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Screening of polluted water of different habitat for some physicochemical parameters and algal flora in summer season of District Charsadda, KP, Pakistan

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Abstract

The purpose of the study was to assess the algal flora and water quality of summer season of district Charsadda. There are three tehsil in district charsadda; Tehsil Charsadda, Tangi and Shabqadar were studied. From three sampling sites Water samples were collected in summer season for three months (June - August 2015). For identification of algal flora photographs from specimen were captured and identified with the help of slandered monographs of (Tiffany, 1952: Desikachary, 1959: Prescott, 1962). Methods used for physico-chemical analysis of water were standardized according to the procedures of (APHA-AWWA-WPCF, 1995). A total of 86 algal species belonged to 34 genera were studied. Species distribution was as; tehsil charsadda occupied 64 species followed by tehsil tangi with 59 species while tehsil shabqadar represents 49 species. Class Chlorophyceae reperesent high diversity, followed by Bacillariophyceae while a single species of Xanthophyceae was isolated from tehsil Charsadda. Genus *spirogyra* shared 16 species which was maximum. Different physicochemical parameters of polluted water were Temperature, pH, Turbidity, Total dissolved solids, Dissolved oxygen, Electrical conductivity, Total suspended solids, Ammonia, Nitrogen, Nitrate, sulphate, phosphate, Biological Oxygen demand, Alkalinity, Chlorides and Sodium. Water quality analysis showed that Temperature, pH. Turbidity, DO, TSS, Ammonia and BOD were found in very high concentration as compared to the standard value of environmental protection agency and world health organization (EPA, 1991& WHO, 2004). The water is not suitable for drinking purposes without some physical and chemical treatment while useful for agricultural purposes.

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Introduction

Water is one of the pivotal to both natural ecosystems and human development. It is essential for various activities such as drinking, cooking, industrial, agricultural and recreational purposes (Jayalakshmi *et al.,* 2011). Rivers are vital component of the biosphere that contains less than one percent of the world's fresh water with their higher ecological and social significance which are being polluted by indiscriminate disposal of sewage, industrial waste, and by excess of human activities affecting their physico-chemical characteristics and leads to various deleterious effects on aquatic organisms (Murhekar, 2011; Annalakshmi and Amsath, 2012). Water quality provides current information about the concentration of various solutes at a given place and time (Ali *et al.,* 2004). The nature and extent of water pollution is characterized by several physical, chemical and biological parameters. (Chitmanat and Traichaiyaporn, 2010).

Natural water contains different types of impurities which are introduced in aquatic ecosystem by different ways such as weathering of rocks and leaching of soils, dissolution of aerosol particles from the atmosphere and from several human activities, including mining, processing and the use of metal based materials (Adeyeye, 1994: Adefemi & Awokunmi, 2010: Simpi *et al*., 2011). Several recent studies on physico-chemical parameters and phytoplankton community of rivers are conducted on the Greater Zab River, Iraq (Ali, 2010), River Haraz, Iran (Jafari *et al.,* 2011), Imo River, Nigeria (Ogbuagu and Ayoade, 2012) and Kenti River, Republic of Karelia (Chekryzheva, 2014).

Algae being sensitive to the pollution or other changes in water serve as bio-indicator of water quality and pollution status (Saladia, 1997) and hence are commonly used for monitoring environmental contamination (Wu, 1999). The pollution in water causes changes not only in physical and chemical variables but also in algal species composition especially in tropical inland waters leading to deterioration of potable potential of water (Mercado, 2003).

Materials and methods

Sites selection

To study the impact of polluted water on diversity of algae of district Charsadda, three research sites were selected for sampling in distric charsadda. These research sites were tehsil Charsadda, tehsil Tangi and tehsil Shabqadar. Water of these sites becoming polluted every day receiving pollutants mainly from domestic and municipal waste including soaps, detergents and sewages from residential area.

These sites also have mills (Sugar mills and Marble factories) that directly dump their waste into all the water resources which is fresh water present in the form of standing and running water.

Sampling of water and algae

From each station, the algal and water samples were collected from ten different spots randomly. Sampling was done in summer season from May to august 2015. Methods used for chemical analysis were standardized according to the procedures given by (APHA-AWWA-WPCF, 1995).

The algal specimens were collected regularly from the waste water of floating habitat, attached with stones and submerged plants and growing on side walls of pond, stream and river. The algal specimens were also collected from the waste water coming out from homes and cities. The algal specimens were collected with the help of forceps, tooth brush, net mesh and blade. The collected specimens were kept in plastic bottles having sizes of 50ml. Analysis of waste water were performed in the Laboratory of the Water Management Department, Agriculture University Peshawar.

Preservation of algal specimen

The specimens were washed carefully and preserved in 4%formalien solution and kept for a long time to avoid spoilage (Edler and Elbrachter, 2010).

