Science World Journal Vol 5 (No 3) 2010
www.scienceworldjournal.org
ISSN 1597-6343

Full Length Research Article

NITRATE AND PHOSPHATE LEVELS IN RIVER JAKARA, KANO STATE, NIGERIA.

DIKE, N. I[1].; *ONIYE, S. J[2].; AJIBOLA, V. O[3]. & EZEALOR, A. U [2].

[1]Department of Biology, Federal College of Education, Zaria, Nigeria.
[2]Department of Biological Sciences,
[3]Department of chemistry
Ahmadu Bello University, Zaria, Nigeria
*sjoniye@yahoo.com

ABSTRACT
Nitrate and phosphate levels of the surface water of River Jakara in Kano State, Nigeria, were determined over a period of twelve months (January to December 2003) at 5 sampling sites along the river. The nitrate and phosphate values showed significant difference (p<0.05) between seasons. The lowest mean concentration (3.25mg/l) of nitrate was observed in March (dry season) and the higher mean values of 11.46mg/l and 10.10mg/l were observed in August and September respectively, both significantly different (p<0.05) from the other months. The lowest mean concentration of phosphate (3.80mg/l) was recorded in April and was significantly different (p<0.05) from the other months; higher values were obtained in July and August. Higher mean values of both nutrients in most of the sites during the wet seasons were related to surface run offs containing domestic wastes, and fertilizers applied to farmlands. The nitrate value did not exceed the international maximum permissible limit but the phosphate did. It was proffered that sewers and waste treatment facility is of paramount importance in Kano, while the relevant organ of government should find alternative farmlands for the farmers.

Keywords: Nitrate, Phosphate, River Jakara, Kano State, Nigeria.

INTRODUCTION

The River Jakara in Kano State, Nigeria, used for the irrigation of vegetables and fruits which are consumed by the inhabitants of the area and the environs, receives untreated municipal waters through networks of drainage system. Urban waste water contains large quantities of nutrients such as nitrogen and phosphorus (Jens *et al.,* 2000) resulting from the use of commercial fertilizers and pesticides applied to crops in nearby farms and animal and human wastes. These nutrients exist mainly as phosphates and nitrates. Nitrogen is quite mobile in soil and can be leached into ground water or washed into the surface waters, thus becoming hazardous to the environment (Ajibola & Baiyewu, 2004). It was reported (David *et al.*, 1997) that 49% of the inorganic pool in a corn and soybean field in Illinois (USA) was leached through drain tiles and seepage and the concentration of nitrate in the tiles were synchronous with the nearby river. Nitrates may be hazardous to human health as it is a common cause of methehaemoglobinemia or blue baby syndrome. Methhaemoglobinemia is potentially fatal, usually in infants under six months (Wolfe & Patz, 2002), as concentrations of metaehemoglobin greater than 50% can quickly lead to coma and death, (Knobelock *et al.,* 2000). It has also been observed (Wolfe & Patz, 2002) that nitrate endogenously reduced to nitrite and nitrosation reactions produce carcinogenic N-nitroso compounds and that elevated nitrate concentrations in water are associated with both genotoxic and cytogenetic effects. Nitrate has been implicated in organ cancers. Weyer (2001) reported that a cohort study of over 20,000 women in Iowa found a positive association between nitrate water concentrations and bladder and ovarian cancers. Weyer (2001) further reported that Chinese populations exposed to high concentrations of nitrates in drinking water suggested links between nitrate contamination and stomach and liver cancers.

High concentrations of nitrates and phosphates lead to eutrophication of water bodies (Taylor *et al.,* 1997). Such environmental problems are increasingly occurring on a worldwide basis and now affect marine as well as freshwater ecosystems (Jens *et al.,* 2000). As nitrates and phosphates are added to water bodies, they can lead to overgrowth of plant life, which in turn, leads to depletion of dissolved oxygen; which may through their effects on the aquatic life and vegetation, be transmitted to humans (Wolfe & Patz, 2002). In the last several decades there has been a global increase in harm to fish and other aquatic life (Rabalais, 2002). This study seeks to investigate the concentrations of nitrate and phosphate in selected irrigational sites along River Jakara in Kano State, Nigeria.

