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Analysis of some aspect of Physico-chemical Parameters of River Hadejia, Jigawa State, Nigeria.

Azubuike Adams (Ph.D)
Biological Science Department, Nigeria Police Academy, Wudil, P.M.B 3474, Kano – Nigeria.
Email of the Correspondence Author: dr.azubuikeadmas@yahoo.com

Abstract
Analysis of some aspects of physic chemical parameters of River Hadejia was conducted from July 2012 to June 2013.
The parameters measured were Temperature, Oxygen concentrated, Ph, Total dissolved solutes (TDS), Transparency and conductivity. The data were analyzed. Tables 1 – 7, most of the parameters measured were within the limits required for fish production. Stations A, B and C sampled revealed that there was a negative correlation between temperature and PH in all the sites. The same relationship obtained between temperature and conductivity for Stations A, B and C.
Temperature and total dissolved solids (TDS) the relationship was insignificant (P>0.05). the relationship between PH and conductivity for stations A, B and C was positive but insignificant (P>0.05).
Keywords: Temperature, dissolved oxygen (DO), Transparency, PH, Conductivity.

Introduction
Physic-chemical parameters of water temperature
Temperature is one of the most important environment factors; it not only affects the survival and distribution of species but, also growth, rate of development, activity and reproduction as well as susceptibility to diseases. Fishes can live at very different temperatures, the highest temperature, over 52^c is tolerated by a fish of the family *cyprinodontidae* which lives in the small hot springs of Calfonia (Lagler, 1977). Denver (1967) determined an upper lethal limit of 42^c for *O.niloticus* experimentally. At opposite extreme, the *crucian carpcarassius* can survive freezing, though only if the body fluid remains unfrozen. The normal range of temperature to which fish is adapted in the tropics is between 8^c and 30^c (Alabaster & Lloyd, 1980). These are the critical thermal minimum and maximum respectively. The least temperature observed in some burrow pits was 17^c (Bala, 1996) while the maximum temperature was 29^c.

Besides, the adaptations of a fish to a particular temperature, the amplitude of fluctuation of the temperature at which fishes of the same species can live are extremely important. Usually, tropical and sub-tropical fishes are more stenothermal than those of the boreal and higher latitudes. Marine forms are also more stenothermal than freshwater species. The optimal temperature to which a fish is adopted is also species characteristics. Fishes of high latitudes have envolved a metabolic type which enables them to feed successfully at very low temperature. But the activity and feeding rate of cold water fishes decreases at higher temperatures. However, fishes in the tropics have higher metabolic rates with increasing temperatures. At higher temperatures, the metabolic rate will rise until denaturation leads to death cross (1959) noted that *S.mossambicus* became inactive at temperature below 15^c an increase in the rate of food consumption and increase in the digestive rate. High temperatures usually induce spawning. Generally, in the tropics, a temperature of 21 – 23^c is required for spawning to take place (Huet, 1972). Temperatures above 20^c will trigger off development of secondary sexual characteristics and nest building (Fryer and Iles, 1972). Both the developmental period and the hatching period are generally shorter at higher temperatures than at lower ones. There has long been interest in the direct relationship of temperature to development of individuals within species. Such a relationship was determined more than a hundred years ago for the brook trout *salrelinus fontinalis*. For this fish, the developmental period decrease with rise of average water temperature (in degrees Fahrenheit) as follows: 37,65 days, 50, 47 days; 54, 32 days (Lagler, 1977). Temperature affects the efficiency with which food stored in the egg is converted into body weight of the embryo.

Alanson et al (1971) described striking changes in the kidney histology and ultra-structure of the cells of the proximal tubules in *S.mossambicus* at 11^c thus renal failure and subsequent high water permeability have been proposed in part as the reason for the coma.

