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Assessment of Pollution Status of Wataridam Using Selected Physiochemical Parameters in Kano State, Nigeria

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ABSTRACT
The variations in selected physico-chemical factors were investigated for three seasons of the years to determine the water quality of Watari reservoir which are pH, Temperature, Conductivity, Turbidity, Total Dissolved Solid(TDS), Total Hardness(TH), Biological Oxygen Demand(BOD), Dissolved Oxygen(DO), Chemical Oxygen Demand(COD), Suspended Solid (SS), Chloride Cl^-, Nitrate ($NO2^-$), Nitrite ($NO3^-$), Phosphate ($PO4^{2-}$) were analysed using standard procedure. Four sampling sites (WFA, WFB, WFC and WFD) were chosen on the Dambased on the geographical positioning The mean values of these parameters indicate the effectiveness of the treatment process on suspended solids, turbidity, $NO3^-$ and colour. The ranges of these factors were found to be comparable to those reported for other African reservoirs except for nitrogen and phosphate which were foundin higher concentration above freshwater limits. Runoff of nitro-phosphate and sulphate fertilizers from nearby farm lands and washing of cows dungs from the watershed into the reservoir were found to have caused cultural eutrophication in the reservoir. There is significant variation (P <0.05) between the values of colour, nitrate, phosphates temperature, suspended solids and conductivity, observed for the three seasons. The overall quality of Watari reservoir was found to be within the WHO recommended value for drinking water. It is therefore recommended that proper attention need to be given to the water body by appropriate authorities due to its possible health implication on the consumers through continuous monitoring so as to track any adverse environmental changes in the dam.

KEYWORDS: Assessment, Pollution, Physico-chemical, Reservoir, Water Quality, Seasonal Variation

I. INTRODUCTION

Wateris an extremely important substance for all life (including humans) on our planet. Water exists in large amounts, as there are around 4.16818183km^{3}of water on Earth in three its three physical states: solid, liquid, and gas. It differs in its abundance across the following contexts: seas and oceans (97.24%), glaciers and icecaps (2.14%), groundwater (0.61%), freshwater lakes (0.009%), in land seas(0.008%), soil(0.005%), atmosphere(0.001%), and lotic systems (0.0001%) (NOOA, 2021)

Water is a valuable natural resource that is essential for human, animal, and plant life cycles. Water in its pure state is tasteless, odourless, transparent and colourless, except for as light blue undertone (Listyani and Peni, 2020). Surface and groundwater are particularly vital resources for human existence and health. It is reported that one in three people worldwide do not have access to safe drinking water, as such one of the United Nation's strategic development goals (SGD6) seek to ensure access to clean water and sanitation for all (Bebbingt on and Unerman, 2018). Similarly, water protection is one of the priorities of the European Commission which adopted the Water Framework Directive (WFD) in 2000, that is a legislative framework for securing an adequate supply of high-quality water for all of Europe (Kontopoulouetal.,2017). According to Ibrahim (2009) Water resources are of critical importance to both natural ecosystem and human development. It is essential for agriculture, industry and human existence. The healthy aquatic ecosystem is depended on the physicochemical and biological characteristics (Vermaetal.,2012).The quality of water in any eco system provides significant information about the available resources for supporting life in that eco system (Ibrahim, 2008). Good quality of water resources depends on a large number of physic- chemical parameters and biological characteristics to assess the monitoring of these parameters is essential to identify magnitude and source of any pollution load (Adesaluet al., 2010). Due to increased population and use of fertilizers in agriculture and man-made activities, the natural aquatic environment is increasingly polluted leading to depletion of aquatic biota and water quality (Adakoleet al., 2008 and Kawoet al., 2008).

Dams are structural barriers built to obstruct or control the flow of water into rivers and streams (ICOLD, 2005).They can be used to generate electricity, to direct water from rivers into water supply systems, to direct water into canals and irrigation systems to increase depths for navigational purpose to control flow during times of flood and drought to create artificial lakes for fisheries and recreational purposes (EPA, 2002). In ancient times, dams were built for the single purpose of water supply or irrigation. As civilization developed, there was a greater need for water supply, irrigation, flood control, navigation, water quality, sediment control and energy (Ita et al., 2011).

In general trend, the water quality of the rivers is better in the upstream side as compared to the downstream side because of accumulation of waste and toxicants in the stream while flowing from the upstream side to the downstream side (A.H.etal.,2013). River water pollution is one of the major global environmental concerns today. Diminished river water quality upsets the balance of aquatic eco system and lead to fatal con sequences both for humans and animals. It is not only and environmental concernbutal so a socio-economic issue that need to be acted upon immediately (D.S. 2008)

This study was conducted for the purpose of monitoring the quality of Watari reservoir, Kano state Nigeria for drinking water purpose, using selected physico - chemical parameters. The result will help in predicting the pollution status of the reservoir and form a baseline data in identifying emerging water quality problems. Reservoirs in Kano state have subjected to contaminating materials capable of initiating the impairment of the aquatic environment. Untreated industrial effluents are discharged into water bodies (Bichi, 2013) because most industries in Kano do not have waste water treatment facilities. This poses a great threat to the aquatic environment (El-Buraire, 2010).

STATEMENT OF THE PROBLEM

- Kano state home of over 320 industries which release over 5 million liters of untreated wastes daily into rivers, streams and canals (Huangeet al., ,2010 and Karofi,2009). Most of the waste were discharge in to the reservoir (dams) that are used in water supply to residential and industrial areas (Jimoh,2011) .
- Rapid industrialization with improper planning in Kano environment lead to the discharge of industrial waste into rivers and canals. The rivers have a complex and fragile ecosystem, as they do not have self-cleaning ability and therefore readily accumulative pollutants which are dumped into the reservoirs with the corresponding sediment from the watershed (Indu et al., 2010).
- The toxins are taken into the bodies, moving up the food chain their by increasing concentrations, in a process known as bio-accumulation, when large animals feed on these contaminated organisms like, fish and shell fish, water fowl, fresh water and marine mammals may accumulate hazardous concentrations of toxic chemicals due to some contaminants in the sediment. (Akan, 2012)

This study aimed at assessing the pollution status of reservoir water, soil and plants grown in the vicinity of watari dam in Kano State Nigeria The results will form the baseline for monitoring and tracking changes in the water quality as a result of the reservoir’s natural dynamics over time or impact of men’s activities on the reservoir and its water shed

STUDY AREA

Description of the study Area

Kano state is located in the North-Western Nigeria. It shares borders with Katsina to the North-West, Jigawa to the North-East and Bauchi and Kaduna to the South. It has a total area of 20,131 Square km. Kano is locate dat 481 meters (or about 1580 feet) above sea level. The region features savanna vegetation and a hot, semi-arid climate.