MATERIALS AND METHODS

Description of Study Area: Five designated points along the River Jakara were used for the study. The choice of the sampling sites (except for site 1 which was near the origin of the river) was based on the irrigational activities associated with them. Site 1 is the "T" junction of Ibrahim Badamasi Babangida and Ibrahim Taiwo roads. Site 2 is the abattoir and Katsina roads junction. Site 3 is the Burma and Zungeru roads junction. Site 4 is the airport road bridge and site 5 is the PRP village (Fig. 1). While site 1 receives little or no pollution, site 2 receives domestic sewage and effluent from Fagge and abattoir respectively. Site 3 receives domestic sewage from Sabon Gari and wastes from mechanic workshops from Egbe street. Site 4 receives domestic wastes from Sabon Gari extension (No-Man's Land) while site 5 receives wastes from Nigeria Airport Authority quarters, Gwagwarwa and PRP quarters.

Sample Collection: Water samples were collected from the designated points in triplicates in clean dark two-litre plastic containers with screw caps. The samples were taken to the laboratory in boxes containing ice. Samples were collected monthly for twelve months (January to December, 2003) between the hours of 10 am and 12 noon.

Determination of Nitrate and Phosphate: Phenol-disulphuric acid and Ascorbic acid methods were used in determining nitrate and phosphate concentrations respectively (APHA, 1980; 1985).

Data Analysis: Data collected were subjected to statistical analysis. One-way analysis of variance was used to test differences, while the means were compared using multiple range test (MRT). Correlation analysis was used to estimate the degree of association between the two parameters.

RESULTS

Marked variations in nitrate and phosphate concentrations were observed between sites, seasons and months. The results are presented in Tables 1 and 2. Monthly variations in the parameters are illustrated in Figs 2 and 3.

Low nitrate mean values (3.59mg/l and 4.84mg/l) were observed at sites 1 and 5 while higher values (7.53mg/l and 7.75mg/l) were at sites 3 and 4 (Table 1). The nitrate concentrations showed significant difference (p<0.05) between seasons. The lowest concentration (3.25mg/l) was at site 1 and the highest (10.08mg/l) was at site 4, both in the wet season (Table 1).

Science World Journal Vol 5 (No 3) 2010
www.scienceworldjournal.org
ISSN 1597-6343