Dissolved Oxygen (DO)
Like all the animals, fish cannot live without oxygen. The lack of access to oxygen by the blood leads to stress which makes the fish vulnerable to disease and parasite out breaks which eventually may lead to death. Only a few species living in water in which for various reasons, they frequently develop structures that are adapted to breathing atmospheric air, for example, *prototerus, annectens, polyterus spp, claria spp, Hyperopsus bebe* which are facultative air breathes with highly sacculated or alveolar lining in the gas bladder which enables it to take in

atmospheric oxygen. These species are mainly found on the Kainji Lake (Holden and Reed, 1991). The amount of oxygen used by fishes is not constant; it varies with age and in relation to the changes in the activity of the fish and the condition under which it lives. Young fishes require more oxygen than the older ones for metabolism (Alabaster and Lloyd, 1980). In fishes which are adopted to living under conditions of a periodical onset of oxygen deficit, the activity is reduced in these periods, the metabolic rate falls and the amount of oxygen used for respiration is reduced which finally affects the growth rate (Payne 1971). In the tropics, especially in the burrow pits, depletion usually occurs at night (Bala 1996). The main cause is the rich development of aquatic vegetation which rapidly uses up the oxygen at night (Maitland, 1978). Oxygen is also used up in the oxidation of organic matter which is abundant in water masses 'in Bloom' by day the consumption of oxygen is compensated by photosynthesis at night when photosynthetic process cease but the consumption of oxygen continues at the same rate. This could in a deficit and lead to the death of fishes. As a general rule, if dissolved oxygen is equal to, or in excess of 5mgl-I, no stress would be placed on the aquatic organism (Wheaton, 1977). However, some species of *cichlids*, for example, *O. niloticus* are able to tolerate dissolved oxygen concentrations well below 1.2mgl with litter or no resultant stress (George, 1575). The comparative low oxygen demand of this group is one factor which enables this species to occupy such extreme conditions. Another species of fish that could survive very low concentration of dissolved oxygen is *protopterus annectens* which posses a pair of lungs that enable it to breathe air and can hibernate when the lake dries up (Holden and Reed, 1991).

Hydrogen Ion Concentration (PH)

Huet (1972) recommends a ph of 7-8 as best for fish cultivation and the less variable the fluctuation in ph, the better the biological conditions. Liming is recommended to maintain the alkalinity in order to prevent ph from suddenly dropping to lethal levels, either due to the pond becoming diluted by sudden rains, or excessive photosynthesis changing the ph Mabaye (1981) reports that low ph reduced the appetite of *T.rendalli*. Similarly (pruginin, 1975) mentioned the attempt to cultivate *T.rukwaensis* from the waim alkaline lake Rukwa in the Njambe region of Tanzania which ph is 5 and low temperature resulted in a fish production of only 100kg/ha. It would therefore, seem that acid water has an adverse effect on fish production but little is known of the actual effect on fish Huet (1972) indicates that a ph of 4.5 is decisive to the survival of most fish but also claims that lethal level to rise to pH 5.5 if iron is present. This would most probably be due to iron becoming deposited as hydroxide on the gills where there is likely to be higher low pH due to ammonia excretion. Prolonged exposure to low pH value could result in significant reduction in egg hatchability, egg laying and general growth in many fishes (Lee and Gerking 1980). The maximal acceptable pH level varies with species. (Gruber 1962) stated that fish can live at pH 12 but only if this is due to photosynthesis. *O.niloticus* was found to tolerate high pH levels 8-11 (John Sto et al, 1983). This agrees with the findings of (George 1975) in ponds in the sudan where limed to raise the pH level above 4.5.5 led to a stimulation of T.rendalli feeding in ponds (Gruber, 1962).

Anions / Cations

Phosphorus and nitrogen are usually considered essential for plant production including algae which are eaten by fish directly or indirectly. This is due to their roles in the formation of high energy compounds in the cells and forming major constituent of protein respectively. It is note worthy that the number of young of certain marine commercial fishes are in close dependence upon the amount of phosphates in the water. In regions where sea birds nest enmass, the enormous amount of excrement falling into the water forms an excellent fertilizer and favours the development of organisms upon which fish feed. Under the conditions of pond fertilization with various mineral salt, including phosphates, is frequently used and causes a significant increase in the production of fishes.

In fresh waters, both phosphorus and nitrogen are commonly found in low concentrations but varying proportions from one water body to another (Payne, 1986), in most temperature waters, phosphorus is usually reported as the principal limiting factor of production (Wetzel, 1975). In tropical waters however, nitrogen is probably more critical than phosphorus.

