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Study of heavy metals and physicochemical attribute of Romi River, Kaduna, Nigeria

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Abstract
The menace of allege contamination of Romi river is discussed. Many cases of pollution in Romi river could be remedied and the river affected restored to an acceptable state for fishing, irrigation, recreation and domestic use with reasonable expense, if all industries concerned would co-operate. To obtain this cooperation, it is very necessary to understand the situation of the water body and judge it fairly. Much confusion and misunderstanding has arisen in attempts to define the industry responsible for this contamination and the extent of damage to the aquatic organisms, but due to lack of available information on the ecological condition to be defined, in the present study findings and other widely scattered scientific literature by experiment and field work of various agencies brought together covering. (1) The condition which should be maintained to be the recommended standard for drinking water. (2) The specific effects of some physicochemical parameters and some heavy metals which now polluted our streams or rivers. It is hope that use of this information will make possible the definition of undesirable condition of the river with fairness both to the industrialist who discharge the effluent into the water body and to the Romi populace who are entitled to enjoy this same river. The study covered five sampling stations, chosen from the water body stretch. Temperature, pH, Turbidity, Total dissolved Solid (TDS), Biological Oxygen Demand (BOD), Electrical Conductivity (EC), Phosphate, Nitrate and Oil and Grease were analyzed monthly between January, 2015 to May, 2015 using standard method and procedures. The ranges of these factors were found to be comparable to federal ministry of environment (FMEnv) permissible limit for drinking water. The concentration of Turbidity, BOD, Lead, Arsenic, Mercury, Copper, Iron, Manganese and Cadmium were above the federal ministry of environment (FMEnv) permissible limit in station B. DO was within the recommended limit in all stations except station B (effluent discharge point) which was above the standard limit. The level of pollution is more pronounced at sampling point B due to greater EC, BOD and some heavy metals like cadmium, chromium, lead, Arsenic, mercury, copper, iron, manganese, and Nickel which greatly affect the water quality of the river. The study concluded that Romi river water body is slightly polluted due to effluent discharged by the Kaduna refinery (KRPC) and other anthropogenic sources.

Keywords: Anthropogenic**,** Information, Menace, permissible, pollution, industry.

1. Introduction
The aquatic environment with its water quality is considered the main factor controlling or posing serious threat and controlling the state of health and disease of the survival of aquatic organisms [1]. Aquatic pollution by heavy metals is very prominent in industrialized and mining areas and these metals are released or leached directly to the water bodies [2]. Human are exposed to these metal by ingestion (drinking or eating) or inhalation (breathing). Working in or living near an industrial site which utilizes these metals and their compounds increases ones risk of exposure especially where these metals have been improperly disposed [3, 4].
Environmental menace is cause by factors such as rapid population growth, bad agricultural practices, industrialization and Urbanization of society, which may result in the release of complex mixture of contaminants or pollutants [5, 6].
Human developmental activities have led to increased pollution and waste water generations, which in turn contributed to the degradation of the environment. Waste water can find its way into the environment as gaseous, liquid or solid materials. They apparently have impacts on the environment and the living organisms in the receiving media.
Studies on physicochemical parameters and heavy metals of lotic fresh water and fresh water in general in Nigeria are scanty [7]. Worked on River Mu, [8]. Studied the Mbo river, [9] worked on Talar, Iran, [10]. Investigated the heavy metals in drinking water, [11].

Studied the heavy metals levels of Gulf of Khambut-India, [12] worked on the hazard of heavy metals and [13] studied the water quality of River Owo, Agbara.

The accurate determinations of water quality using the physicochemical parameters and heavy metals pollution are very important factor for controlling their pollution. The aim of the study was to provide additional information to existing data on water quality assessment.

2. Materials and Methods

2.1 Site description

Romi river is in Chikun Local government area of Kaduna State Nigeria, which lies in the northern guinea savannah vegetation zone of Nigeria, is located approximately 10 ^{0}25' 35.3 N and 7^{0} 20' 25.06, elevation 568m above sea level. The state lies in the southern guinea savannah vegetation with two distinct wet and dry seasons. The wet season usually last between April and October, while the dry season last between November and March

Sampling stations were chosen on the river string; upstream and downstream of effluent discharge out fall. Sampling station A (pre-effluent discharge). Station A is upstream before the effluent discharge. Sampling station B (effluent discharge point), this is the discharge tunnel point. Sampling station C is the confluent point of station A and B,

Sampling station D (Juji) and E. (Romi), the water is clear and runs fast.

