PHYTOPLANKTON POPULATION PRODUCTIVITY IN RELATION TO SOME PHYSICO-CHEMICAL PARAMETERS OF KUDIDDIFFI-KUBANNI STREAM, ZARIA NIGERIA.

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Abstract

Phytoplankton samples were collected using a silk plankton net of 25cm diameter and of 70meshes/cm attained with a bottle of 50cm capacity at the base sample water for physiochemical analysis was used for pH, dissolved oxygen (DO),Biological Oxygen Demand(BOD) ,Nitrate Nitrogen (No_3-N).

The water quality parameters, nutrient levels and Plankton productivity of the Kudiddiffi-Kubanni stream Hanwa-Makera, Zaria,Nigeria were studied for a period of 12 months,2006 to2007. Water samples were collected from six stations. Highest temperature of 28^0C was observed in May and lowest of 11.5^0C was observed in December. Stations 3 and 5 were most transparent while Station 2 was most turbid. Nitrate-nitrogen value ranged from 3.08 to 15.22mg/L. Phosphate-phosphorus value varied between 2.09 and 8.4mg/L. PO_4-P was low in all the stations while NO_3-N was high in all stations and in the Dry season. High concentration of Dissolved oxygen (DO) which ranged from 4.60 to 8.80mg/L was observed in all stations throughout the season except station 2 with a low mean DO of between 1.10-3.40mg/L. Biological Oxygen Demand (BOD) was generally below the standard value of 6mg/L in all stations. The BOD recorded for stations 2, 4 and 6 is an indication of organic pollution. Phytoplankton were found in all stations. The percentage composition of the phytoplankton in stations 1,2,5,4,3 and 6 were 25.54, 19.50, 18.75, 15.42, 13.5, and 7.29 respectfully (.1>2>5>4>3>6). Cyanophyta made up 52.57% of the taxa of Phytoplankton. *Microcystis* sp. formed 90.40% of all Cyanophytes. The Cyanophytes observed included *Oscillatoria* sp., *Anabaena* sp., *Nostoc* sp., *Agmenellum* sp., *Gomphosphaeria* sp. and *Microcystis* sp. Calculation of the Biotic Index of Pollution (BIP) and Morpho-edaphic Index of Water (MEI) showed that the water was highly polluted.

Key Words: phytoplankton population,water quality parameters,nutrient levels.

Introduction

Water is an important basic resource for humanity. The quality of tropic water is determined by the quality of algae which are important as Bio indicators (Odhiambo and Gichuki, 2000; Chia, 2007).

Algae are distributed almost as widely as bacteria. The occurrence and abundance of algal species in ponds is a result of complex interactions between them and their biotic and abiotic components. Algae are diverse in form and habit comprising of thousands. They form the first trophic level of the food chain in aquatic habitat and can determine the productivity of a lake or river.

The use of abiotic parameters to assess the fishery potentials of many water bodies in the developing countries is scanty. Where such data are available they are not properly used in developing the indigenous fisheries. However, many European water bodies have been classified by their abiotic factors (Jenkims, 1982). The use of water quality criteria in predicting the potential fishery production of various European water bodies is widely known (Khan et.al, 1983; David et.al 1983; Chia et.al 2009).

The direct effects of interaction of many frequently measured water quality parameters with biotic components that affects productive potentials of fish species have been demonstrated (Anadu et.al 1990; Kemdirim 1990; Babatunde et.al,2014). The most widely studied and diseased abiotic factors associated with primary production in water bodies are the phosphate and nitrate contents. Both are associated with algae blooms, variations in chlorophyll contents and the phytoplankton dynamics of the water body. While phosphorus is particularly limiting in temperate water bodies (Weich *et.al*, 1978). In the tropics nitrogen was found to be the primary limiting nutrients for the growth of *selenastrum capricornutum* in one dam and phosphorus in another dam (Torien and Steyn, 1975).