Kano State covers an area extending between 11-99^0 North latitude, 8.51^0 East longitude. Climate is tropical wet and dry with mean annual rain fall of 850mm, and population of 9.3 million (Ahmed, 2008). It is a flat city drained by the Jakara River and several streams (Niger River Water shed) and River Challawa (Lake Chard Watershed) all of which are severely polluted by urban and industrial effluents (Akanetal., 2009 and Dan Azumi and Bichi,2010).

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Watari Dam It was positioned 2 km from Bagwai town and 8 km south west of Bichi, Kano, Nigeria. It has 1,959 hectares surface area with active storage capacity of 92.74 million liters. The dam is located between latitude 12°9'24"N and 8°8'12"E with two distinct seasons (wet and dry). (Adamu et al 2014).

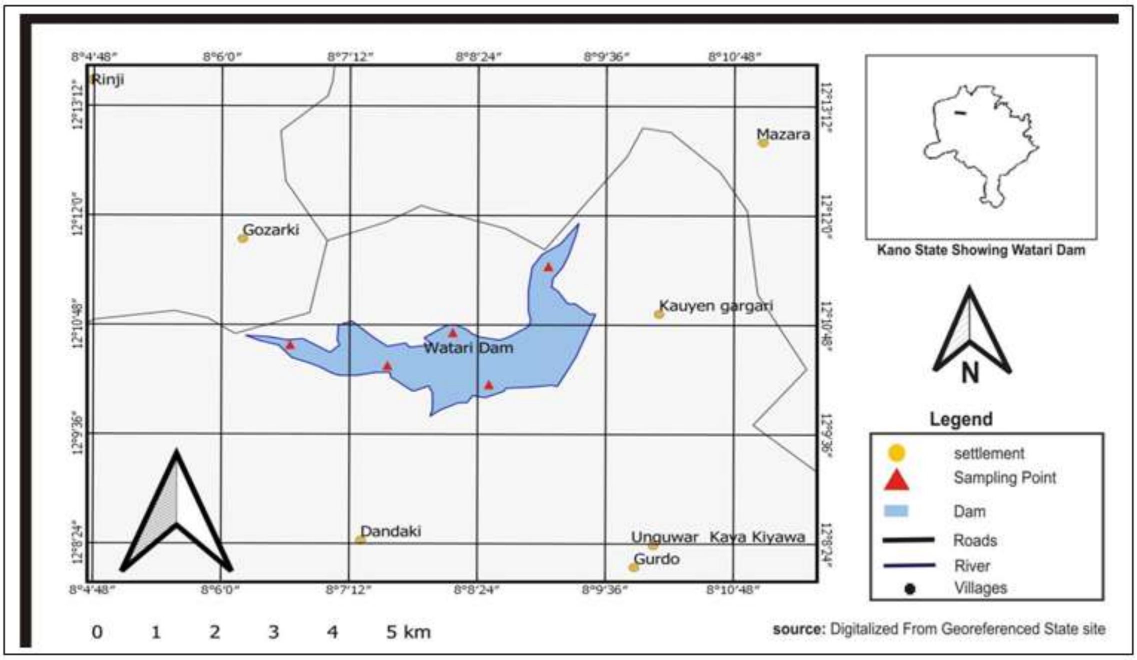

Figure I

II. MATERIALS AND METHOD

Water Sampling

Water samples were collected using clean plastic containers (Maitera et al., 2010), and preserved following (Manjareetal.,2010) procedure. Approximately1000cm^{3}ofwaterwere collected into each container. The pH of the first container was adjusted to less than 2 by the addition of 2 cm^3 Conc. HNO3to prevent adsorption of metals into the walls of the plastic container (APHA,1995). The samples were transported to the laboratory to analysed physical and chemical parameters which include pH, color, Temperature, Conductivity, Turbidity, Nitrates, Nitrites, DO, COD, BOD, Dissolved Solids, Suspended Solids, Total Solids, Appearance, Chlorides, Sulphates, and Phosphate for three seasons between the months of March - June (dry season), July - September (rainy season) and November - February (cold season).

Sample Preservation and Storage

Samples were collected from Reservoir, Plant, and Soil in three seasons of the year using the method adopted by (Nollet, 2007).

Collection of Soil Samples

A mild steel soil auger was used for soil sampling. Soil samples were collected at a depth of 15 cm from the top. All the soil Sample was subsequently air dried to constant to avoid microbial degradation.

Plant Analysis

The plant samples including maize (Zea mays), okra (Abelmoschus esculentus) and Spinach (Spinacia oleracea**)** samples were collected from different sample sites in an irrigated area. The samples were collected both in dry and reining seasons of the years.(Midraretal.,2005).

III. RESULT

Physical parameters

The descriptive results of the physiochemical and chemical parameter were measured across the sampling location. Table1shows the result of all the physical and chemical parameters pH, color, Temperature, Conductivity, Turbidity, Nitrates, Nitrites, DO, COD, BOD, Dissolved Solids, Suspended Solids, Total Solids, Appearance, Chlorides, Sulphates, and Phosphate. The data showed that there was a highly significant difference among the researviour

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in physiochemical parameter in both the sampling site.

Dissolved oxygen showed a minimum value of 1.9±0.160mg/L obtained in cold session and a maximum value of 4.5 ± 0.10mg/L obtained in rainy season. In contrast, COD Showed higher when compared with BOD i.e (50.0-60.0mg/L) and (3.0-7.0mg/L) the higher readings was recordedCOD50.0-60.0mg/L. The data indicated that Total dissolved solids and conductivity have mean range values of44.3-60 (30-44.5) (mg/L) and (60-90.6) ((µS/cm)) respectively for the three seasons Table I. TS and TH recorded lower concentration in rainy season 55.0-70.0mg/L,100.0-174mg/Land highest value were recorded in Cold season in both TS and TH (Table I)The data indicated that TDS recorded high value rainy season 60mg/L and SS shows a lower value in rainy season . Temperature recorded a mean value of (32-38^{o}C) and pH recorded a mean value range from acidic to basic in different seasons. The Turbidity value fluctuated between the lowest mean of 110-120mg/L obtained in both seasons. In the present study colour values ranged from 120-140 Hazen as shown in table I while conductivity of soil and water indicated a range valueof378-528 µScm-^{1} for soil and 100±0.240 µScm-^{1}

