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EFFECT OF SOME PHYSICO-CHEMICAL PARAMETERS ON THE ABUNDANCE, DISTRIBUTION AND DIVERSITY OF AQUATIC MACROPHYTES IN RIVER NGADDA, MAIDUGURI, BORNO STATE,NIGERIA.

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ABSTRACT

The effects of some Physico-chemical parameters on aquatic Macrophyte abundance, distribution and diversity were investigated for a period of twelve (12) months from June 2021-May 2022 at downstream River Ngadda along Lagos Bridge in Maiduguri Metropolitan council, Borno State. Nigeria. Physico-chemical parameters are the major factors when considering the quality of water body in relation to the presence of Macrophyte in aquatic ecosystem. Aquatic Macrophyte and water sample were collected at four (4) sampling stations in the study area. Macrophytes were collected with the aid of shovel, rake and hand pulling. Physico-chemical parameters of the water sample were determined using specialized instruments (pH meter, TDS/EC meter, spectrophotometer, secchi discs and digital thermometer). The parameters show ranges of air temperature (22 – 29)°C, water temperature (18-26)°C, pH(7.4 – 8.5), Electrical Conductivity (119.8-129.7)µS/cm, Total Dissolved Solids (14.4-19.20)ppm, Dissolved Oxygen (5-7)mg/l, Biochemical Oxygen Demand (0.4-2.23)mg/l, Transparency (5.5-14.70)cm, Nitrate (0.3-2.23)ppm, Phosphate (0.5-1.0)ppm, Manganese (0.41-4.02)ppm, Iron (0.11-1.6)ppm and Copper (0.19-1.7)ppm. During the study period, thirteen (13) Macrophyte species that belonged to seven (7) families were identified, where a total of 227 aquatic Macrophyte were collected. Furthermore, a total of 22 *Vossia cuspidata* with a relative abundance of 9.7% in all stations, 18 *Lemna minor* (7.9%), 19 *Lemna trisulca* (8.4%) abundance, 15 *Cyperus rotundus* (6.6%), 28 *Carex acuta* (12.3%), 12 *Scleria verrucosa* (5.3%), 12 *Cyperus iria* (5.3%), 15 *Potamogeton pasillus* (6.6%), 19 *Potamogeton Pectinatus* (8.4%), 22 *Echinochloa colona* (9.7%), 15 *Vallisnera spiralis* (6.6%), 18 *Alternathera* *sessilis* (7.9%) and 12 *Ruppia spiralis* (5.3%) abundance was encountered during the study. The computation of Shannon-Wiener index of Macrophyte revealed that station1 had the highest species diversity (2.54), station 2 (2.40) and station 4 (2.36) recorded medium diversity while station 3 had the lowest diversity (1.27). The correlation co-efficient between Physico-chemical parameters and Macrophyte abundance during the wet season showed nine (9) significant correlation ($P<0.05$) in station 1 and 2, while station 3 and 4 had (10) significant correlation ($p<0.05$). In the dry season, station 1 had (7), station 2 and 4 have (8) correlation and station 3 had (9) significant correlation. All parameters analyzed were within permissible limits which indicate that the River is not polluted.

Keywords: Abundance, Diversity, Physico-chemical, Macrophyte, River Ngadda

INTRODUCTION

Aquatic Macrophyte is an aquatic plant that grows in or near water and is either emergent, submergent, or floating and includes halophytes (Hickey and King, 2001).Aquatic Macrophytes are considered photosynthetic organisms of freshwater habits, comprising vascular plants, aquatic bryophytes and a Macro-Algae growing permanently or temporally in aquatic environment (Jones *et. al*., 2010). They play an important role in the structure and functioning of freshwater ecosystems (Wetzel, 2001; Tamire and Mengiston, 2012). The Macrophytes serves as a base of aquatic food chains, and they also actively contribute to the promotion and maintenance of food webs services in freshwater ecosystem (Scheffer and Jeppesen, 2007; Smith, 2011). Aquatic Macrophyte also acts as important bio-indicators of environmental conditions and long term ecological changes in water quality (Lacoul and Freedman, 2006). The function of Macrophytes in these ecosystem is related to their structural attributes like species composition, distribution, abundance and diversity, which in turn relies on various environmental factors such as light, water temperature, substrate composition, disturbance, competitive interactions, herbivory, epiphyte loading, water levels, quality of river water and sediment nutrients (Cronk and Fennessey, 2001; Feldmann, 2012).