Studies have been done on plankton abundance and distribution in some Nigerian fresh water (Imevbore1968, Chia, et.al 2009, Babatunde et.al 2014).there has not been any such documented studies on Kudiddiffi-Kubanni stream in Nigeria.

The objective of the present study is therefore to investigate the plankton productivity in relation to nutrients levels and water quality factors in Kudiddiffi stream in northern parts of Nigeria.

Material and Methods

Routine sampling was carried out between 10.00hr and 17.00hr fortnightly from July 2006 to Jun 2007. Temporal changes in water land were measured with a sample gauge. Air and surface water temperature were measured in the field with mercury-in-glass thermometers. The water pH and conductivity were measured in situ using the griffin battery-operated pH and conductivity meters respectively. The water sample for dissolved oxygen (DO) determination was taken using a 250ml reagent bottle with a glass stopper, and the concentration of oxygen estimated by the Winkler method (APHA 1998).

Water samples for other chemical analysis were collected with 2L polyethylene bottles, previously washed, rinsed and dried in the laboratory. Total alkalinity was estimated by titration with 0.02NHU, using phenolphthalein and methyl orange indicators. Phosphate-phosphorus ($P0_4$-P) and Nitrate-Nitrogen ($N0_3$-N) were determined calorimetrically (APHA 1998)

Plankton net 25cm diameter of 70meshes/cm with a radius of 25cm was used to collect the Phytoplankton from the water surface and was preserved in Lugol's Iodine solution. The algal samples were concentrated in the laboratory before sedimentation. The concentrated samples were mixed well and an aliquot of 1ml was withdrawn by quick suction on a regular large-bore pipette and introduced into one corner of a Sedgewick-Rafter counting cell/chamber of 1ml capacity the cover of the cell was placed diagonally. Precautions were taken to ensure that no air-bubbles were formed in the counting chamber and throughout the counting period. The cell has a 1ml capacity with a dimension of 20mm × 50mm base × 1mm height= 1000mm^3 volume.

Identification of the Phytoplankton was done using the procedures of Prescott (1997), APHA (1998) and other recourse materials. Unidentified specimens were recorded and the drawings and photomicrographs of some Phytoplankton were taken. Two-way Analysis of Variance (ANOVA) and DMRT were carried out to determine significant differences.

Results and Discussion

Results of pH and DO are shown in figs 1&2 respectively. pH was generally alkaline throughout the year peaking in November (2006) February and March (2007).

Figs. 3&4 show the monthly variations of nitrate-nitrogen and phosphorus-phosphorus of Kudiddiffi-Kubanni stream. Highest peak was observed in January for all sample stations apart from station1.samplingstation 2 has the highest peak for No_3-N and $P0_4$-Pconcentrations.

DO shows highest peak in February during the windy harmattan season. DO of station 2 which is the lentic part of the watercourse shows a remarkably significantly low concentration throughout the course of the study while the lotic parts of the watercourse (Stations 1,3, 4 , 5 and6) show consistently high DO values.

A total of twenty-eight (28) algal taxa belonging to Cyanophyta, Chlorophyta, Bacillariophyta and Chrysophyta were observed in this work. Fourteen (14) of these algal taxa belonged to Cyanophyta, six (6) to Chlorophyta, one (1) to Chrysophyta and seven (7) to Bacillariophyta. Relatively, Cyanophyta were the most abundant (52.57%) followed by Chlorophyta (31.49%), Bacillariophyta (15.94%) and lastly Chrysophyta (0.067%) (Table 1).

The species of Cyanophyta identified in the sampling stations during the course of this research included *Oscillatoria sp., Anabaena sp., Microcystis sp., Nostoc sp., Agmenellum sp.* and *Gomphosphaeria sp.* (Plate 1). *Microcystis sp.* had 90.46% of the total Cyanophyta followed by *Oscillatoria sp.* (7.87%), *Anabaena sp.* (0.39%), *Nostoc sp.* (1.02%), *Gomphosphaeria* (0.19%) and *Agmenellum sp.* (0.06%) . The high percentage of the *Microcystis sp*. showed that the water is heavily polluted with organic pollutants. A high correlation between Cyanophyta and BOD and also a negative significant correlation between Cyanopyta and DO were observed statistically.