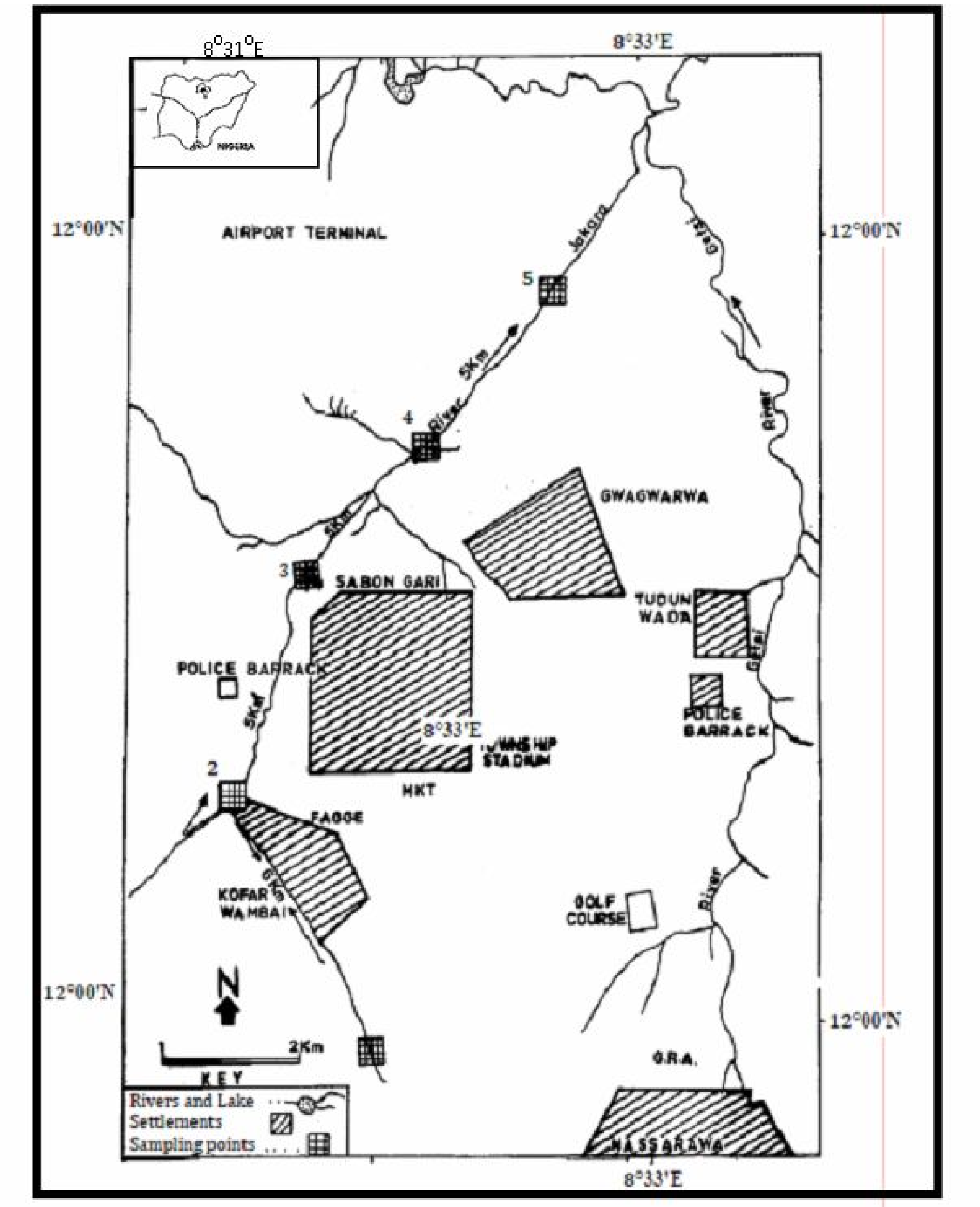

FIG 1. MAP OF THE STUDY AREA SHOWING THE SAMPLING POINTS

TABLE 1. MEAN VALUES OF NITRATE AND PHOSPHATE AT DIFFERENT SITES OF RIVER JAKARA (JANUARY 2003 – DECEMBER 2003).

Parameters (mg/l)	Sites 1	2	3	4	5
Nitrate	3.5^{ab} (±0.47)	5.75^{ab} (±1.42)	7.53^{a} (±0.88)	7.75^{a} (±1.71)	4.84^{b} (±0.62)
Phosphate	3.97^{c} (±0.44)	5.37^{bc} (±0.48)	9.26^{a} (±1.44)	7.68^{ab} (±1.32)	9.09^{a} (±1.65)

Mean values with the same letter within the same row are not significantly different (p>0.05).
Values in parenthesis are standard errors of means.

TABLE 2. DRY AND WET VALUES OF NITRATE AND PHOSPHATE AT DIFFERENT SITES OF RIVER JAKARA (JANUARY, 2003 – DECEMBER, 2003

Parameters (mg/l)	Seasons	Sites 1	2	3	4	5
Nitrate	Dry	3.93 (±0.73)	3.98 (±0.82)	6.47 (±1.15)	5.42 (±1.31)	3.47 (±0.52)
	Wet	3.25 (±0.63)	7.52 (±2.63)	8.58 (±1.27)	10.08 (±3.01)	6.22 (±0.83)
Phosphate	Dry	4.73 (±0.61)	6.63 (±0.55)	6.90 (±1.76)	5.27 (±1.32)	6.50 (±1.64)
	Wet	3.20 (±0.50)	4.10 (±0.26)	11.61 (±1.95)	10.10 (±1.88)	11.68 (±2.59)

Values in parenthesis are standard errors of means.