Certain dissolved mineral salts, particularly those of iron are very important for the life of fishes. As the experiment of Minkina (1949) showed a concentration of iron of 0.2mgl-I cause a sharp reduction in the metabolic rate of fishes and slow down their growth. Conversely, a concentration of 0.1mgl-I stimulates their growth. An increase in the concentration of iron in the water leads to some reduction in the rate of oxygen consumption of fishes. Nikolsky (1966) reported that cations have a considerably greater effect upon fish than do the anions. In recent times, the presence of substances dissolved in the water which are not normal constituents of the water but which enter it as the result of various human activities such as tree – felling, industries effluents, sewage pollution, oil pollution has became particularly important to fishes. The effect on fish of acids which enters the water is very great but the investigation of their toxic effect is made difficult by the fact that the acids do not affect fishes in the same way in relation to the hardness of the water and the concentration of hydrogen ions.

Industrial effluents containing sulphuric acid affects the eggs and larvae of fishes. Both the H+ and SO^- ions affect the fish. The effect of the SO^- is particularly great on developing eggs, destroying their normal metabolism (Nikolsky, 1966).

Turbidity

Suspended solids are bits of particulate matter, larger than 0.45um found in the water column; they are made up of sediments, organic materials (detritus composed of plants and animals remains, waste food particles and faecal materials) as well as phytoplankton cells and other living micro-organisms. Most African ponds are supplied from perennial streams and prolonged rainfall which causes a considerable rise in turbidity due to the increase of suspended clay particles (Okories, 1975). The suspension of particles in water has the most varied effects upon fishes. The greater effect occurs when the water contains up to 4% by volume of sold particles. Fishes of turbid rivers have a number of adaptations such as a great reduction in the size of the eyes which reduces the unprotected surfaces which could be damaged by suspended particles with small eyes are bottom dwellers and they orientate towards food by means of their tactile organs (Lange 1987). The occurrence of large quantities of suspensions in the water would also hinder the respirations of fishes. Apparently, in fishes which live in turbid waters, the mucus secreted by the skin has the property of rapidly sedimentation the fish is always surrounded as it were by an envelope of water, even in turbid waters. Naturally, the coagulating property of the mucus is important as a means of protecting the gills from being choked by the suspended particles. (Okories, 1975) states that high turbidity reduces primary productivity and oxygen level in the ponds and often increases fungal diseases, this could be an advantage in reducing the growth of filamentous algae and aquatic macrophyte but could be a disadvantage if a phytoplankton boom is required to provide food for young organism or herbivores.

This work is tries to evaluate the physic-chemical parameters of River Hadejia, Jigawa State, and hopes to elucidate the level of development and the factors that influence fish production through experimentation.

Materials and Methods

Site A: (Up Stream)

This site coincides with the Auyo L.G Area of Jigawa State. It falls within the Chad formation, made up of unconsolidated sediment, which are of tertiary terrestrial in origin. Vast accumulation of this is found in form of sand plains and interfluves recent accumulation in Channels complexes as well as in depressions.

The relief of the area falls within low Chad plain that is developed in sedimentary rock. On the average relief of 400 metre above sea level while the relative relief is between 15m to 20m above sea level.

Dominant soil in the study site consists of unconsolidated sediment, predominantly sand, silt and sandy loam. They are formed from the deposition of materials over sedimentary formation the soils have fair clayed content and become increasingly down the profile due to alleviation from up stream.

Site B: (Mid-stream)

This area is covered by quarterly deposits of sand, silts and clay of the Chad formation, which has great influence on the relief of the area. The western part of the area is known to be the tail of Hausa plain with and elevation of about 500m. The relative relief if the area is about 15 to 18m above sea level.

Immediately west of the hydrological divide, the Chad sediments extended in the area to a depth of approximately 50 meters. The thickness increases eastward in the section of the present day lake Chad.

Site C: (Down-stream)

The site is to be within the lower course of the valley, having the same geological formation. It has a relatively peculiar surface landscape, with little activity of undercutting in the upshore of the river banks, About two-third of the South-Eastern section of Guri is an area of inundation especially in the rainy season when the rainfall maxima aid the raising of the discharge volume of the available streams. This phenomenon gives room for the formation of marshy land especially during wet season.

The main streams in the area include, River Hadejia and River Kafagun. The two rivers flow eastward and cut across the area diagonally. The finally confluence in the Western margin of Yobe State and ascend in to River Yobe. The confluence of these two rivers in the rainy reason results in the expansion of water volume. This provides a conductive atmosphere for narigation as well as carrying out of fishing activities.