Chlorophyta had the highest species diversity of which the taxa included *Euglena sp., Spirogyra sp., Selenastrum sp., Scenedesmus sp., Pediastrum sp., Chlorella sp., Protococcus sp., Volvox sp., Ankistrodemus sp., Oedogonium sp.* and *Chlamydomonas sp.* The only member of the Chrysophyta genus seen was *Tribonema sp.* . *Euglena sp., Spirogyra sp. and Chlamydomonas sp.*, showed greater monthly densities than the rest. (Table 2)

Bacillariophyta taxa included *Navicula sp., Actinocyclus sp., Gomphonema sp., Diatoma sp., Synedra sp., Buddulphia sp. Cyclotella sp.* and *Pinnularia sp.* (Plate 3). *Actinocyclus sp.* was the most abundant (55.42%) followed by *Navicula sp.* (32.56%), *Diatoma sp.* (11%) *Gomphonema sp.* (0.28%), *Cyclotella sp.* (0.25%), *Syndera and Biddulphia sp.* (0.4%). (Table 2) Seasonally, there was no significant difference between Bacillariophyta and Nitrate-Nitrogen

The physicochemical parameters show that the water is highly polluted and that the pollution correlates with types of Phytoplankton. *Microcystis* which is often used as a pollution index forms 90% of the cyanophytes and 56% of the total Phytoplankton. The high BOD of 14.79mg/L of the lentic part of the stream, is above the international regulatory limit for fresh water and the DO mean value of the pond throughout the period of study 2.68±0.35mg/L the lentic part however showed a water that is indicative of pollution. These are indicators of the impacted state of the water. Thus, Phytoplankton common in polluted water were of highest abundance. Other reasons according to Chia (2007) could be due to anthropogenic activities around the catchment area and also the extent of usage of the ponds. This agrees with the works of Babatunde (2008) and USEPA (2002).

The water quality parameters, the nutrient levels and phytoplankton abundance of the waterbodies varied rather with season.High pH values have indicated a good buffering capacity of water.High biota production due to high pH values is supported by high nutrient production as seen in this study and which agrees with the work of Winger (1981) and Chia(2007).They reported that surface run-offs into water due to excessive land utilization strongly influence the amount of nutrients that enter the receiving water.Large amount of nutrients (NO_{3-} N) and ($PO_{4\,-}$