Table1: Concentration of Physical Parameters

Season	DO	BOD	COD	TDS	SS	TS	TEMP	TBR	COL	TH	pHW	pHS	CON.W	CON.S
Rainy	4.5±0.060	3.1±0.030	56±0.030	60±0.660	4±0.660	55±0.150	34±0.0830	115±0.0900	140±0.0800	100±0.0100	8.2±0.0130	6.62±0.0430	100±0.240	378±0.6660
Dry	2.2±0.360	3.8±0.060	57.2±0.400	53±0.0330	8±0.076	70±0.1930	38±0.1660	120±0.0030	120±0.0400	120±0.500	7.2±0.0160	5.7±0.01660	115±0.3330	528±0.3260
Cold	1.9±0.160	7±0.230	54±0.0660	47±0.0660	5±0.0070	65±0.230	32.5±0.0790	110±0.0650	140±0.0230	174±0.540	7.5±0.0060	5.51±0.03000	130±0.0470	435±0.296

Table2: Seasonal Variation of Physical Parameters

Season	DO	BOD	COD	TDS	SS	TS	TEMP	TBR	COLOR	TH	pHW	pHS	CON.W	CON.S
Rainy	4.5	7.0	56.0	60.0	4.0	55.0	34.0	115.0	140.0	100.0	8.2	6.62	130.0	378.0
Dry	2.2	3.8	57.2	53.0	8.0	70.0	38.0	120.0	120.0	120.0	7.2	5.7	115.0	528.0
Cold	1.9	3.1	54.0	47.0	5.0	65.0	32.5	110.0	140.0	174.0	7.5	5.51	100.0	435.0

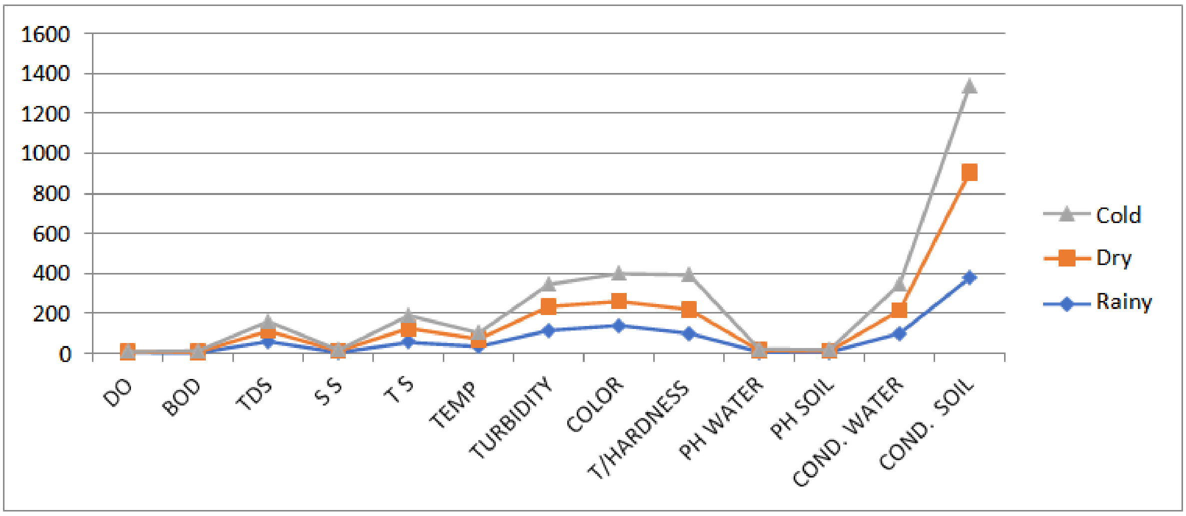

Fig ii: Mean concentration of Physical Parameter

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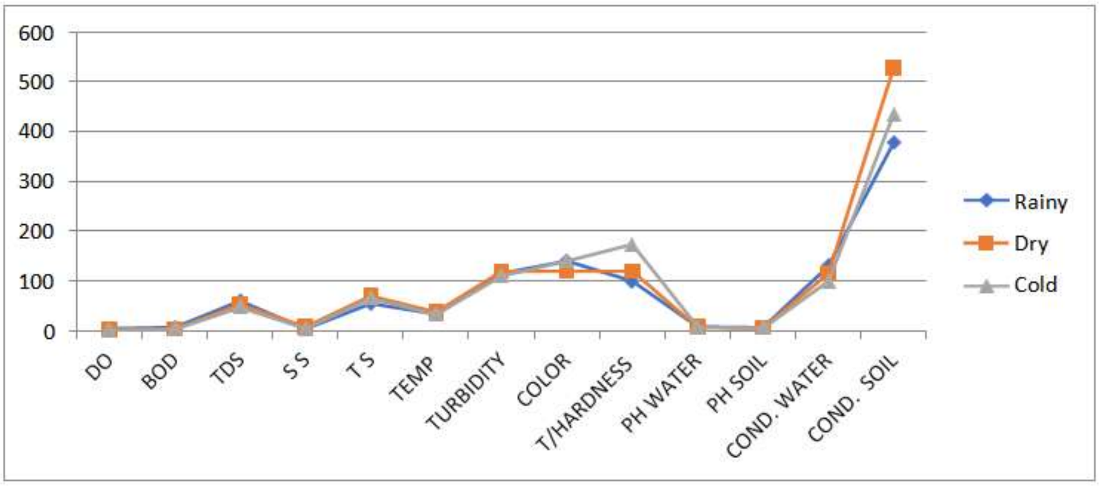

Fig iii: Mean seasonal Variation of Physical Parameter

Chemical Parameters

The mean concentration of nitrate and Chloride recorded a mean value of 10-16.0mg/L,22.0- 35.3mg/ Linrainy, also the value obtained from Nitrite value ranged from 0.03-0.07mg/L while the Phosphate found to have high value during cold season i.e1.8 mg/L. Table 3

Table 3: Mean concentration of Chemical Parameters

Season	NITRITE	NITRATE	CHLORIDE	PHOSPHATE
Rainy	0.07±0.001	16±0.20	35.3±0.1660	0.5±0.0100
Dry	0.03±0.0010	11.5±0.170	25.25±0.0830	1.8±0.0160
Cold	0.027±0.0020	10.2±0.026	22.34±0.0530	1.2±0.01670

Table 4:Mean Seasonal Variation of Chemical Parameters

Season	NITRITE	NITRATE	CHLORIDE	PHOSPHATE
Rainy	0.07	14	36.5	0.7
Dry	0.05	9	23.25	0.99
Cold	0.03	8.2	20.5	1.5