The only river of significance that drains the Chad formation is the Hadejia River and this part of its course, its extensive shallow flood plains which flow only during rainy season most of them disappearing into the sandy dunes as the water they carry evaporates or percolates into the ground.

The Hadejia River has many tributes between Ringim and Hadejia taking water from it. At Miga (Jahun Local Government) it bifurcates into two forming Hadejia and Kaffin Hausa rivers. The Kaffin Hausa River flows in a defined formation before it reaches the lowland area between Jiga Gandi and Kisigin where it widely floods the area during the rainy season loosing large of water before it meets the Jama'are River at

Abonabo. While the Hadejia River flows eastwards, past Hadejia town to an area South of Madaci where it enters a series of lakes and swamps. This widely spreads flooding retards the speed and quantity of water flowing down. Here, three rivers leave the swamp, Marma, Burun Gandi and Hadejia rivers.

Temperature

This was measured with a dipping mercury bulb thermometer as described by Bennett and David, 1974, correct to 0.1 c. the first few measurements did not show much variations between both air and water temperatures, hence measurements for air and water temperature were discontinued.

PH

The PH values were determined by the colorimetric method using the lovibond comparator, bromothymol blue as indicator as described by Hach, (1980) 10m/ of each water sample was taken into each of the two glass tubes contained in the comparator. Ten droops o the indicator were added into the water sample contained in one of the tubes and thoroughly mixed.

The indicator colour disc was then inserted in the comparator to compare with the colour in the tube containing the indicator and the water sample, the corresponding pH value was then read and recorded.

Dissolved Oxygen (Digital Titrator method (Model DRELS)

The dissolved oxygen was determined by the use of the Azide modification of Winkler's method as described in (ApHA, 1980). Water sample from the three station's A-C were collected using a 2 litre Van Dorn water sampler. The water emptied into Biological Oxygen Demand (BOD) sample bottles allowing them to overflow for two minutes. This ensured that no air bubbles were trapped in the bottle.

The content of one dissolved oxygen reagent powder pillow and one dissolved oxygen 2 – reagent powder pillow were added. The stopper was immediately inserted so that no air was trapped in the bottle and the bottle was several times to mix. A flocculent precipitate was formed which was brownish orange; this indicated the presence of oxygen.

The sample was allowed to stand until the floc had settled, leaving the top half of the solution clear. The bottle was again inverted several times to mix and was allowed to stand until the upper half of the solution became clear again, the stopper was removed and the contents of one dissolved oxygen 1 – reagent powder pillow were added, the stopper was replaced carefully so that no air bubbles were trapped in the bottle. The bottle was again inverted several times mix. The flock dissolved leaving a yellow colour, which again indicated the presence of oxygen.

Twenty mills (20mls) of the prepared solution were then transferred into a titration flask. A hand held titration was then carried out with a clean straight stem delivery tube attached t 0.300nN Sodium Triosulphate titration cartridge. The cartridge was twisted onto the titration body. Turning the delivery knob to eject a few drops of titration flushed the delivery tube. The counter was reset of zore and the tip was wiped.

The prepared solution was titrated with sodium thriosulphate 0.2000N, until the sample changed from yellow to colourless. The number of digits was read from the counter window, and valve was multiplied by 0.1 to determined concentration of dissolved oxygen in mg/i.

Conductivity of the water sample was measured using a HACH DR/2 conductivity meter. The instrument was standardized using distilled water. Then the probe was inserted into the sample with the instrument at the "NO" position, the conductivity value was then read as displayed on the meter and this value was recorded.

Water transparency was determined before setting the net on sampling days every evening by means of a 25.4cm diameter secchi-disc as described by Boyd (1981). The disc was immersed in the water until it just disappeared. The depth at which it disappeared was recorded and the depth was also until it reappeared and the depth was also recorded. The average of the two readings gave the transparency reading.

RESULTS

Water Quality

Tables 1 – 7 show a summary of the variation in the monthly water quality parameters for River Hadejia.

Temperatures

The overall mean temperature was $28.34^c \pm 0.05$ it ranged from $23.5^c + 33.00^c$ for station A, the mean temperature is $28.30^c \pm 2.63$ the lower temperature of 23.80^c was recorded in February while the highest for the station (32.60) was recorded in September (Table 1). For station B, the mean temperature was 28.34c ± 2.86. I range from a lowest of 23.5^c, recorded in September.