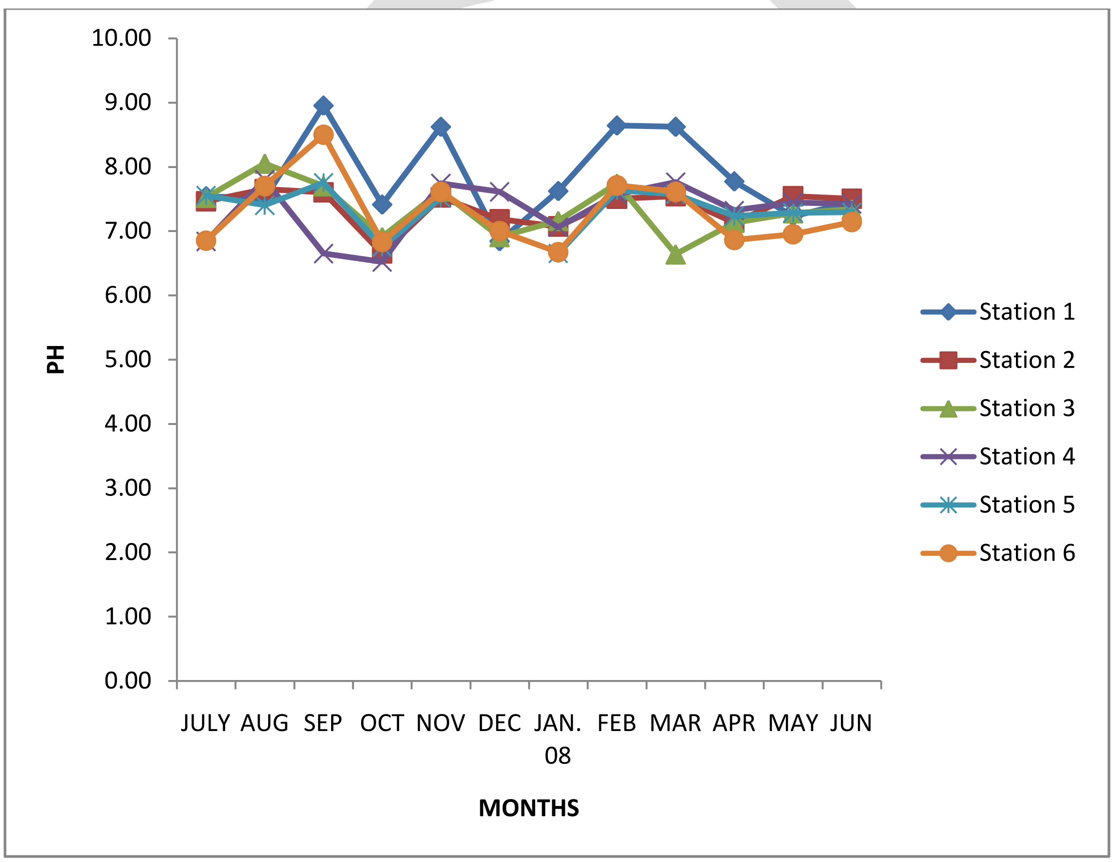
P) as observed in this study could possibly be responsible in increased amount of energy input into the water system.Kemidirim(1990) and Agbugui and Deekae(2014) works agreed with this study.They explained that nitrate-nitrogen and phosphate-phosphorus values obtained in rainy months indicated high nutrient production level.The values also favoured high plankton production.So phosphate-phosphorus and nitrate-nitrogen could be limiting factors to phytoplankton productivity in water.