2.2 Sample collection

Duplicate samples for water chemistry and heavy metals analysis were collected in plastic bottles respectively for five months (January to May, 2015). On each trip, samples were taken between 08:00 – 09:00 hours.

2.3 Analysis of heavy Metals

200ml of water sample was collected using plastic bottle container previously washed. This was followed by the digestion of 50ml in 10ml concentrated Nitric acid (HNO_3) and concentrated Hydrochloric acid in ratio 1:.3 in a water bath. Heavy metals were determined using Atomic Absorption Spectrophometry (AAS) Model 180 - 80. Corresponding concentrations were obtained from standard curves at chemical laboratory of Kaduna State Environmental Protection Agency (KSPA) Values were expressed in ppm, wt. %, pp mug.L^{-1} respectively.

2.4 Analysis Physicochemical parameters

Water temperature, pH and Electrical conductivity were determined *insitu* using suntex Ph/Ec/Temperature meter TS2, Turbidity using Jenway 6035 turbidity meter, NO_3 and PO_4-Spectrophotometer Model using HACH DR 2010 series, BOD and DO *insitu* using Lutron DO-5511 meter.

3. Results

3.1 Nature of sampling stations

The physical appearances of sampling station B, C and D were similar with a blackish colour, stinks offensively. Sampling station D appeared different from sampling station B, C. Station D; the water is darkish green colour with choking smell. Sampling station A is quite different from station B, C, D and E with a colourless appearance and odorless.

3.2 Physicochemical parameters and heavy metals

The result of physicochemical properties and heavy metals for the five consecutive months are shown in figures i-xviii. The values of the results were compared with standard values of Federal ministry of Environment Nigeria (FMEnv) regulatory limit for environmental pollution control in Nigeria.

Physicochemical aspect The surface water temperature in the five sampling stations are presented in fig.i, lowest temperature values of 19.5 ^{0}c and 18^{0}c were recorded in December and January respectively after which it began to rise, reaching a peak (36.7 ^{0}c) in April and then began to fall in May. The pH values ranges from 5.0 to 9.0. The lowest value (5.0) was recorded in February and March while the highest (8.5) was recorded in January in station B. The conductivity values varied considerably during the study period, the values were high (538mg/l) in station B while station E recorded lowest values (97mg/L). DO values range from 2.4mg/L to 7.4mg/L. The BOD reading varies from lowest 3.7 mg/L in January at station B while station C had the highest (53mg/L) recorded in March.

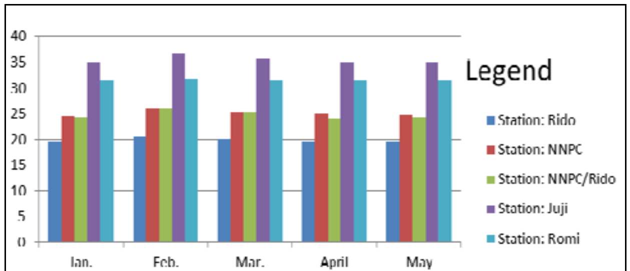

Fig.i:. The values of temperature at five sampling stations in Romi river for five