The mean temperature from station C was $28.39^c \pm 2.04$ January had the lowest record (24.90^c) while September had the highest of 31.75^c.

PH

The PH ranged from 6.90 – 8.20, the overall mean pH was 7.31 ± 0.14. The pH for station A range from 7.05 in July to 7.70 in January, with a mean of 7.43 ± 0.30. Station C had a mea pH of 7.15 ± 0.15 as well as a range of 6.90 in February to 7.50 in January.

Table 1:
Surface water T (oC) at River Hadejia

MONTHS	STATION A	B	C	Monthly Means
July 2012	29.70	29.50	29.20	29.49 ± 0.25
August 2012	28.90	28.70	27.90	28.50 ± 0.53
September 2012	32.60	33.70	31.75	32.45 ± 0.64
October 2012	30.80	31.20	30.90	30.97 ± 0.21
November 2012	29.50	28.70	28.40	28.53 ± 1.06
December 2012	26.30	26.60	26.40	26.43 ± 0.15
January 2012	24.50	23.5	24.90	24.30 ± 0.72
February 2012	23.80	24.45	26.60	24.95 ± 1.42
March 2012	27.10	25.45	27.00	26.52 ± 0.93
April 2012	26.80	28.5	27.90	27.73 ± 0.86
May 2012	29.20	29.45	29.00	29.47 ± 0.25
June 2012	30.40	31.00	30.70	30.70 ± 0.30
Station Mean	28.30 ±2.63	28.394 ± 2.86	28.39±2.04	
Overall Monthly Mean				28.34 ± 0.05

Table 2:
Surface water pH at River Hadejia

MONTHS	STATION A	B	C	Monthly Means
July 2012	7.05	7.20	7.05	7.05 ± 0.09
August 2012	7.10	7.20	7.10	7.13 ± 0.06
September 2012	7.30	7.40	7.15	7.28 ± 0.13
October 2012	7.45	7.60	7.20	7.42 ± 0.20
November 2012	7.48	7.55	7.20	7.41 ± 0.19
December 2012	7.60	7.40	7.25	7.42 ± 0.18
January 2012	7.7	8.20	7.50	7.80 ± 0.36
February 2012	7.10	7.30	6.90	7.10 ± 0.20
March 2012	7.45	7.50	7.15	7.37 ± 0.19
April 2012	7.45	7.55	7.25	7.42 ± 0.15
May 2012	7.30	7.2	7.05	7.18 ± 0.13
June 2012	7.10	7.05	7.05	7.07 ± 0.03
Station Mean	7.34 ± 0.22	7.43 ± 0.30	7.15.15±0.15	
Overall Monthly Mean				7.31 ± 0.14

Dissolved Oxygen (DO_2)

The overall dissolved oxygen for the lake was 6.53 ± 1.08. The DO_2 ranged from 4.3mg/1 to 8.8mg/1. (Table 4.3). The mean DO_2 for station A, B, C are 6.57mg/1 ± 1.08, 6.36mg/1+1.07 and 6.66mg/ ± 1.17 respective. These DO_2 ranged from 4.7mg/1 in January for station B and 4.5mg/1 in May to 8.8mg/1 January for station C.

Table 3:

Dissolved Oxygen (DO_2) at River Hadejia

MONTHS	STATION A	B	C	Monthly Means
July 2012	5.9	6.0	6.3	6.07 ± 0.21
August 2012	6.2	6.7	6.9	6.66 ± 0.36
September 2012	6.9	7.0	7.4	7.10 ± 0.26
October 2012	7.07	6.41	7.70	7.60 ± 0.65
November 2012	7.6	7.2	7.0	7.27 ± 0.31
December 2012	7.9	7.5	7.5	7.63 ± 0.23
January 2012	8.30	3.10	8.8	8.40 ± 0.36
February 2012	6.8	6.4	6.4	6.53 ± 0.23
March 2012	6.3	6.0	6.1	6.13 ± 0.15
April 2012	5.1	4.9	5.0	5.0 ± 0.10
May 2012	4.7	4.3	4.5	4.50 ± 0.20
June 2012	6.1	5.3	6.3	6.07±0.25
Station Mean	41.60 ± 8.39	6.36 ± 1.07	6.66 ±1.17	
Overall Monthly Mean				6.53 ± 1.08

Transparency

The overall mean secchi disc transparency was 0.71m ± 0.17. It ranged from 0.35m to 0.95m. (Table 4) station A had the minimum of 0.22m which was recorded in July while the highest for the station was 0.95m and was obtained in February, March and April. The mean for the station was 0.76 ± 0.16 for stations B and C the lowest transparencies were 0.40m in July and 0.35 in July respectively. The highest were in March/April and February respectively. The main transparencies for the two stations were 0.72 ± 0.17 respectively.