Laboratory method

Microscopic morphology of the Non-Diatomaceous algae was determined by using the wet-mount staining method (Edler and Elbrachter, 2010).

This was done by using a sterile forceps to pick up algal filaments from temporarily preserved samples and placed onto a clean glass slide on which a drop of distilled water was added. A drop of Karosin oil was added, and the preparation was covered with clean cover slips. The slides were subsequently viewed under 10×, 20×, 40× 60× and 100× Nikon Eclipse E200 microscope objectives. Images of the taxa were taken with a BRESSER digital microscope.

The Diatomaceous algae were washed by using hydrogen peroxide (H_2O_2) technique (Swift, (1967). The organic materials in the sample get oxidize in the presence of peroxide and the silica cell walls of diatoms remain undisturbed. The empty frustules of the diatoms were then mounted and analysed for their morphology. Micrometric measurement (length and width) for each algal specimen has taken with the help of stage and ocular micrometre.

Identification of algal species

For identification of algae, photograph from algal specimens were taken with the help of Camera. These pictures were identified with the help of standard monographs of (Tiffany, 1952 : Prescott, 1962) available research papers, publications and keys given by (Desikachary, 1959) and some microphotographs of dominant forms**.**

Results

The results revealed that 86 species which belonged to 34 algal genera were isolated from the polluted water of district charsadda (Table 1). The species distribution in studied sites were as that 64 species was recorded from tehsil Charsadda, from tehsil Tangi 59 species and from tehsil Shabqadar 49 species was isolated (Table 1).

Table 1. Diversity of algal species in summer in district Charsadda in 2015.

S. No	Algal Species in Summer	Research sites		
		C	T	S
Chlorophyceae				
1	Chlorella vulgaris Beyerinck	+	_	+
2	*Chlorella sp.1*	_	+	+
3	*Clorella sp.2*	_	+	_
4	*Chlorococcum hemicola* (Naeg.)Rabenhorst	+	+	+
5	*Cladophora glomerata* (L.) kuetz.	+	+	+
6	*Closterium lunula* (Mueller)Nitzsch	_	+	+
7	*Closterium acerosum* (Schrank) Ehrenb.	+	+	_
8	*Closterium attenuatum* Ralfs	+	+	_
9	*Dactylococcus infusionum* Nägeli	+	_	_
10	*Hydrodictyon reticulatum* (L.) Lagerhein	+	+	+
11	*Microspora* sp.1 Thuret 1850; emend. Lagerheim 1888	+	+	+
12	*Oedogonium punctatum* Wittrock	+	+	+
13	*Oedogonium calliandrum* L. R. Hoffman	+	+	+
14	*Rhizoclonium* sp.1	+	+	+
15	*Schizomeris leibleinii* Kutzing	+	_	_
16	*Spirogyra varian* (Hasall) Kuetz.	+	+	_
17	*Spirogyra porticalis* (Muell.) Cleve	_	+	_
18	*Spirogyra jugalis* (FI. Dan.) Kuetz.	+	_	+
19	*Spirogyra crassa* Hoffmann & Tilden	+	+	+
20	*Spirogyra maxima* (Hassl) Wittrock	+	+	+
21	*Spirogyra rectangularis* Trasneau	+	_	_
22	*Spirogyra circumlaneata* Trasneau	+	_	+
23	*Spirogyra longata* (Vaucher) Kuetz.	_	+	+
24	*Spirogyra punctiformis* Trasneau	+	+	_
25	*Spirogyra aequinoctialis* G. S. West	_	+	+
26	*Spirogyra subsalsa* Kuetz.	+	+	+