This study was conducted to identify Physico-chemical parameters that drive Macrophytes and to understand the species abundance, distribution and diversity in River Ngadda which will provide important information that can be used for management purposes.

MATERIALS AND METHODS

Study Area

Maiduguri is located between the latitude 11° 51'-11° 55'N and longitude 13° 02'-13° 16'E. It lies on a vast open plain, which is flat with gentle undulations at an average elevation of 354m above sea level. The climate of the region is characterized by a cool-dry season (October to March), the hot season (April to June) and a rainy season (July to September). The area is fragile and highly susceptible to drought with relative humidity of 13 % in dry season and 15% in rainy season. The area is also highly vulnerable to desertification (Dibal, 2002). The study area dominantly derives its groundwater resources from the Chad formation, which is the youngest stratigraphic unit of the Chad Basin and the most prolific in terms of groundwater resources. The river flows in a north-easterly direction, which originates from River Yedzeram and River Gombole, which meet at a confluence at Sambisa Forest both in Nigeria, and it flows as River Ngadda in to Alau Dam and stretches down across Maiduguri then empties into Lake Chad. The river is used for various human activities such as fishing, irrigation, bricks making and residents along the riverbank use it for bathing, washing and as drinking water by animals. The river receives copious amount of wastes from residential houses and abattoir sited along its course. Processed water from municipal waste and abattoir located near the river contains large amounts of pollutants including heavy metals, which, when in great abundance may cause disruption to the ecological balance of the river.

Sampling Sites

Sampling sites were chosen based on factors such as Volume of water, Accessibility, Security and Human activities around the area. The sampling stations were along Lagos bridge in the proximity of Maiduguri where four (4) sampling stations were used, covering both side of the bridge (left and right). Two (2) sampling stations 1 and 4 were situated at the left side of the bridge and station 2 & 3 were situated at the right side of the bridge. Sample collection was conducted on a monthly basis from June 2021-May 2022 covering both rainy and dry season.

Sampling Procedure

The sampling procedure includes collection of aquatic macrophytes and recording of physical parameters like pH, Atmospheric temperature, Water temperature, transparency, Total Dissolved Solute (TDS), Dissolved oxygen (DO), Biochemical Oxygen Demand(BOD), Electrical conductivity (EC) etc, which are the crucial parameters influencing the presence or absence of Aquatic Macrophyte. Additionally, at each Sampling Station, time and date were also recorded.

Collection and Identification of Aquatic Macrophytes.

Water and Aquatic Macrophytes Samples from the river were collected from June 2021 to May 2022. Aquatic Macrophytes were collected along the river banks and on the surface waters for a period of twelve (12) months, comprising of both creeping and standing aquatic macrophytes. Aquatic Macrophytes were collected manually with the aid of Shovel, Rake and Hand pulling. Collected Aquatic Macrophytes were arranged in white paper and covered with brown paper envelop to avoid drying up. It was quickly transported to Botany Laboratory, Department of Botany, University of Maiduguri, for identification. Macrophytes were identified from family to species level with the use of Handbook of West African weeds (Agbogidi *et al*., 2000)

Determination of Water Quality Characteristics

APHA (2020) recommends in-situ measurement of parameters that change over time due to chemical reactions or biological changes.

Temperature

Digital thermometer was used to determine the Atmospheric and water temperature in situ each time a trip was made to the site. For each each station, atmospheric temperature was initially taken, before immersing the probes in water. It was followed by water temperature by dipping thermometer probes into the water until a steady value was observed and then recorded as the water temperature in °C as described by (Anene 2003).

