could be attributed to run off of fertilizer, manure, loose dirt's and pesticides from the rice paddy into the water as a result of cultivation practices such as intensive tillage, fertilizer and manure application (Robert, 2006).

Nitrates indicate the presence of fully oxidized organic matter and it is essential for plant growth (Murdoch and Stoddard, 1992). The nitrate level in this study was higher in Station A (Figure 3). This could be due to higher amount of decomposed dead organic plant matter in this station than any other stations under investigation.

Sulphates are formed due to the decomposition of various sulphur containing substances present in water bodies (Anna and Adedipe, 1996). The higher sulphate level recorded in Station A (Figure 4) could be due to dumping of agricultural waste or decaying plant matter containing sulphur, high amount of undissolved component of sulphur from fertilizers, poorly managed irrigation system, and other farming operations washed into the river. However, the amount recorded in this study (5.90 mg/L) cannot be considered to constitute an issue on the water quality since it did not exceed the WHO standard of clean water which is 42-50mg/l (Robert, 2006).

Conclusion

This study shows that all the chemical parameters analyzed are low and within the WHO standard for clean water. However, the nutrient load is higher in Station A which is closer to the point of impact from rice cultivation activities. The nutrient load becomes lower as the distance away from the rice paddy increases. This reveals less impact from agricultural activities.

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Recommendation

We recommend further investigation of nearby rivers to the study stations to verify if the nature of the data recorded for the various parameters in this study are truly as a result of the impact of rice cultivation activities on the water body.

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