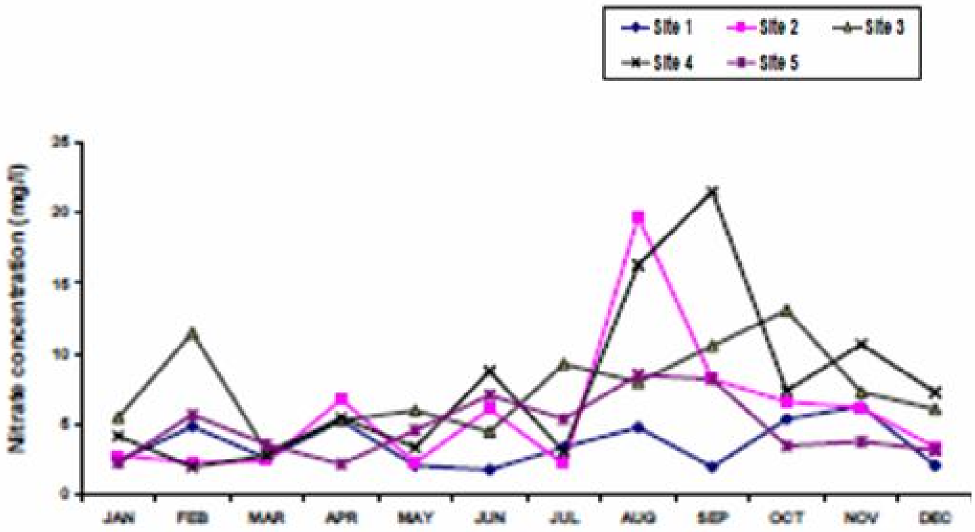

FIG. 2. MEAN MONTHLY VARIATION OF NITRATE OF SURFACE WATER ALONG RIVER JAKARA

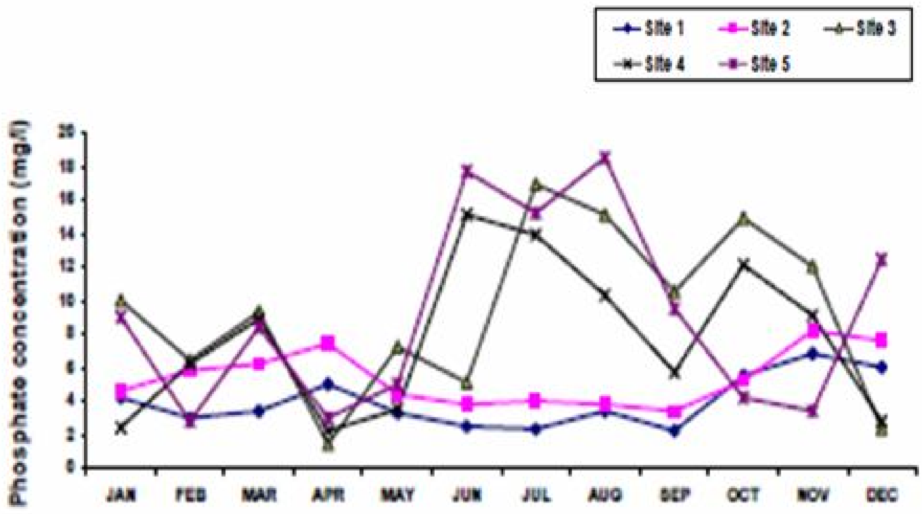

FIG. 3. MEAN MONTHLY VARIATION OF PHOSPHATE OF SURFACE WATER ALONG RIVER JAKARA

Relatively higher wet season values were also recorded at sites 2 and 3. The lowest mean value (3.25mg/l) observed in March and the higher mean values (11.46mg/l and 10.10mg/l) in August and September respectively were significantly different ($p<0.05$) from the other months (Fig. 2).

While the lowest mean concentration of phosphate (3.97mg/l) was at site 1, high mean concentrations (9.26mg/l and 9.09mg/l were in sites 3 and 5. The mean phosphate concentration ranged between 3.20mg/l and 11.68mg/l. The lowest was recorded at site 1 and the highest at site 5, both in the wet season. Higher wet season mean concentrations were also observed at sites 3 and 4. The mean monthly variation revealed that the lowest value (3.80mg/l) was in April and significantly different ($p<0.05$) from the other months; higher values were obtained in July and August.

Figs 4 and 5 show that there was no correlation between the concentrations of nitrate and phosphate respectively in wet and dry season. This means that different factors were responsible for the concentration of nitrate during the two seasons studied. Also no significant correlation between nitrate and phosphate during the period as shown in Fig 6.

DISCUSSION

The relatively high nitrate values observed at sites 2 to 5 could be due to oxidation of ammonia to nitrites and then to nitrates by bacteria during the nitrogen cycle. This nitrifying activity will deplete the dissolved oxygen in the river and may create anaerobic conditions in water. Nitrates result mainly from excreta and urine in domestic waste which were abundant and observed during the trips to the sites.