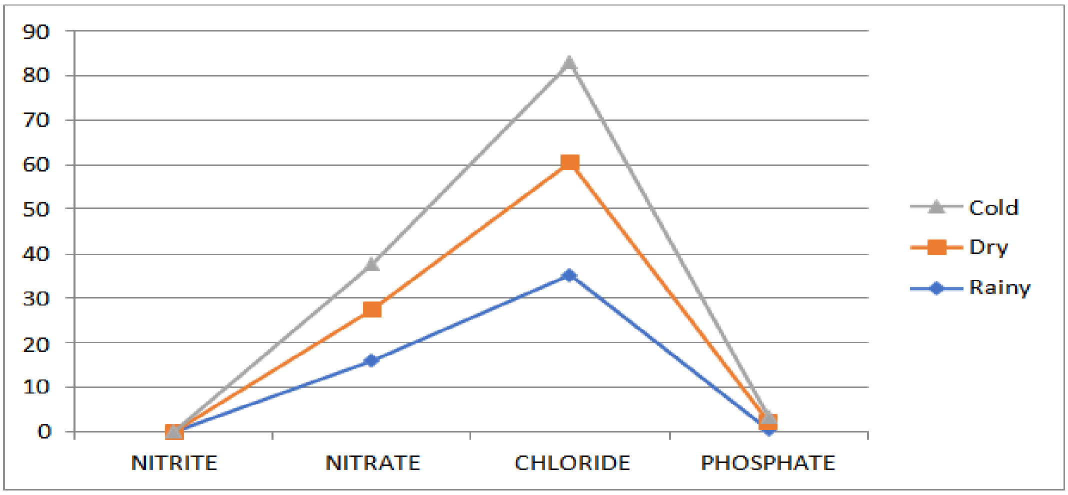

Fig iv: Mean concentration of Chemical Parameter

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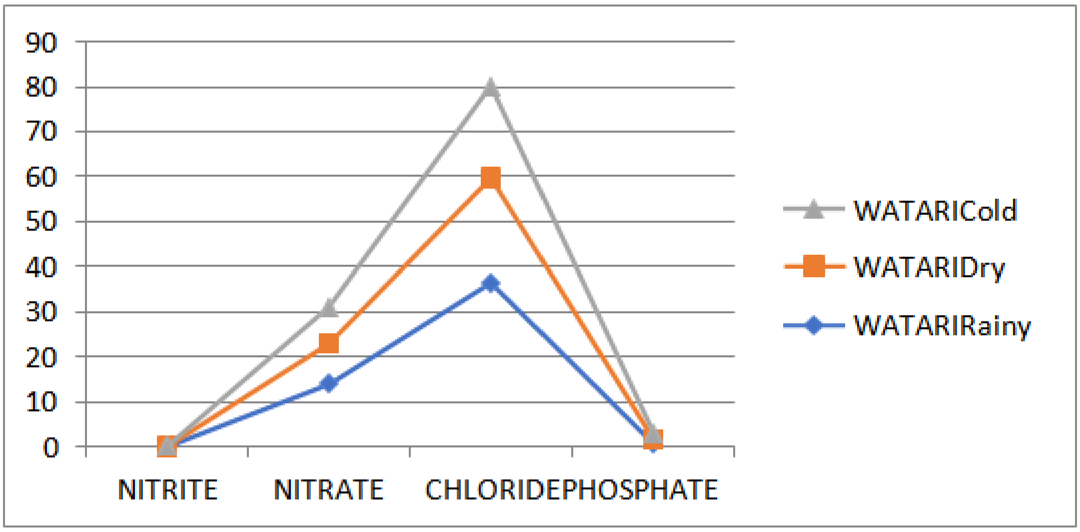

Fig v: Mean seasonal variation of Chemical Parameter

Heavy Metal in Plant

The mean concentrations of Co, Cr, Cu, Ni, Pb, Cd, Mn, Fe and Zn in plant samples from sampling site were presented in Table 4. The results generally show significant levels ($p<0.05$) of metals. The result of heavy metal were shown in table 4, Cd show a higher value in Okra during dry season (1.56mg/kg) and maize show a lowest value of 0.004 mg/kg during cold season, Co has a higher value in spinach during Dry season (0.69 mg/kg) while the result of Coin maize is low (0.02 mg/kg) during dry season, okra has a higher value of Cu during dry season (2.44 mg/kg) and lower value of 0.02 mg/kg in maize during dry season. The result of Fe show a higher value of 1.57mg/kg in okra during dry season and lower value in spinach 0.142 mg/kg while spinach has a higher value of Ni(0.99 mg/kg) during raining season. Pb has a higher value in Spinach of 0.65mg/kg when compare with maize and okra, Zn recorded the higher value of 1.69 mg/kg during both the season while Mn show a higher value of 2.1 mg/kg in Okra during dry season. Cr the data obtained higher value of 0.57 mg/kg in spinach during cold season and lower value of 0.010 mg/kg during dry season in Maize as show in Table 4

Table 4: The Mean Concentration (Mg/Kg) of heavy metal in plant

		Cd	Co	Cu	Fe	Ni	Pb	Zn	Mn	Cr
spinach	Rainy	0.45±00250	0.22±0.0160	0.3±0.0230	0.142±0.00	0.99±0.0030	0.65±0.060	1.59±0.0010	0.23±0.0160	0.18±0.0010
	Dry	0.25±0.1462	0.69±0.004	0.33±0.006	0.56±0.016	0.39±0.0050	0.3±0.0010	1.69±0.0250	1.42±0.0410	0.53±0.0020
	Cold	0.23±0.0040	0.2±0.0030	0.29±0.001	0.21±0.002	0.27±0.0030	0.29±0.0010	1.53±0.0010	1.01±0.0190	0.57±0.00060
okra	Rainy	0.56±0.0010	0.24±0.0260	2.42±0.021	1.68±0.002	0.88±0.0240	0.71±0.0010	1.32±0.00010	1.2±0.00020	0.24±0.0020
	Dry	1.56±0.0014	0.18±0.0060	2.44±0.016	1.57±0.0019	0.57±0.0030	0.53±0.0020	1.22±0.0010	2.1±0.00270	0.16±0.0010
	Cold	1.2±0.0020	0.17±0.0120	2.12±0.027	1.21±0.0012	0.47±0.0030	0.510.0040	1.1±0.00020	1.1±0.00010	0.15±0.0130
maize	Rainy	0.11±0.0010	0.05±0.0001	0.03±0.002	0.2±0.0003	0.01±0.000	0.03±0.0010	0.03±0.0010	0.01±0.00010	0.03±0.00100
	Dry	0.06±0.0030	0.02±0.0003	0.02±0.0003	0.3±0.0006	0.031±0.005	0.04±0.0040	0.02±0.00120	0.02±0.00120	0.010±00130
	Cold	0.04±0.0002	0.03±0.0002	0.02±0.0004	0.22±0.016	0.003±0.005	0.02±0.0007	0.019±0.0013	0.017±0.0013	0.013±0.0007