Total Dissolved Solids (TDS):

This was measured using Hanna TDS meter (Model HI 98801). The meter was inserted into the water and was then allowed to attain a steady value; the value was recorded as TDS in mg/l as described by (Anene 2003).

pH

pH of the water sample was measured with a standard pH meter (Hanna Instrument Model) which has an accuracy of ±0.05. The electrodes of pH device were rinsed with distilled water and blotted with dry soft absorbent paper before lowering it into the water sample for about 10-30 seconds. The reading was recorded to the nearest 0.1 pH units and the procedure was repeated three times to get the average pH of the sample as described by (Oloyede et al., 2016).

Electrical Conductivity (EC).

The electrical conductivity of the water sample was measured using a standard electrical conductivity (EC) meter (Hanna Instruments EC 215 meter). The EC meter probe electrode was cleaned with distilled water and then immersed into the sample for 10-30 seconds and the reading for the meter was recorded. The procedure was repeated three times to ascertain the average EC reading in µS/cm as described by Oloyede et al., 2016).

Dissolved Oxygen (DO)

Water samples were collected into 60ml glass-stoppered bottle by allowing the sample to overflow the bottle for two to three minutes to ensure absence of air bubbles trapped in the bottle, and it was analyzed using the digital titrator method (DREL/5).

Biochemical Oxygen Demand ($BOD)_5$

Water samples were collected into 60ml glass-stoppered BOD bottle by allowing the sample to overflow the bottle for two or three minutes to ensure the absence of air bubbles trapped in the bottle, and were analyzed using the digital titrator method (DREL 5). The same procedure as in dissolved oxygen was repeated on each sample after five days. The differences between the two readings were considered as BOD_5. Biochemical oxygen demand was calculated as follows.

$BOD_5 = (DO_1 – DO_2)$ mg/l
DO_1 = Dissolved oxygen (initial)
DO_2 = Dissolved oxygen after 5days

Heavy Metals
Water sample were placed in acid washed container sterilized with 10% N-HCL and were transferred to the laboratory. The sub-sample was collected in 250ml bottles and each heavy metal concentration were determined using direct reading spectrophotometer as described by USEPA, (2017).

Transparency
A Secchi discs with graduated rope meter was used to obtain the degree of water transparency of the water at the sampling point before sample collection. The disc was lowered in water, until it disappeared and then depth was recorded. The disc was then raised until it reappears and the depth at which it appears was recorded. The average of the two measurements was considered as the Secchi Discs visibility.(SDV).

$$SDV = \frac{\text{Depth 1 + Depth 2}}{2}$$

Statistical Analysis
Data collected for aquatic Macrophytes were subjected to descriptive statistics to determine species abundance using frequency and percentages. Furthermore, data on the Physico-chemical parameters of the water sample were subjected to descriptive statistics to determine the mean, standard error and range that varies at various stations.

Two-way-ANOVA (α=0.05) was used to analyse the monthly variations of the Physico-chemical parameters in the sampling stations for both seasons (dry and wet seasons). Correlation co-efficient was used to determine the effect of Physico-chemical parameters on aquatic Macrophytes abundance and distribution at 5% level of significance. Shannon-Wiener Diversity Index and Equitability Index were used to determine Macrophytes diversity at the sampling stations in the study area.

RESULTS AND DISCSUSSIONS.