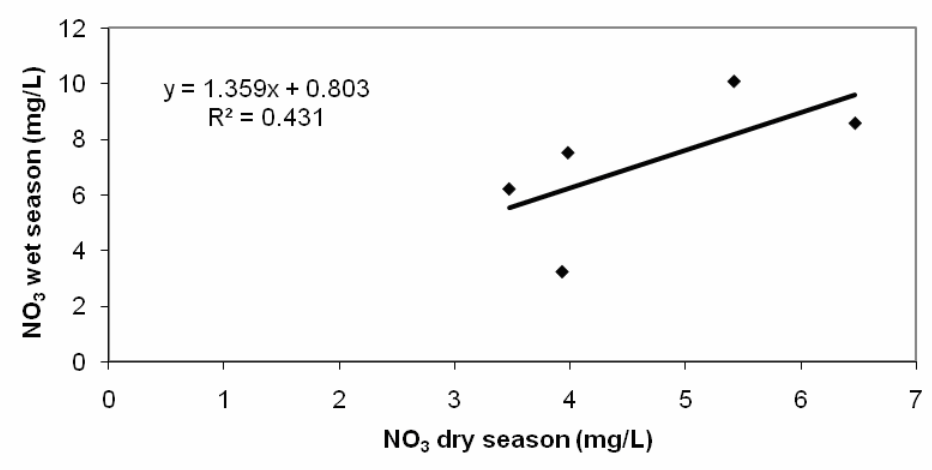

FIG 4. CORRELATION OF DRY AND WET SEASON CONCENTRATION OF NO_3 IN RIVER JAJARA

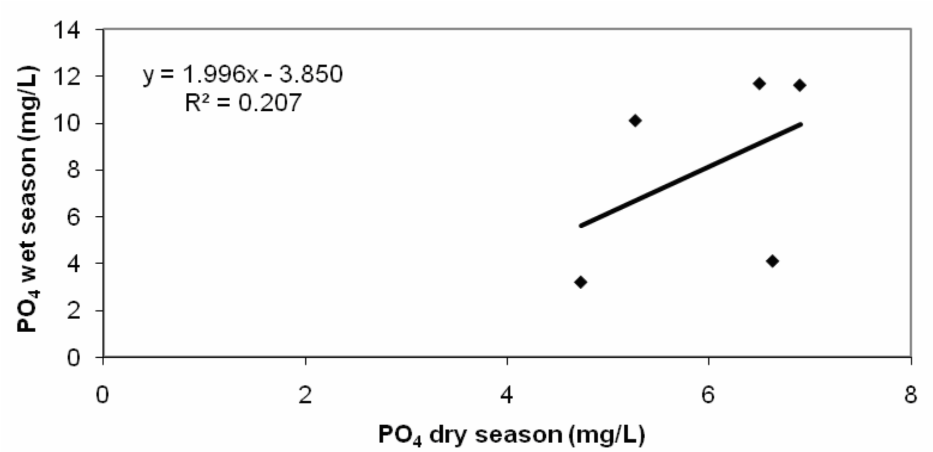

FIG 5. CORRELATION OF DRY AND WET SEASON CONCENTRATION OF PO_4 IN RIVER JAJARA

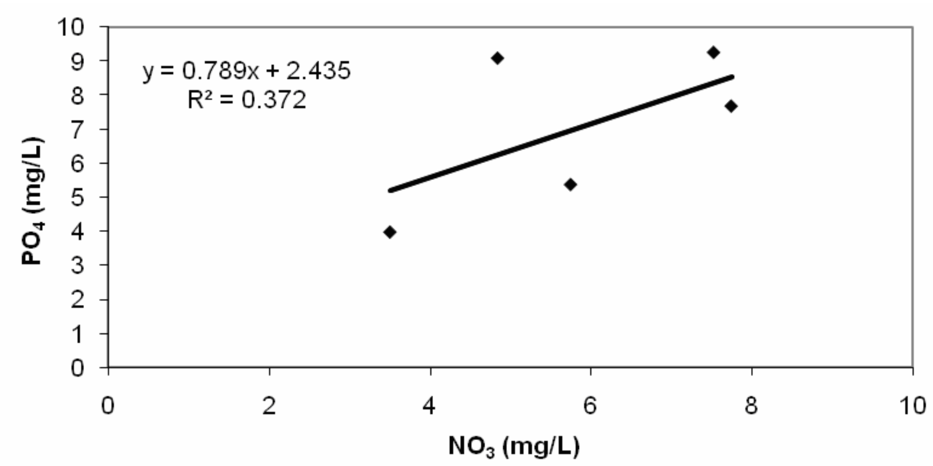

FIG 6. CORRELATION OF THE MEAN NO_3 AND PO_4 IN WATER OF RIVER JAJARA

This might have contributed to the relatively high mean values of nitrates at sites 2, 3 and 4. Site 2 also receives abattoir waste located close to it, site 3 receives domestic wastes from Sabon Gari and site 4 from Sabon Gari extension (No-Man's Land) and all were highly polluted. The higher wet season mean values in all the sites except site 1 might also be related to surface runoffs from the surrounding farmlands and domestic wastes. This is supported by the report of Commins *et al.* (1983) that high nitrate concentration in some bodies of the water may be related to inputs from agricultural lands. The annual mean value of nitrate (5.89mg/l) obtained in this study is within the desirable limit of 20.0mg/l for drinking water recommended by (WHO, 1984).