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Table 5: Mean seasonal variation of heavy metal in plant

		Cd	Co	Cu	Fe	Ni	Pb	Zn	Mn	Cr
spinach	Rainy	0.22	0.18	0.3	0.99	0.65	1.59	0.45	0.23	0.142
	Dry	0.69	0.53	0.33	0.39	0.3	1.69	0.25	1.42	0.56
	Cold	0.2	0.57	0.29	0.27	0.29	1.53	0.23	1.01	0.21
okra	Rainy	0.24	0.24	2.42	0.88	0.71	1.32	0.56	1.2	1.68
	Dry	0.18	0.16	2.44	0.57	0.53	1.22	1.56	2.1	1.57
	Cold	0.17	0.15	2.12	0.47	0.51	1.1	1.2	1.1	1.21
maize	Rainy	0.03	0.05	0.03	0.03	0.01	0.03	0.11	0.01	0.2
	Dry	0.02	0.02	0.02	0.01	0.031	0.04	0.06	0.02	0.3
	Cold	0.019	0.03	0.02	0.013	0.025	0.02	0.04	0.017	0.22

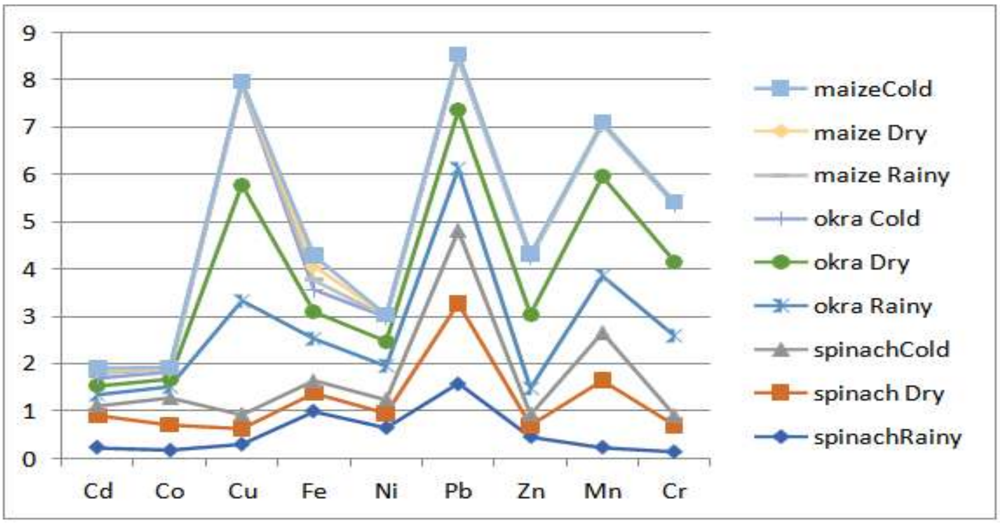

Fig vi: Mean Concentration of Heavy Metal Concentration in Plants

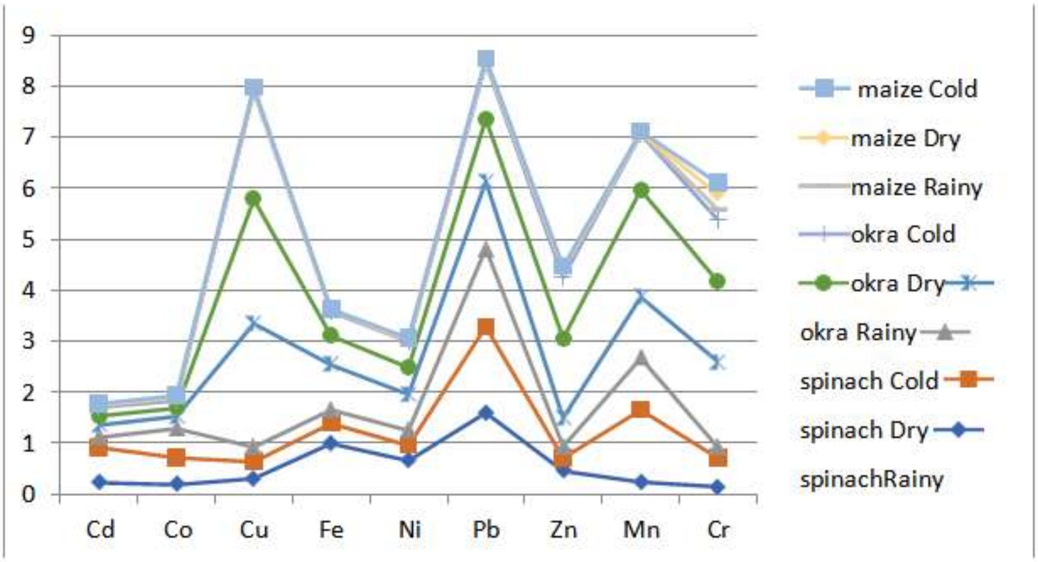

Fig vii: Seasonal variation of Heavy Metal Concentration in Plants

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Heavy Metal in Soil

The concentration of heavy metals in soil (Cd, Cr, Mn, Co, Zn, Ni, Cu, Fe and Pb) showed temporal variation in all the locations during the study period (Table 6) The concentration of metals observed in soil was Cd has the lowest concentration observed in all the sampling site ranged from 0.01±0.00120 to 0.02±0.04100 $mgkg^{-1}$. The mean concentration observed for Chromium (Cr) in all the soil sampling site ranged from a minimum of 0.16±0.023 to a maximum of 1.0 ±0.010 $mgkg^{-1}$. Co recorded a value in soil from the different locations investigated ranged from a minimum of 0.01±0.00070 $mgkg^{-1}$ to a maximum of 0.6±0.16230 mg/kg^{-1}. Copper concentration in the soils from all the sampling site ranged from a minimum valueof0.01±0.0010$mgkg^{-1}$to a maximum value of 0.6±0.14620mg kg^{-1}.The results indicate relatively low copper values (Table 6).The mean concentration of Fe in the soil from different sampling site investigated was found to be in the range of 1.3±0.0026 to12.5±0.5300 $mgkg^{-1}$. The values obtained for Mn in soil from all the sampling site ranged from a minimum of 0.12±0.00070 mgkg-1 to a maximum of 5.8±0.5300 mgkg-1 The Ni investigated ranged from 0.019 ± 0.00130 to 1±0.03000$mgkg^{-1}$.The concentration of Zn obtained in the soil ranged from 0.12 to 0.2 mg kg^{-1} (Table 6).