Table 4:

Transparency at River Hadejia

MONTHS	STATION A	B	C	Monthly Means
July 2012	0.55	0.40	0.35	0.43 ± 0.10
August 2012	0.55	0.50	0.43	0.49 ± 0.06
September 2012	0.58	0.54	0.50	0.54 ± 0.04
October 2012	0.63	0.59	0.57	0.60 ± 0.03
November 2012	0.68	0.65	0.63	0.65 ± 0.03
December 2012	0.75	0.75	0.72	0.74 ± 0.02
January 2012	0.90	0.78	0.77	0.82 ± 0.07
February 2012	0.95	0.90	0.99	0.91 ± 0.01
March 2012	0.95	0.95	0.80	0.90 ± 0.09
April 2012	0.95	0.95	0.90	0.93 ± 0.03
May 2012	0.85	0.85	0.70	0.80 ± 0.09
June 2012	0.75	0.75	0.65	0.72 ± 0.06
Station Mean	0.76 ± 0.16	0.72 ± 0.17	0.66 ±0.17	
Overall Monthly Mean				0.71 ± 0.17

Table 5:
Dissolved Solids (TDS) mg/l at River Hadejia

	STATION			
MONTHS	**A**	**B**	**C**	**Monthly Means**
July 2012	44.32	47.17	50.34	47.27 ± 3.01
August 2012	48.61	50.10	55.30	51.34 ± 3.51
September 2012	50.92	54.61	57.20	54.24 ± 3.16
October 2012	54.63	42.94	36.46	44.68 ± 9.21
November 2012	50.10	40.32	33.41	41.28 ± 8.39
December 2012	41.00	33.21	30.14	34.78 ± 5.60
January 2012	40.21	30.18	30.00	33.46 ± 5.84
February 2012	35.14	28.20	24.10	29.15 ± 5.58
March 2012	30.10	25.65	22.20	25.98 ± 3.96
April 2012	28.8	38.30	39.91	39.00 ± 2.07
May 2012	35.8	38.30	39.91	39.00 ± 2.07
June 2012	40.1	42.20	43.70	42.00 ± 1.81
Station Mean	41.60 ± 8.39	36.61 ± 9.23	38.19 ± 11.50	
Overall Monthly Mean				39.47 ± 1.8

Table 6:
Surface water conductivity umhoslem at River Hadejia

	STATION			
MONTHS	**A**	**B**	**C**	**Monthly Means**
July 2012	110.10	92.50	105.70	102.8 ± 9.2
August 2012	94.70	90.40	105.10	96.7 ± 7.6
September 2012	90.50	94.30	112.10	98.9 ± 11.5
October 2012	125.00	116.0	118.3	97.2 ± 0.20
November 2012	120.25	112.15	119.0	117.1 ± 4.4
December 2012	90.10	99.00	104.20	97.8 ± 7.1
January 2012	125.20	113.4	116.4	87.80 ± 0.36
February 2012	118.40	133.20	121.62	114.4 ± 7.8
March 2012	130.32	145.15	129.0	135.0 ± 17.3
April 2012	145.20	165.10	130.55	147.0 ± 17.3
May 2012	90.10	85.50	92.15	89.3 ± 3.4
June 2012	99.21	90.50	97.30	95.7 ± 46
Station Mean	109.45 ± 17.48	113.17 ± 25.58	112.22 ± 11.58	
Overall Monthly Mean				111.61 ± 18.68

Table 7:
Correlation Matrix for physic-chemical parameters for sampled stations on River Hadejia

STATION A						
	Temp	**PH**	**Conductivity**	**TDS**	**DO_2**	**Transparency**
Temperature	1					
PH	- 0.38	1				
Conductivity	- 0.62	0.46	1			
TDS	- 0.23	- 0.07	0.38	1		
DO_2	- 0.91	0.54	0.76	0.44	1	
Transparency	- 0.01	0.36	- 0.23	-0.86	-0.11	1