Table 1: Mean of Physico-chemical parameters and the Distribution of Macrophytes at stations during the wet season (June – September, 2021)

Parameters (Mean±S.E)	Station 1	Station 2	Station 3	Station 4
Atm. Temperature (°C)	27.50±0.29	25.75±0.75	25.00±1.78	25.75±1.10
Water Temperature (°C)	24.25±0.25	21.00±0.91	22.00±1.83	22.00±1.08
Transparency (cm)	12.25±1.93	9.95±0.40	11.63±0.74	6.08±0.51
pH	7.30±0.09	7.43±0.16	7.78±0.09	7.40±0.18
TDS (mg/l)	9.78±0.25	10.43±0.11	24.80±1.34	22.50±3.22
Conductivity (µS/cm)	118.50±1.19	118.75±1.38	123.58±1.37	118.50±2.26
DO (mg/l)	5.9±0.27	6.2±0.87	5.4±0.49	57.20±0.13
BOD (mg/l)	0.9±0.09	1.0±0.09	0.8±0.17	16.80±0.29
Nitrate (ppm)	1.80±0.39	1.48±0.31	1.38±0.24	1.65±0.52
Phosphate (ppm)	1.28±0.16	1.56±0.27	0.06±0.01	0.16±0.05
Manganese (ppm)	4.52±2.35	0.06±0.02	1.05±0.26	0.93±0.29
Iron (ppm)	2.18±2.2	0.84±0.19	0.89±0.29	1.11±0.22
Copper (ppm)	1.05±1.05	0.15±0.11	1.82±0.34	2.33±0.22
No. of Macrophytes/station	48	42	16	40

Table 2: Mean Summary of Physico-chemical parameters and Distribution of Macrophytes at stations during dry season (October–May, 2022)

Physico-Chemical parameters	Station 1	Station 2	Station 3	Station 4
Atm. Temp.	26.00±0.74	26.88±1.12	27.88±1.46	26.50±1.03
Water Temp.	22.63±1.19	21.88±0.74	24.38±1.33	22.25±0.79
Transparency (cm)	11.98±2.72	8.06±1.21	8.34±1.28	8.15±0.35
pH	7.93±0.19	8.21±0.19	8.54±0.15	8.31±0.10
TDS (mg/l)	9.74±0.13	9.54±0.09	27.48±0.67	25.04±0.93
Conductivity (µS/cm)	125.63±0.94	126.75±0.65	124.63±1.15	131.75±0.85
DO (mg/l)	6.74±0.41	4.89±0.62	3.49±0.32	6.98±0.24
BOD (mg/l)	1.29±0.21	0.94±0.31	0.63±0.23	1.59±0.26
Nitrate (ppm)	0.46±0.12	0.46±0.11	0.38±0.09	0.51±0.18
Phosphate (ppm)	0.59±0.32	0.76±0.15	0.01±0.003	0.04±0.03
Manganese (ppm)	1.29±1.24	0.01±0.003	0.44±0.03	0.20±0.04

Iron (ppm)	1.19±0.46	0.41±0.09	0.03±0.006	0.02±0.006
Copper (ppm)	0.04±0.01	0.02±0.005	0.90±0.13	0.89±0.09
No. of Macrophytes	25	21	6	27

Physico-chemical parameters

In this study water temperature ranged from 18°C – 26°C which agrees with (Usman et al., 2017) recorded in Ajiwo reservoir where temperature ranged from 16.5°c to 28.0°c. Ali et al.,(2014) also recorded a temperature range of 23°C – 27.9° C in river Ngadda which was close to what was obtained in this study. The highest value recorded was 26°C in November while the lowest value recorded was 18°C in January in dry season. December, January and February were marked with lowest temperature due to Harmattan dry wind, this observation is supported by the findings of Adakole *et al*., (2000) which attributed variations in water temperature during the dry season to the effect of Harmattan. In early June to September, the rain and associated cloudy weather conditions caused the decrease in temperature, which was supported with the reports of Timms (2001) that climatic factors were the determining factors for increase or decrease in temperature in the Arid zone and river Ngadda shares the climate of the Northeast Arid zone. Correlation between temperature and Aquatic Macrophytes abundance has significant positive effect on Aquatic Macrophytes distribution. Temperature influences the growth and distribution of both Flora and Fauna (Singth and Mathur 2005, Tanko and Chippa 2013, Jalal and Sunalkumal, 2013).