Table 6: Heavy metal Concentration in Soil

Season	Pb	Co	Mn	Fe	Ni	Cd	Zn	Cu	Cr
Rainy	0.03±0.0010	0.02±0.0002	1.5±0.1000	4.5±0.0523	0.2±0.14200	0.02±0.0410	0.5±0.00250	0.01±0.0010	0.20.007
Dry	0.9±0.0740	0.06±0.0003	4.2±0.02500	12.5±0.530	0.35±0.1289	0.02±0.0410	0.99±0.1620	0.6±0.14620	2±0.030
Cold	0.02±0.0013	0.01±0.0007	0.12±0.0007	3.6±0.0530	0.12±0.3500	0.02±0.04100	0.23±0.0007	0.012±0.0002	0.16±0.023

Table 6: Seasonal Variation Heavy metal Concentration in Soil

Season	Cd	Co	Cu	Fe	Ni	Pb	Zn	Mn	Cr
Rainy	0.02	0.02	0.01	4.5	0.2	0.03	0.5	1.5	0.2
Dry	0.02	0.06	0.6	12.5	0.35	0.9	0.99	4.2	2
Cold	0.02	0.01	0.012	3.6	0.12	0.02	0.23	0.12	0.16

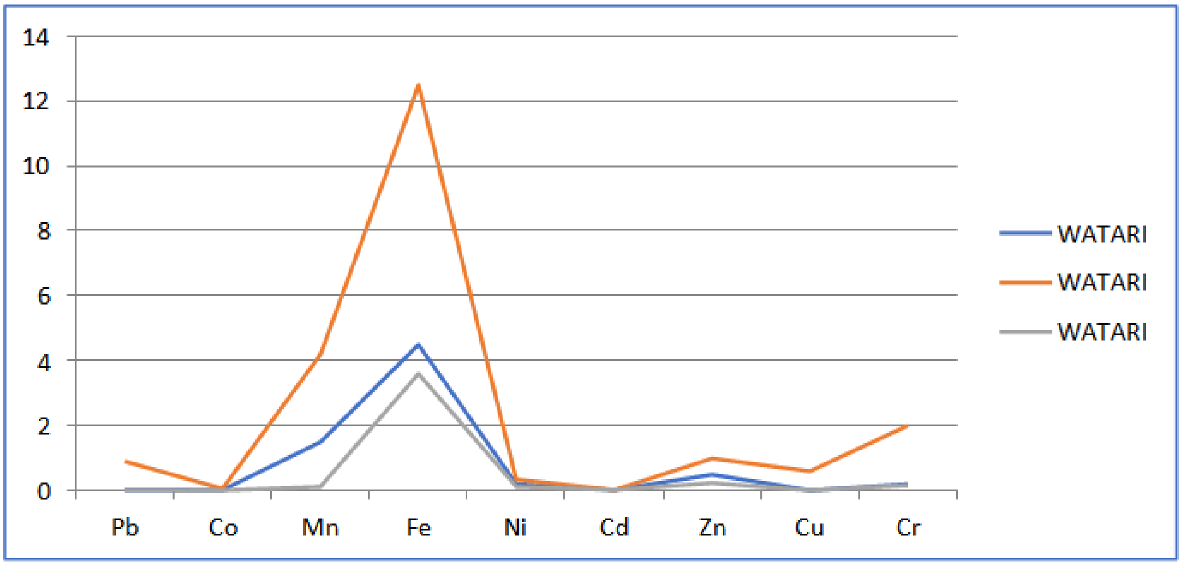

Fig viii: Heavy Metal Concentration in Soil

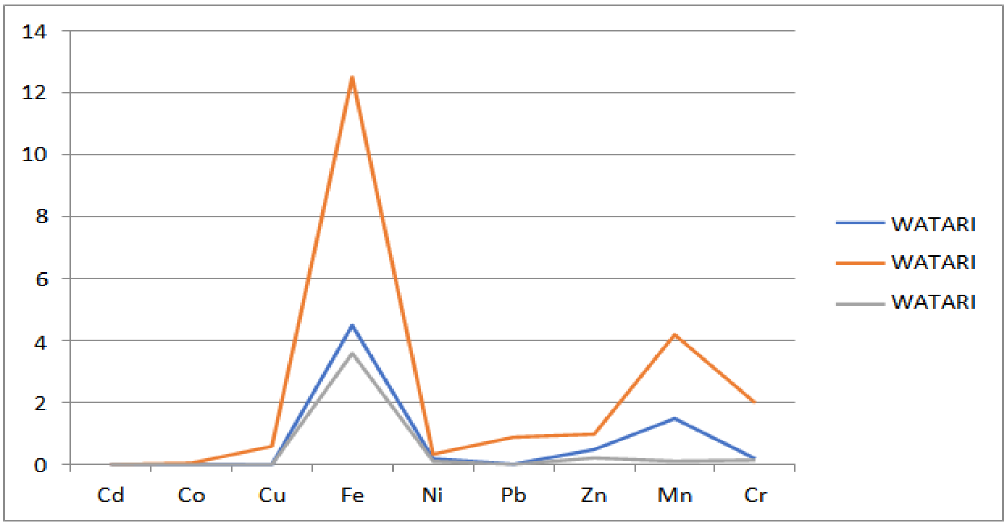

Fig ix: Seasonal Variation of Heavy Metal Concentration in Soil

Concentration of Heavy metal in Water

The descriptive results for the Heavy metal Concentration of water in Watari reservoir were shown in (Table 7), the cadmium values range from 0.012±0.00190 mg/L to 0.05±0.00130 mg/L with the lowest mean values obtained in cold season. The results obtained for chromium ranged from 0.00to0.01±0.0002mg/L. The mean values of cobalt in this work ranged from 0.00 to 0.82±0.00620mg/L while copper ranged from 0.019 to 0.046 mg/L. The data obtained for iron has a mean range from 1.2±0.0300 to 6.4±0.0800 mg/L and lead in this work ranged from 0.023±0.0704 to 0.046±0.142.0.The data obtained for manganese in this work range from 0.3±0.00250 to 0.62±0.03900 mg/L also the values for Nickel is 0.00 to 0.18±0.00260 mg/L while that of Zinc range from 0.2 ± 0.0500 to 0.12 ± 0.00070 mg/L. (Table 7)