Table 1 ABUNDANCE, M.E.I AND M.B.I INDICES OF KUDIDDIFFI STREAM, HANWA-MAKERA, ZARIA NIGERIA

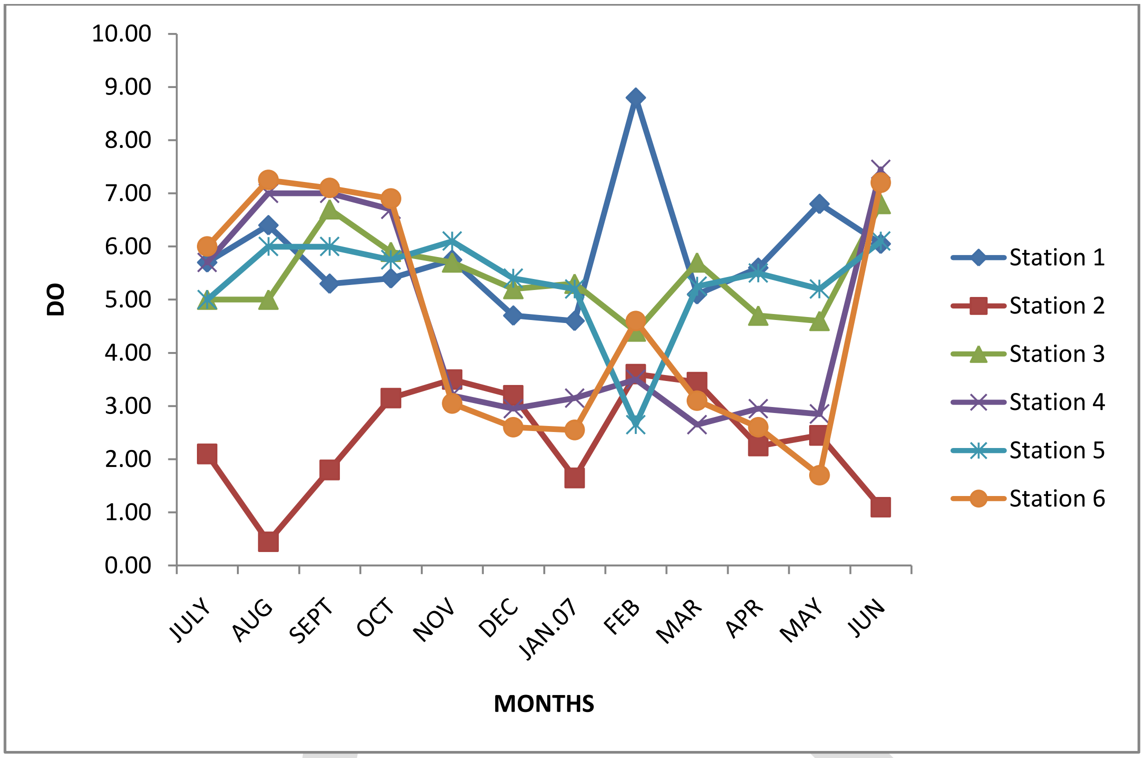
Cyanophyta	**(%)**	**Chlorophyta and Chrysophyta**	**(%)**	**Bacillariophyta**
Oscillatoria	*7.87*	*Euglena*	*20.00*	*Navicula*
Anabaena	*0.39*	*Spirogyra*	*13.15*	*Actinocyclus*
Microcystis	*90.46*	*Chlamydomonas*	*29.47*	*Gomphonema*
Nostoc	*1.02*	*Selenastrum*	*0.11*	*Diatoma*
Agmenellum	*0.06*	*Scenedesmus*	*2.17*	*Synedra*
Gomphosphaeria	*0.19*	*Pediastrum*	*0.43*	*Biddulpha*
		Coeleostrum	*0.22*	*Cyclotella*
		Protococcus	*0.11*	
		Volvox	*1.52*	
		Ankistrodesmus	*0.76*	
		Oedogonium	*0.22*	
		Tribonema	*0.11*	
		Encystment	*0.81*	

Table 2 SPECIES DIVERSITY (%) OF BIOTA IN KUDIDDIFFI STREAM, HANWA

SAMPLING STATIONS	*1*	*2*	*3*	*4*	*5*	*6*	*% Total*
Cyanophyta (%)	13.24	40.28	16.34	10.00	14.91	5.16	52.57
Chlorophyta (%)	37.88	19.16	13.98	13.63	10.65	8.56	31.49
Bacillariophyta (%)	4.83	5.06	4.43	28.26	52.53	4.83	15.94
M.B.I index (pollution)	1.34	7.86	8.00	8.00	8.00	8.09	--
M.E.I Index (Productivity)	302.50	158.44	670	249.22	245.22	245.65	99.72



Figs 1 MEAN MONTHLY VARIATION IN HYDROGEN ION CONCENTRATION (PH) IN KUDIDDIFFI –KUBANNI STREAM, HANWA-MAKERA, ZARIA



Figs 2. MEAN MONTHLY VARIATIONS IN DISSOLVED OXYGEN CONCENTRATION (DO) IN KUDIDDIFFI – KUBANNI STREAM, HANWA-MAKERA, ZARIA