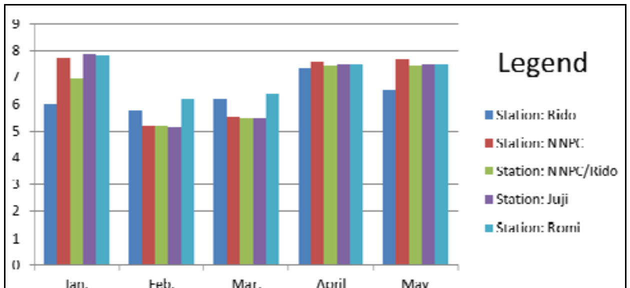

Fig. ii: The values of pH at five sampling stations in Romi river for five

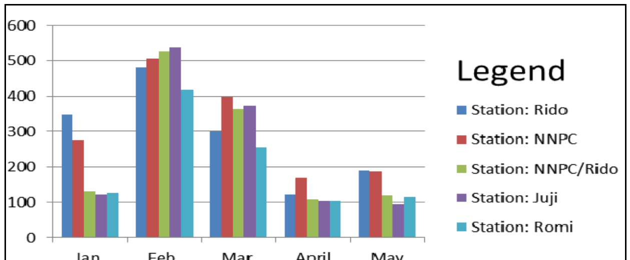

Fig.iii: : The values of Ec at five sampling stations in Romi river for five

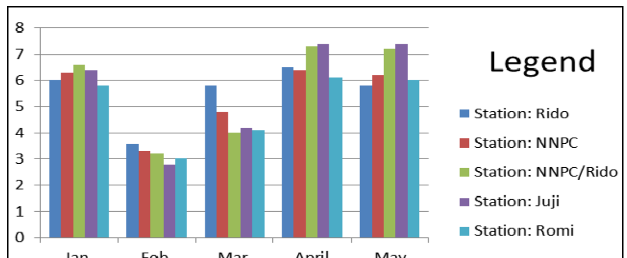

Fig.iv: The effect of DO at five sampling stations in Romi river for five

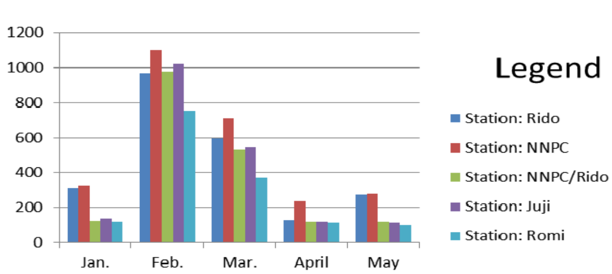

Fig. v: The values of TDS at five sampling stations in Romi river for five

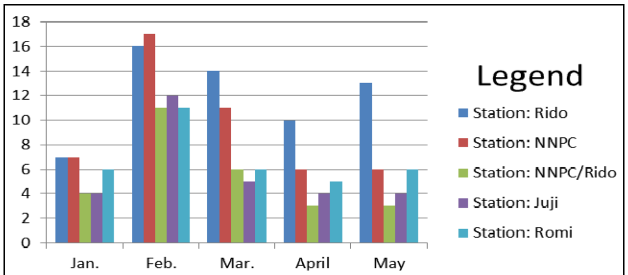

Fig. vi: The values of Turbidity at five sampling stations in Romi river for five

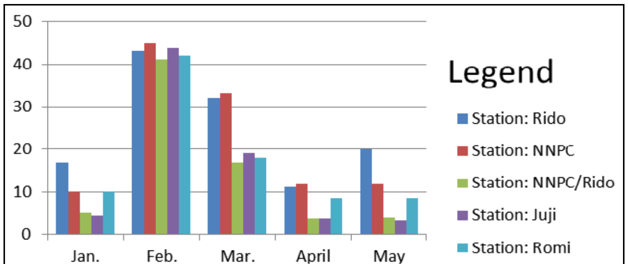

Fig. vii: The values of BOD_5 **at five sampling stations in Romi river for five**

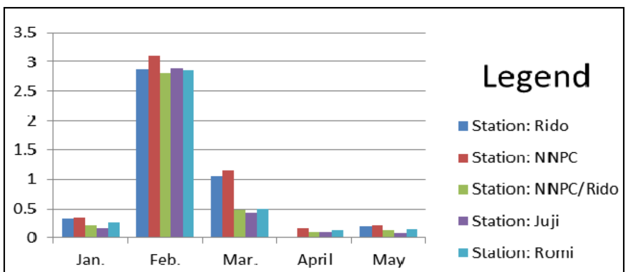

Fig.viii:The values of PO_4-P **at five sampling stations in Romi river for five**