Table7: Heavy metal Concentration of Water

Season	Co	Cr	Cu	Ni	Pb	Zn	Cd	Mn	Fe
Rainy	0.15±0.00120	0	0.046±0.00030	0	0.046±0.142.0	0.12±0.0070	0.05±0.00130	0.62±0.03900	1.2±0.0300
Dry	0	0	0.03±0.0010	0.18±0.00260	0.045±0.00430	0.2±0.0500	0.023±0.0070	0.3±0.00250	6.4±0.0800
Cold	0	0	0.019±0.00840	0.14±0.1620	0.023±0.0704	0.11±0.000	0.012±0.00190	0.58±0.06080	4.2±0.0500

Table 8: Seasonal Variation of Heavy metal Concentration in Water

Season	Ni	Zn	Fe	Cu	Pb	Co	Cd	Mn	Cr
Rainy	0	0.2	1.2	0.046	0.046	0.15	0.05	0.3	0
Dry	0.18	0.12	6.4	0.03	0.045	0	0.023	0.62	0
Cold	0.14	0.11	4.2	0.019	0.023	0	0.012	0.58	0

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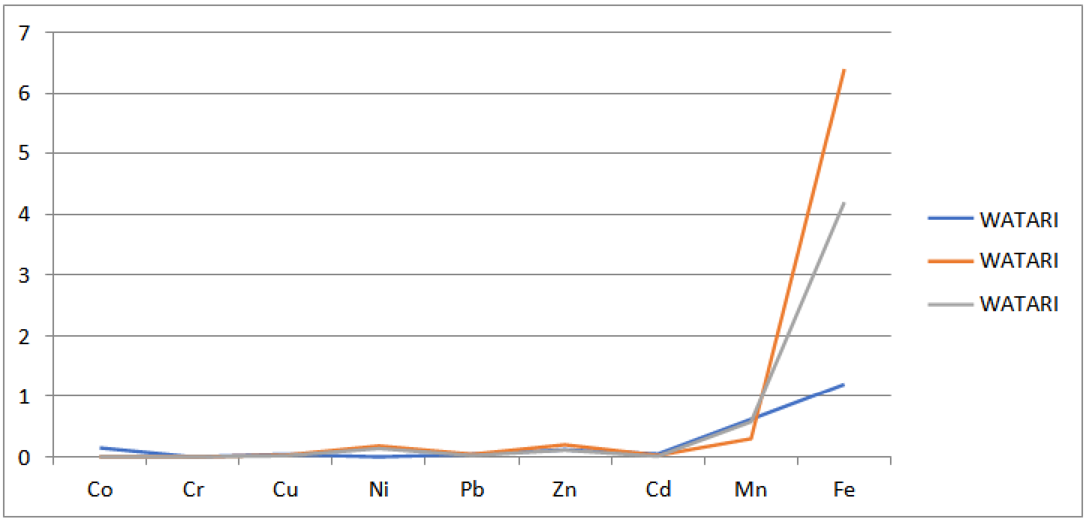

Fig x: Heavy Metal Concentration in Water

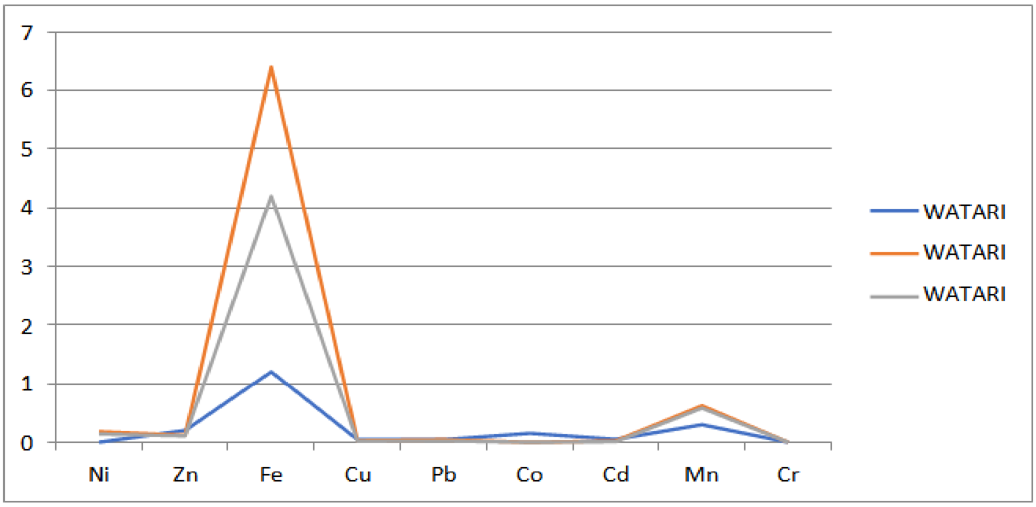

Fig xi: Seasonal Variation of Heavy Metal Concentration in Water

Table 1.0 Water quality index for all the sampling location in both rainy, dry and cold season in Watari Dam

Season	Result obtained	Water quality index level	Water quality status
Rainy	35.486	26-50	Good Water Quality
Dry	41.240	26-50	Good Water Quality
Cold	45.3614	26-50	Good Water Quality

IV. DISCUSSION

Physical parameters

During present study pH values for both water and soil range from(5.51to8.2).It is indicating alkalinity nature throughout the study period (Figure ii).The acceptable pH range for surface waters is 6.0 to 9.0 (WHO, 2003), Higher pH^{-} values were obtained in rainy season with significant variations $p<0.05$. This might be due to the deposition of sewage, some organic matters being discharged by surrounding city and agricultural fields pH value is very important for plankton growth (Chisty, 2002). According to Umavathi et al (2007) pH is ranged 5 to 8.5 is best for plankton growth.

Temperature have a mean range value between 32.0-38.9^{0}C which is lowest during the hamattan period and highest during dry season. There is however no significant variation at $P<0.05$ between the three seasons. High temperature enhances the growth of microorganisms and may increase taste, odour color corrosion problems. It can also trigger algal bloom in the presence of elevated concentrations nutrients such as phosphates and nitrates (WHO, 2008) and this is potentially hazardous to human health due to the production of cyanotoxms.