High phosphate values at sites 2-5 may be due to wastes emanating from homes, abattoir and car washing activities. Temperature and pH conditions in these sites may aid oxidation of organophosphorous compounds to inorganic phosphates. High values recorded in July and August (i.e. the peak of rainy season) at sites 3, 4 and 5 compared to other months could be associated with surface runoff from surrounding farmlands where fertilizers such as NPK are used. The relatively high values recorded at site 2 during the rainy seasons may have resulted from increased evaporation, thus, altering nutrient situation of watering the bodies (Kolo & Oladimeji, 2004). The annual mean value of phosphate of (7.07mg/l) recorded in this study is higher than the value of 5.0mg/l approved by WHO (1984).

High phosphate levels will result in the eutrophication of the river. Growth of algae in the river will be supported by the phosphate. As the algae die, they are decomposed in the water by microorganisms which consume the dissolved oxygen making the river unable to support aquatic life. This anaerobic conditions might have been responsible for having the water septic, changing the colour, reducing stable minerals and producing oxides with offensive odour (Sax, 1979).

CONCLUSION

The nutrient assessment that emerges from this study is that the River Jakara in Kano State is already polluted to an extent that the offensive odour emanating from it is discomforting to inhabitants of Kano, particularly those residing close to it and passersby. Therefore, the relevant government authority should establish a close sewer system and waste treatment facility, and find alternative farmlands for the farmers within the catchment area of the river. These will reduce the amount of stench being experienced and, domestic and chemical pollutants being discharged into the river.

REFERENCES

Ajibola, V.O. & Baiyewu, O.O. (2004). Dynamics of Nitrates and Phosphates in some selected farm soils around Zaria. *Chem Class Journal*, 1:174-176.

American Public Health Association (APHA), American Water Works Association and National Pollution Control (1980). *Standard Methods for the Examination of Water and Wastewater*, 15th ed. Washington DC, USA, 1076pp.

American Public Health Association (APHA), American Water Works Association and National Pollution Control (1985). *Standard Methods for the Examination of Water and Wastewater* 16th ed. APHA, New York, 1193pp

Commins, K.A., Alouso, M., Lopez, P. & Comelles, M. (1983). Limnology of Ciallocanta Lake, Argon, North Eastern Spain. *Hydrobiology*, 105:207-239.

David, M. B., Gentry, L.E., Kovacic, D.A & Smith, K. M. (1997). Nitrogen Balance in and export from an agricultural watershed. *Journal of Environmental Quality*, 26:1038

Jens, S., Per, L., Rutger, R., Per, J., Mats, O. & Dag, M. (2000). Eutrophication and contaminants inaquatic Ecosystems. *Ambio;* 29 (4-5): 184-194.

Knobelock, L., Salna, B., Hogan, A., Postle, J. & Anderson, H. (2000). Blue babies and nitrate-contaminated well water. *Environ Health Perspective,* 108, 675-678.

Kolo, R.J & Oladimeji, A.A. (2004). Water Quality and some Nutrient Levels in Shiroro Lake, Niger State. *Journal of Aquatic Sciences*, 19(2):99-106.

Rabalais, N. (2002). Nitrogen in aquatic ecosystems. *Ambio*. 31, 102-112

Sax, N. I. (1979). *Industrial Pollution*. Van Nostrand Reinhold Co., New York.

Taylor, D. J., Green, N. P.O. & Stout, G.W. (1997). *Biological Science* Cambridge. Cambridge University Press, United Kingdom 984pp.

Weyer, P. (2001). Municipal drinking water nitrate level and cancer risk in older women: the Iowa women's health study. *Epidemology;* 12, 327-338.

WHO, (1984). Guidelines for Drinking Water Quality. World Health Organization, Geneva, 211pp.

Wolfe, A. H. & Patz, J. A. (2002). Reactive nitrogen and human health: Acute and long term implications. *Ambio: A journal of the human environment*; 23 (2), 120-125.