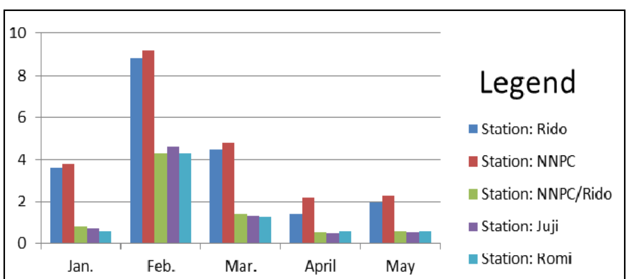

Fig. ix:The values NO_3-N **at five sampling stations in Romi river for five**

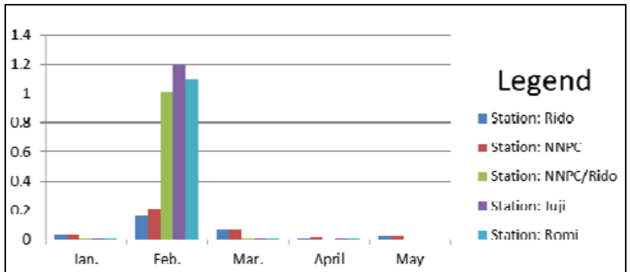

Fig. x:The value of chromium at five sampling stations of Romi river for five months.

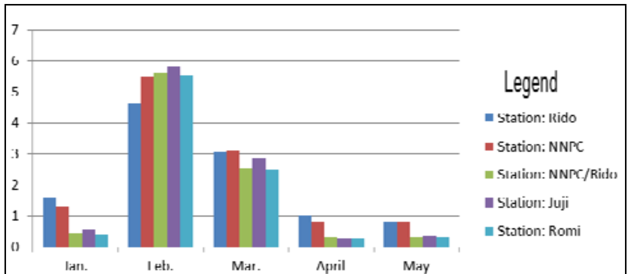

Fig. xi: The values of zinc at five sampling stations of Romi river for five months..

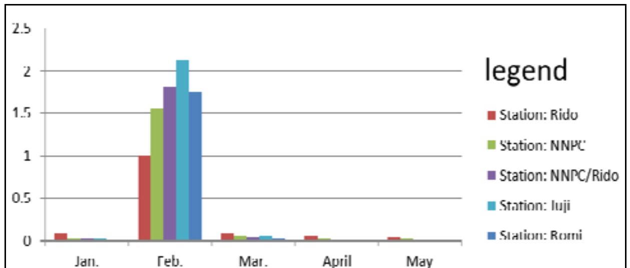

Fig. xii: The values of Lead at five sampling stations of Romi river for five months.

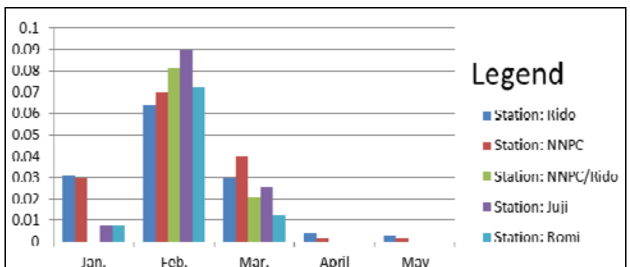

Fig xiii: : The values of Arsenic at five sampling stations of Romi river for five months.

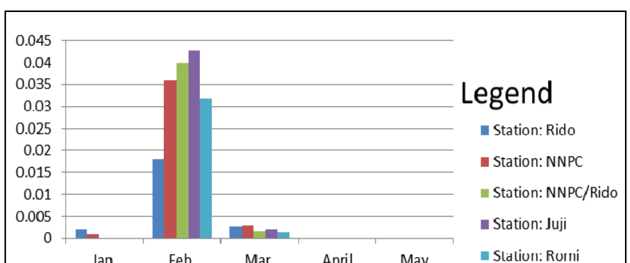

Fig xiv: The values of Mercury at five sampling stations of Romi river for five months.

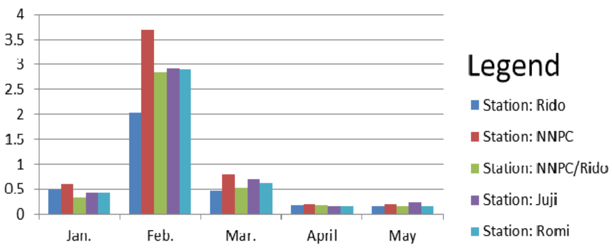

Fig xv: The values of COpper at five sampling stations of Romi river for five months.