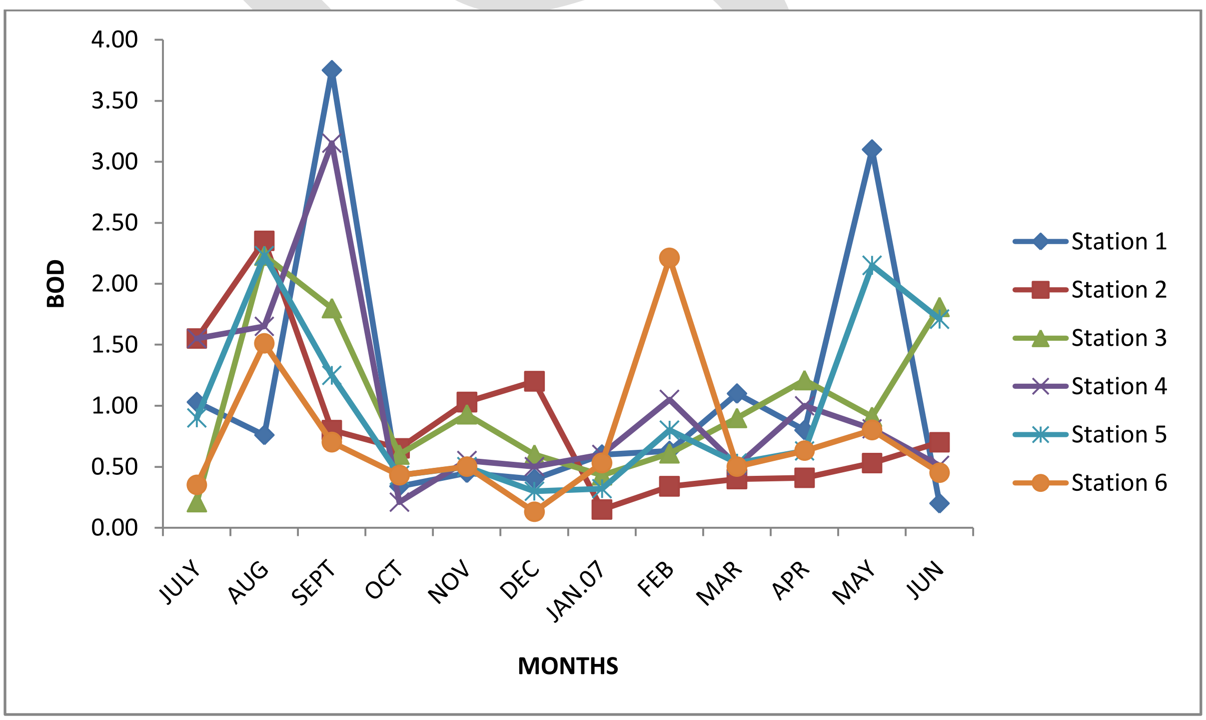


Fig2a.MEAN MONTHLY CONCENTRATIONS OF BOD OF KUDIDDIFFI-KUBANNI STREAM,HANWA MAKERA.ZARIA.NIGERIA.