pH value of the study site ranged from 7.4 to 8.5 indicating the alkaline nature of the river when compared to WHO standard (WHO 2013). The pH values were within desirable range of pH (6.5 to 8.5) set by (WHO 2011). Higher level of pH can affect aquatic life at a certain level however an optimum level of 7-8.5 was recommended by (BIS 2003, Boyd 1990 and WHO 2013).In this study station 1 recorded the lowest value of 7.30 + 0.009 and station 3 recorded highest value of 8.54 ± 0.13 and this may be due to the association with the decomposition of sediment which is known to contribute to an increase in pH levels, as reported by Salmiatic (2015). There was a seasonal variation in pH level, where the highest pH value obtained was 8.5 in the month of December which was during the dry season which may be due to decomposition of living organisms in the water coupled with the reduction in the water level during the dry season.This observation was supported by several studies, Dublin-Green (1990) reported higher pH value during the dry season with lower value in the late rainy season in Bonny River, It also agrees Abowei (2010) who recorded higher pH values in the dry season (8.5) and lower value during the rainy season (6.1) in August at the Nkoro River. The little decrease in pH (7.30 ± 0.009) during the rainy season was probably due to the stirring effect of the incoming flood. The result of this study is supported by *Epepe et al.*, 2012 who reported that non-acidic water body supports Aquatic Macrophytes abundance.

Total Dissolved Solids (TDS) value ranged from (9.54±0.09 - 27.48±0.04) mg/l. The maximum TDS value obtained was 27.48 ± 0.04 mg/l at station 3 during the dry season and the lowest value was 9.54 + 0.09 mg/l at station 3 during the rainy season (Table 1 and 2). The outcome of this study is supported by *Akuma et al.,* (2012) who reported that Aquatic Macrophytes were very effective in reducing TDS. When Macrophytes increased in frequency, the concentration of TDS, EC and TS in water columned decreased.

Electrical conductivity (EC) values ranges from 119.8 – 129.75 us/cm^{-3} in all stations, which was less than 600us/cm recorded from Kiri dam (Ovie et al., 2000). It was also less than what Ali et al., 2014 recorded in same river Ngadda with a range of 173.50 – 369.50 us/cm^{3}. Electrical conductivity of freshwater within WHO standard is normally 1000us/cm^{3} (WHO 2000). Electrical conductivity value was higher in station 4 137.5±0.85 during the dry season with the lowest value 118.50±1.9 in station 3 (rainy season). The minimum concentration of electrical conductivity in rainy season may be due to dilution of water in the river (Patel and Parikh, 2013). The value obtained indicates a much lower level of electrical conductivity.

The value of Dissolved Oxygen (DO) ranged from 5 – 7.9mg/l with the highest value been recorded in station 1 in dry season and the lowest 5.4mg/l in August during the rainy season at station 4. This result was much lower than what *Ali et al.,* 2014 recorded in same river Ngadda with a ranged of 13.0 – 19.0mg/l. The DO values obtained in all stations were within the acceptable limit of 5.0 – 9.0set by WHO (1971).

The maximum value obtained in this study was during the dry season and the lowest was in rainy season which was supported by Davies *et al.,* 2008 who reported lowered dissolved oxygen (4.4mg/l) in wet season than dry season (5.14mg/l) and attributed it to be due to reduced photoperiod and photosynthesis activities of aquatic plants. DO value of this study were within acceptable range for healthy water body. USEPA (1998) reported that DO value ranges from 5-14.6 mg/l indicate a healthy water body. It is also within a desirable range for the survival of the biological components of aquatic ecosystem (Begum A .2008).DO is positively correlated to Aquatic Macrophytes abundance and distribution.

Biochemical Oxygen Demand (BOD) in the water body ranged from 0.4 – 2.23ppm which is within the acceptable limit of (WHO, 1995) standard for testing water pollution of freshwater bodies that ranged between (0 -2ppm). This result indicated that the water body was found to be of good water quality and not polluted which was suitable for survival of aquatic life. Dry season are marked with higher BOD value of 2.23mg/l at station 3 and was lower in station 4 during the rainy season with BOD value 0.33ppm in August and this may be due to inflow of substance during the rainy season and settling effect of the substance in dry season.