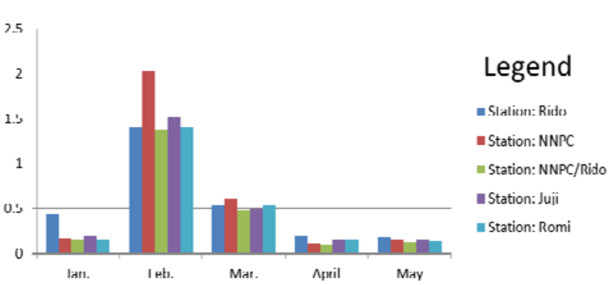

Fig xvi: The values of Iron at five sampling stations of Romi river

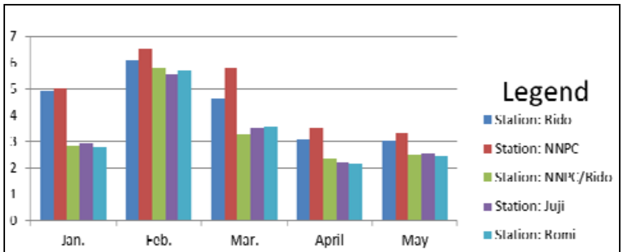

Fig: xvii The values of Manganese at five sampling stations of Romi river

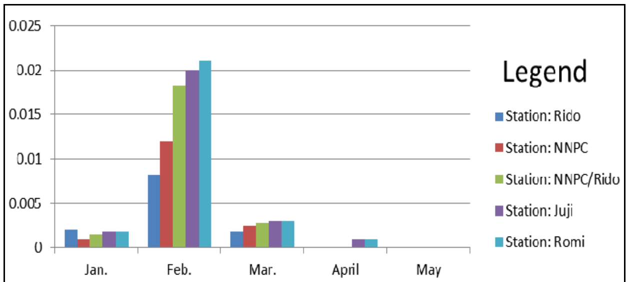

Fig: xviii: The values of Cadmium at five sampling stations of Romi river

Nutrient (phosphorous and nitrogen) values for the five consecutive months were within the standard limit. The concentration of heavy metals was high in stations C and D but was above maximum at sampling station B. Generally, higher level of Chromium (Cr), Zinc (Zn), Lead (Pb), Arsenic (As), Mercury (Hg), Copper (Cu), Iron (Fe), Manganese (Mn) and Cadmium (Cd) was observed at sampling station B which is the effluent discharge point.

4. Discussion

The low temperature experienced between December and January could be attributed to the hamatan wind experienced during this period. Higher temperature values recorded could be due to increased solar radiation and dilution effect by effluent discharge from KRPC as previously observed by [14] in an industrial base settlement in Kaduna.

The pH values for the five stations were not within the acceptable limits of 6.5-8.5 for inland water, which is not in agreement with the observation of [15, 16].

The higher conductivity values recorded during the study period could be attributed to concentration of solid as a result of high evaporation rate of water and dilution effect of effluent. Similar observation was made by [17] in two industrial effluents in Kakuri.

The low DO value recorded could be the effect of high level of pollution by organic waste, oil spills, domestic waste entering the river. Many authors have attributed low DO values to the effect of pollution when part of the oxygen is consumed for respiration and breakdown of organic matter [18, 19]

Biological oxygen demand (BOD) determined the relative waste load, at higher degree; it indicates the presence of large amount of organic pollution and high microbial activities with high oxygen depletion consequent. High levels of nitrate have been reported to exhibit delayed reactions to light and sound stimuli [20-22].

Phosphate are essential nutrient to plant life and productivity but at low concentration growth is limited [23], but when found in excess quantities, it stimulates excessive plant growth such as algae bloom [24].

High level of heavy metals may be attributed to the effluent of companies, factory, materials and other relevant occupational fields [25-27], reported that, the level of pollution is due to greater amount of heavy metals such as Chromium, Zinc, Lead, Arsenic, Copper, Iron and Cadmium which greatly affect the water quality of the river [28, 29]. The present study thereby agree with the report of daily trust,1st April, 2013, [30] which reveals the true picture of the water quality of Romi river.

5. Conclusion

The introduction of NNPC waste water into the river greatly impairs the water quality of this river. The consequence is seen as elevated concentration of heavy metals such as Chromium, Zinc, Lead, Arsenic, Copper, Iron and Cadmium above the FMEnv permissible limit in drinking water. Waste water was also implicated in the increase nutrient (N: P) levels.

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