Total dissolved solids and conductivity have mean range values of 44.3-60 (30-44.5) (mg/L) and (60-90.6) (µScm^{-l}) respectively for the three seasons Fig ii & iii. The values obtained for both TDS and conductivity were found to be higher in dry and cold seasons due to low volume of the reservoir water (Figure ii & iii). The values recorded are much lower than WHO and EPA values for surface water 500mg/L and 100011Scm-l respectively. Similar findings have been reported by Rao et al 2003, Kirubavathy et al 2005, Garg et al 2006b.

Chemical Parameters

The maximum level for chlorides in water is 250 mg/L (NIS 2007). The values obtained for chloride are within the range set by WHO (Stankovic, 2008) and NIS (Taiwo et al., 2012). Similar results were reported by Swarnalatha and Nasingrao (1998) and Umavathiet al (2007) showed that higher concentration of chlorideis association with increased level of pollution. Variation of Nitrate, Nitrite and phosphate in the reservoir reflect the effect of watershed and anthropogenic contamination around the reservoir. Mean values in the range of 0.02, 8.4, 28.5 and 1.1 Mg/L were obtained (Fig. IV& V). Nitrate in elevated levels is linked with two known health problems: Methemoglobinemia or "blue baby syndrome" is caused by anoxygend eficiency in the blood. This causes bluish skin tone in infants (Vermont-Gov2011). Agriculturalrun-off of pesticides, plant and animal's wastes, phosphate fertilizers from nearby farms in addition to cow dungs washing from the watershed into the Reservoiris also a major contributing source of organic pollution to water bodies in Nigeria. The maximum level for nitrateinwateris10.0mg/L.WHO,(2008),the values obtained (Fig. IV &V) is in agreement with the work by (Dan azumiet al., 2010).

Color has a mean value that ranges from of 0.02 to 540.80 HAZEN. The large difference is as a result of values obtained at the treated and potable water which is very low compared to that obtained at the reservoir (Fig. IV & V). Khan and Chowdhury (1994) reported that higher transparence occurred, during winter and summer due to absence of rain, run off and flood water as well as gradual settling of suspended particles. Kadam et al (2007) also reported similar observation from Masoli reservoir of Parbhani district, Maharashta

Concentration of Heavy Metal of in Plant

The level of concentration of heavy metal analyzed by plant fall within the WHO limit and limnology, some of the heavy metals in plant are higher than the recommended values indicting the extent of pollution in the study location. Eutrophication was noticed in the plant which is likely caused by excessive use of fertilizers and can cause serious pollution problem if unchecked. The problem of anthropogenic activities that probably come from rural and urban sewage, large- and small-scale industries, use of dumpsite as a source of manure and indiscriminate waste disposal around the watershed should be checked before increasing to such critical level that threaten to health of humanity (Fig. VI- VII).

From the value obtain Fe have high percentage but when compared with FAO/WHO its below the permissible limit WHO. This may be due to the evident in the case of the soil which could be attributed to the mobility of metals from dump sites to farmlands through leaching and runoffs. The World Health. Organization (WHO) recommends 0.3 mg/l (WHO, 1993) as maximum concentration limit of iron in drinking water.

Concentration of Heavy Metal in soil

The concentration obtained for heavy metals were higher in soil than in water. There is a marked variations of the metals analyzed with dry seasons having higher concentrations with significant variation $p>0.05$.The results of heavy metals in soil seem to show no possibility of acute toxicity at the moment; nonetheless, continuous monitoring and implementation of pollution laws should be enforced. (Fig. VIII-IX).

The higher concentration of Fe may be due to influenced by other sources which (Sulaiman andAudu2013).Leaching of iron salts (acid mined rain age) and iron product industrial waste may be a pollution source of iron (De Zuane, 1997). (Fig. IX).

Heavy Metal Concentration in Water

Some of the heavy metals in water are higher than the recommended values indicting the extent of pollution in the study location. The values obtained of heavy metals were higher in soil than in water. There is a marked variations of the metals analyzed with dry seasons having higher concentrations with significant variation p>0.05 (Fig. X- XI). The pollution comes from both natural and anthropogenic sources in all the reservoir water, soil and plant investigated. Effective water treatment process may however improve the quality of drinking water supply to urban and rural communities as observed in Watari. (Fig. X- XI).Fe was consistently higher than the other metals there where statistically significance difference in the percentcon centration between the sampling locations. Higher content of iron can be encountered due to the frequency of the elevated iron level in the earth strata related to the feeding aquifers. Leaching of iron salts (acid mine drainage) and iron product industrial waste may be a pollution source of iron (De Zuane, 1997). (Fig. X- XI).

Water Quality Index

In this study water quality index was computed from the important physiochemical parameter's values obtained in four different sampling location. The results of the chemical analyses of the ground water and the percent compliance with SON standards and WHO are summarisedinTable1.0.thevaluesofWQI obtained in both sampling locations of watari (control) 35.486,41.240, 45.361 for both rainy, dry and cold seasons respectively (Table1.0), thus the result of water quality rating study, clearly revealed that the status of water body for Watari reservoir is fit for human consumption since the index value fall in the range of good water quality. (26-50) as shown in Table 1.0. From the result obtained it shows that the level WQI of Watari reservoir has a value with fall within the range set by SON/WHO for WQI

V. CONCLUSION

There is glaring evidence of increasing treat of pollution reservoirs in Kano environment. The sources of water pollution are manifold which makes mitigating a given water pollution problem a challenging task. Effective water treatment process may however improve the quality of drinking water supply tourban and rural communities as observed in watari level 0f heavy metal analyzed in all the sampling location in both water, soil and plant fall within the WHO limit for drinking water supply and limnology, some of the heavy metals in water, soil and plant are higher than the recommended values indicting the extent of pollution in the study location. Eutrophication was noticed in the water, soil and plant which is likely caused by excessive use of fertilizers and can cause serious pollution problem fun checked. The problem of anthropogenic activities that probably come from rural and urban sewage, large-and small- scale industries, use of dumpsite as a source of manure and indis criminate waste disposal around the water shed should be checked before increasing to such critical level that threaten to health of humanity.

RECOMMENDATION

- ❑ Assessment should be carried out on local inhabitants of the reservoirs to ascertain the public health implications
- ❑ The study showed that there is a need for continuous pollution monitoring program of surface water and soils.
- ❑ Further research should be conducted on other irrigated crops around the reservoirs in Kano state and sequential extraction be carried out to distinguish between the extent to which the different metals studied are hosted by all the non-residual fractions

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