Nitrate concentration at the sampling stations ranged from 0.3-2.33mg/l indicating that the sampling stations were not polluted. Unpolluted natural waters usually contain negligible quantum of nitrate. The nitrate values obtained in all sites were within the WHO standard of 10mg/l. The nitrate level found in this work was very much lower than what Ali et al., 2014 recorded in same river Ngadda with a range of 15.10 – 31.17ppm. The highest value obtained was 2.3ppm in rainy season which may be attributed to the introduction of surface water run-off. Correlation between Nitrate and Aquatic Macrophytes was significant ($p<0.05$) with positive effect on Aquatic Macrophytes abundance, which was an indication of the effect of nutrients load on Aquatic Macrophytes abundance and density as reported by *Obot et al.,* (1991) in Kainji reservoir.

The seasonal variation of phosphate in river Ngadda varied from 0.5ppm to 1.0ppm in wet season and 0.04 to 0.91 in dry season. Maximum phosphate concentration was recorded from June to October corresponding to the time of high run-offs. This agrees with Wetzel (1983) that 68% of phosphate was from run-offs and only 28% from other sources. In this study phosphate ranged from 0.04ppm to 1.0ppm which means that there is no suitable amount of phosphorus to cause Eutrophication. And correlation between phosphate and Aquatic Macrophytes abundance were significant with a positive effect ($P<0.005$) on Aquatic Macrophytes.

Iron concentration in river Ngadda ranged from (0.11 to 1.6 ppm). The concentration of iron (Fe) in the river may be due to direct or indirect discharges and land run-off into the river. The (Fe) concentration was higher in the wet season with 1.6ppm and lower during the dry season with 0.11 in the month of January and February. Entry of heavy metals into the river especially during the rainy season may be through the flood and this tends to increase the concentration of the metals. Correlation between Aquatic Macrophytes abundance and iron (Fe) shows positive effect and were significant at 5% level of significance. Heavy metals play an important role for plants growth and development (Singh et al 2016). To grow and complete the life cycle plants use this essential micronutrient (Wuana and Okieimen, 2011). Heavy metals such as Cu, Fe, Zn, Ni, Mn, Mg, Co and Cr are essential elements that are required in very small amount for optimum plant growth and development (Alloway, 2013).

Table 3: Aquatic Macrophytes abundance and distribution along River Ngadda (Lagos Street Bridge) from June 2021 – May, 2022

Family	**Species**	**Stations**					**Abundance (%)**
		1	**2**	**3**	**4**	**Total**	
Araceae	*Lemna minor*	5(27.8%)	5(27.8%)	3(16.7%)	5(27.8%)	18	7.9
	Lemna trisulca	5(26.3%)	6(31.6%)	0(0.0%)	8(42.1%)	19	8.4
Cyperaceae	*Cyperus rotundus*	4(26.7%)	6(40.0%)	0(0.0%)	5(33.3%)	15	6.6
	Carex acuta	8(28.6%)	5(17.9%)	6(21.4%)	9(32.1%)	28	12.3
	Scleria verrucosa	6(50.0%)	6(50.0%)	0(0.0%)	0(0.0%)	12	5.3
	Cyperus iria	7(58.2%)	5(41.7%)	0(0.0%)	0(0.0%)	12	5.3
Potamogetonaceae	*Potamogeton pasillus*	6(40.0%)	0(0.0%)	4(26.7%)	5(33.3%)	15	6.6
	Potamogeton pectinatus	6(31.6%)	4(21.1%)	4(21.1%)	5(26.3%)	19	8.4
Poaceae	*Echinochloa colona*	7(31.8%)	9(40.9%)	0(0.0%)	6((27.3%)	22	9.7
	Vossia cuspidate	6(27.3%)	5(22.7%)	5(22.7%)	6(27.3%)	22	9.7
Hydrocharitaceae	*Vallisnera spiralis*	5(33.3%)	4(26.7%)	0(0.0%)	6(40.0%)	15	6.6
Amaranthaceae	*Alternanthera sessilis*	3(16.7%)	6(33.3%)	0(0.0%)	9(50.0%)	18	7.9
Ruppiaceae	*Ruppia spiralis*	5(41.7%)	4(33.3%)	0(0.0%)	3(25.0%)	12	5.3
	Species Total	**73(32.2%)**	**65(28.6%)**	**22(9.7%)**	**67(29.5%)**	**227**	**100**
	Shanon Diversity Index	**2.54**	**2.46**	**1.27**	**2.36**		
	Equitability Index	**1.00**	**0.97**	**0.50**	**0.93**		