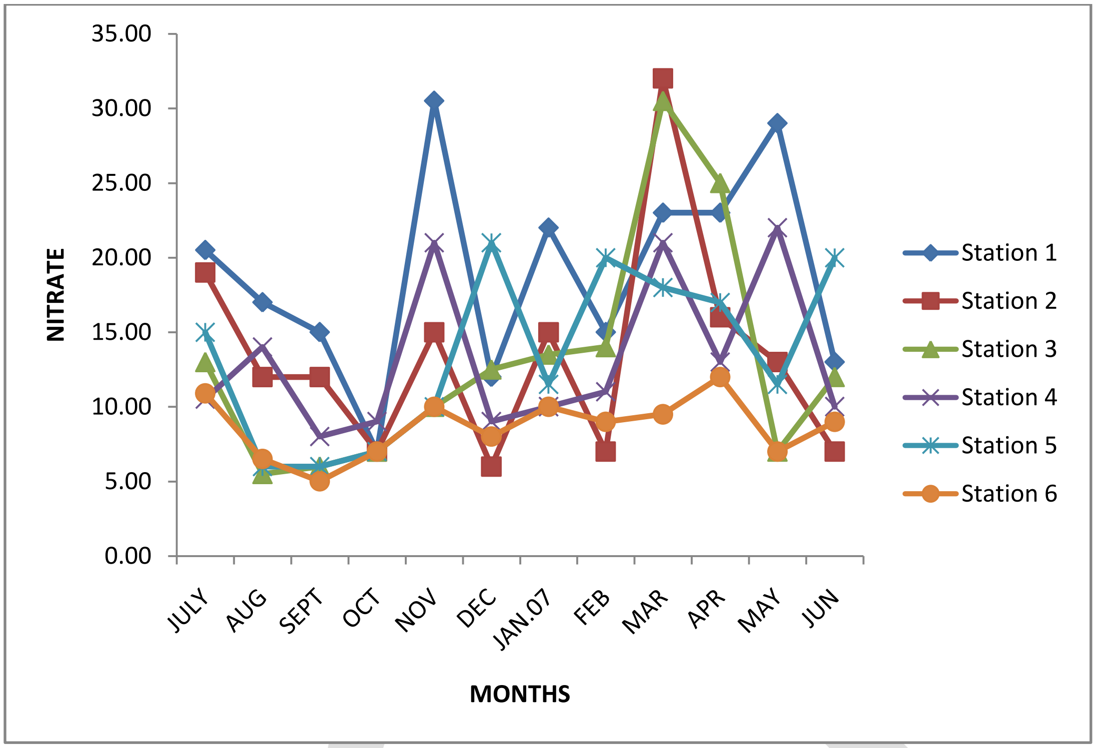
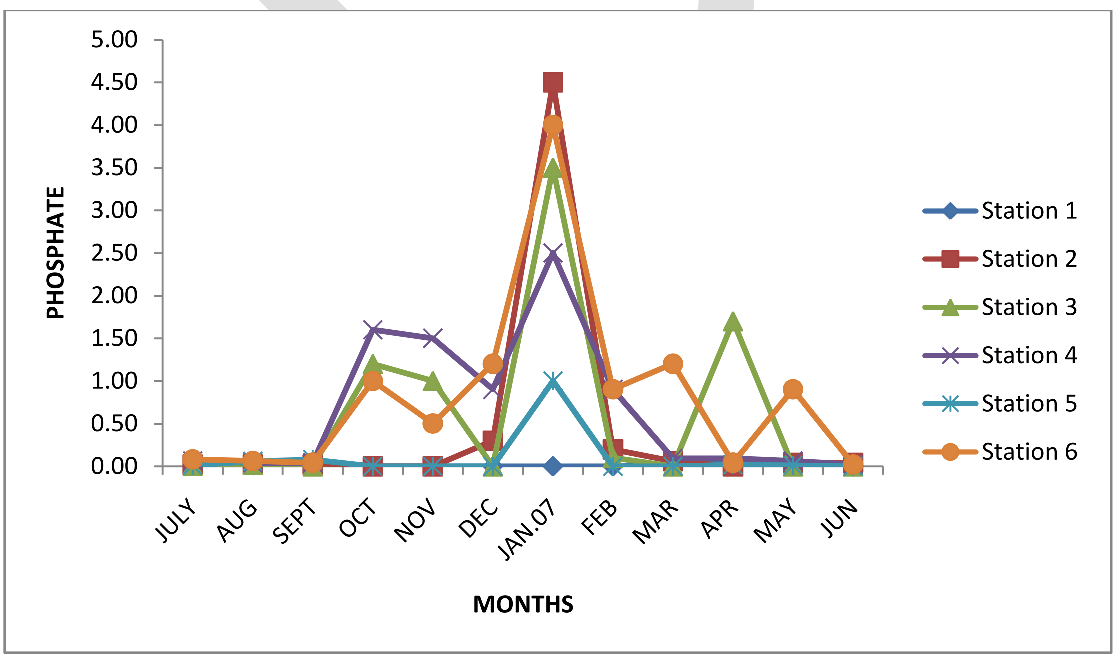


Fig 3. MEAN MONTHLY CONCENTRATION OF NITRATE -NITROGEN(NO_3-N) OF KUDIDDIFI STREAM, HANWA- MAKERA, ZARIA.



Figs 4. MEAN MONTHLY CONCENTRATION OF PHOSPHATE-PHOSPHORUS (PO_4-P)OF KUDIDDIFI – KUBANNI STREAM, HANWA- MAKERA, ZARIA.

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