STATION B

	Temp	PH	Conductivity	TDS	DO_2	Transparency
Temperature	1					
PH	- 0.48	1				
Conductivity	- 0.44	0.19	1			
TDS	0.17	- 0.41	0.14	1		
DO_2	- 0.91	0.54	0.64	0.06	1	
Transparency	- 0.16	0.21	- 0.29	-0.87	-0.33	1

STATION C

	Temp	PH	Conductivity	TDS	DO_2	Transparency
Temperature	1					
PH	- 0.26	1				
Conductivity	- 0.26	0.21	1			
TDS	0.28	- 0.19	0.51	1		
DO_2	- 0.82	0.56	0.38	-0.02	1	
Transparency	0.02	0.15	- 0.40	-0.82	-0.22	1

Discussion and Conclusions

Physic – Chemical Factors

The tables 1 – 7 show a summary of the variation on the monthly water quality parameters for River Hadejia.

The overall mean temperature was 28.34c ± 0.05. It ranged from 23.5c to 33.00c for station A, the mean temperature is 28.30c 2.63. the lower temperature of 23.80c was recorded in September (table 1). For site B, the mean temperature was 28.34c ± 2.86. It ranged from a lowest of 23.5c, recorded in September.

The mean temperature for station C was 28.39c ± 2.04. January, 2005 had the lowest record (24.90c) while September, had the highest of 31.75c.

The PH ranged from 6.90 – 8.20 the overall mean pH was 7.31 ± 0.14. the pH for site A ranged from 7.05 in July, 7.70 in January with a mean 7.34 ± 0.22 (Table 2) site B had pH range of 7.05 in June to 8.20 in January and a mean pH of 7.43 = 0.30. Site C had mean pH of 7.15 ± 0.15 as well as a range of 6.90 in February to 7.50 in January.

The overall dissolved oxygen for the river was 6.53 ± 1.08. The DO_2 for site A, B, C are 6.57mg/1 ± 1.08, 6.3mg/1 in May for site B and 4.5mg/1 in May to 8.8mg/1 in June site C (Table 3).

The overall mean conductivity was 111.61umhos/cm ± 18.68. The lowest was 85.50umhos/cm while the highest was 165.10umhos/cm recorded December and May respectively. The highest for the station was 145.20umhos/cm recorded in April. The station had a mean of 109.45 ± 17.48. Station B had a mean of 113.17umhos/cm ± 25.56 with a range of 85.50umhos/cm in June to 165.10unhos/cm in April. The mean for Station C was 112.22umhos/cm ± 11.93. The range was 92.15umhos/cm in June to 150.55umhos/cm in April. Table 6.

Overall TDS is 39.47mg/l ± 8.89 and it ranged from 42.20mg/l to 57.20mg/l. The mean TDS for Station A was 41.60mg/l ± 8.39. It ranged from 28.3mg/l in April to 54.63mg/l in October. For Station B, the mean TDS was 38.61mg/l ± 9.23 and it ranged from 28.20mg/l in February, to 54 61mg/l in September. The mean TDS for Station C is 38.19mg/l ± 11.50. This ranged from 22.20mg/l in March to 57.20mg/l in September. Table 5.

The overall mean secchi disc transparency was 0.71m ± 0.17. It ranged from 0.35 to 0.95m. (Table 4) Site A had the minimum of 0.22 which was recorded in July while the highest for the site was 0.95m and was obtained in February, March and April. The mean for site was 0.76 ± 0.16 for Site B and the lowest transparencies for two sites were 0.72 ± 0.18 and 0.66 ± 0.17 respectively.

The correlation matrix for physic – chemical parameters on River Hadejia and for the various sites sampled. This reveals that there was a negative correlation between temperature and pH in all the sites. These differ in values obtained were, -0.38, -0.48 and 0.36 for Sites A,B and C respectively. The same relationship obtains between temperature and total dissolved solids (TDs), (Bankole, 1989). The relationship was insignificant for all the Sites ($P>0.05$). This was the same for the relationship between conductivity and total dissolved solids and between total dissolved solids and dissolved oxygen, (Bankole, 1989). Table 7.

Conclusion

The data obtained from the work suggest that River Hadejia has potentially influence in the development of aquaculture and fisheries research.

The management of the water bodies by the inhabitants is of great important for sustainability in Agricultural potentials of the River.

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