Abundance and distribution of Macrophytes

The aquatic Macrophytes species found during this study and its abundance (number of species found) are common aquatic Macrophytes found in various part of Nigeria (Ita 1994). A total number of 13 species from 7 families (*Araceae, Cyperaceae, Potamogetonaceae, Poaceae, Hydrocharitaceae, Amaranthaceae and Ruppiaceae*) were identified during this study where *Cyperaceae* have the highest number of species with four (4) species, then *Araceae*, *Potamogetonaceae* and *Poaceae* recorded two (2) species each while the other families recorded one (1) specie each. Species from *Cyperaceae* and *Poaceae* were the most dominant species with high abundance +++ then rare abundance was observed in the other families. This statistic showed that, the river had more of grass weed Macrophytes than the root knot or leguminous weed Macrophytes which gained the support of Ita (1994) who revealed the abundance of weed aquatic plants in various part of Nigeria.

The comparatively higher number of Aquatic Macrophytes species at station 1, 2 and 4 attributable to be because of their fertility status, drainage patterns and types of activities along the catchment (refuse dumps, diffluent discharged, grazing, soil and sand excavation for construction works and washing). This collaborates the findings of Wandell (2007) who reported that a lake (or water bodies) fertility and its amount of aquatic plants is greatly influenced by its watershed characteristics, topography, soil fertility, drainage patterns and land use. At station 3 lesser number of Aquatic Macrophytes was recorded, although temperature, pH, and dissolved oxygen favours the growth of Macrophytes but nutrients (nitrate and phosphate) were available in less quantity and thus distribution of Aquatic Macrophytes was also affected.

The aquatic species of Aquatic Macrophytes that occur in river Ngadda are few. The species abundance and distribution results confirmed that the two (2) seasons (Dry and the rainy season) influenced the abundance and diversity of the aquatic Macrophytes in the river. The distribution of species (13 species) recorded in the river in all the seasons were very low in comparison with those in similar environments, Idowu and Gadzama (2011) recorded 38 species in Lake Alau,Mwalyosi (1992) recorded 215 species in northern Tanzania.

Diversity of Macrophytes

The sampling sites shows diversity among Aquatic Macrophytes species collected. However, Shannon diversity index of Aquatic Macrophytes varies at the sampling stations, Station 1 indicates high diversity H=2.54, station 2 and 4 showed medium diversity.

CONCLUSION

River Ngadda supports the growth of *Cyperaceae* and *Poaceae* which are family of grass weeds. From most research carried out in lakes, dams and Rivers on aquatic macrophytes, it has been observed that, the families *Cyperaceae* and *Poaceae* dominated the water body. Seasonal variation occurred in the aquatic Macrophytic vegetation. It was observed that Physico-chemical parameters of the water body in River Ngadda fall under normal range that shows a good water quality. The pH value proved that the river is fresh water which supported the growth of the aquatic Macrophytes that were identified.

RECOMMENDATION

To maintain a good water body with diverse vegetation, monitoring of the river should be encouraged as part of environmental management policy, so as to control the affluent that enters each station through canals, washing and irrigation hence to maintain acceptable limit of metal concentration and there is need for careful assessment of nature, extent and potential of aquatic Macrophytes problems before embarking oncontrol.

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