27	*Spirogyra ellipsospora* Trasneau	_	+	_
28	*Spirogyra novae-angliae* Transeau	+	_	_
29	*Spirogyra decimina* (Mueller) Kuetz.	+	_	+
30	*Spirogyra tetrapala* Trasneau	_	_	_
31	*Spirogyra majuscula* Kuetz.	_	_	+
32	*Stigeoclonium farctum* Berthold	+	+	
33	*Stigeoclonium flagelliferum* Kuetz	+	+	+
34	*Stigeoclonium attenuatum* (Hazen) Collins	_	+	+
35	*Stigeoclonium helveticum* (Kinross)	_	+	_
36	*Stigeoclonium lubricum* (Dillw.)Kuetz	+	+	_
37	*Ulothrix zonata* (Weber & Mohr)Kuetz.	+	+	_
38	*Sphaerocystis schroteri* Chodat	+	_	_
Bacillariophyceae				
39	*Fragilaria crotonensis* Kitton	+	+	+
40	*Fragilaria capucina* Desmazieres	+	+	+
41	*Nitzschia palea* (Kütz.) W. Sm.	+	+	+
42	*Nitzschia palea var; tenuirostris* Grunow	+	+	+
43	*Nitzschia hungarica* Grunow	+	_	_
44	*Nitzschia linearis* var; *tenuis* Grunow	+	+	_
45	*Cymbella neocistula* Krammer	_	_	+
46	*Cymbella tumida* (Breb.) V. H.	_	+	+
47	*Cymbella vulgata* Krammer	+	+	+
48	*Navicula cuspidata* Kutz.	+	+	+
49	*Navicula ambigua* Ehrenberg	_	+	+
50	*Navicula cuspidata var; ambigua* (Ehrenb.) Cleve	_	+	+
51	*Navicula tripunctata* (O. Mu¨ ll.) Bory	+	+	_
52	*Navicula gastrum* (Ehrenb.) Kutzing	+	_	_
53	*Gomphonema intracatum* (Kütz.)	+	+	+
54	*Gomphonema parvulum* (Kütz.) Kütz.	+	_	+
55	*Gomphonema eriensis* (Grunow) Skvortzow & Meyer	_	_	+
56	*Gomphonema olivaceum* (Hornemann)Brebisson	_	+	_
57	*Gomphonema gracile* Ehrenb.	+	_	_
58	*Gomphonema augur* var; *augur* Ehrenb.	+	+	_
59	*Frustulia rhomboides* Ehrenb.	+	+	+
60	*Amphora ovalis* (Kutz.) Kutz.	+	+	+
61	*Diatoma anceps* (Ehrenb.) Kirchner	+	_	_
62	*Synedra ulna* (Nitzsch) Ehrenberg	+	+	+
63	*Stauroneis anceps* Ehrenb.	+	+	+
64	*Cymatopleurea solea* (Brébisson) W. Smith	+	_	_
65	*Anomoeoneis exilis* (Grunow) Ross	+	+	+
66	*Cocconies placentula* var. *Lineate* (Ehrenb.) van Heurck	+	+	_
67	*Caloneis bacillum* (Grunow) Cleve	+	_	+
Cyanophyceae				
68	*Lyngbya palmarum* Brühl & Biswas	+	+	+
69	*Oscillatoria tenuis* C. A. Agardh	+	+	_
70	*Oscillatoria limosa* A Eardh (Roth) Ag.	_	+	_
71	*Oscillatoria princeps* Vauch.exGom.	+	+	_
72	*Oscillatoria lutea* C. A. Agardhnom.	+	_	+
73	*Oscillatoria rubescens* De Candolle ex Gomont	+	_	_
74	*Oscillatoria chlorina* (Kuetz.)	_	+	+
75	*Oscillatoria formosa* Bory	+	+	+
Charyophyceae				
76	*Chara globularis* (Graham)	+	+	_
77	*Chara vulgairus* Linnaeus	+	_	+
78	*Chara schweinitzii* A. Braun	_	_	+

79	*Chara aspera* C.L. Willdenow	+	+	_
80	*Chara fragilis* Desvaux	+	+	_
Xanthophyceae				
81	Tribonema minus (Wille) Hazen	+	_	_
Euglenophyceae				
82	*Euglena deses* Ehrenberg	+	_	+
83	*Euglena oblongata* Schmitz	_	_	+
84	*Euglena oxyuris* Schmarda	_	+	_
85	*Euglena virids* (O.F.Muller) Ehr.	+	+	_
86	*Euglena gracilis* Klebs	+	+	_

C- Charsadda, T- Tangi, S- Shabqadar.

The species recorded for Chlorophyceae, from tehsil Charsadda 27 species, from tehsil Tangi 37 species and from tehsil Shabqadar 22 species (Table. 1). The species of Bacillariophyceae showed 23 species from tehsil Charsadda, 20 species from tehsil Tangi and 19 species from tehsil Shabqadar. The species distribution for Cyanophyceae showed that 06 species were recorded from tehsil Charsadda and tehsil Tangi each and from tehsil Shabqadar 04 species were recorded.

The species distribution for Charyophyceae showed that 04 species were recorded from tehsil Charsadda, 03 species from tehsil Tangi and from tehsil Shabqadar 02 species were recorded.

Table 2. Physico-chemical parameters of wastewater from different localities in district Charsadda of Summer seasons in the year 2015.

S. No	Parameters	Research areas			Standard (WHO)
		C	T	S	
1	Temperature ^{o}C	33.5	31.5	32.2	12 ^{o}C
2	pH	9.08	8.46	7.96	6.5-9.2
3	Turbidity (NTU)	425	32	9.0	5 NTU
4	TDS (mg/L)	64	296	102	500mg/l
5	D O (mg/L)	7.0	5.5	3.0	≥3mg/l
6	EC (µS/cm)	308	422	296	400 (µS/cm)
7	TSS (mg/L)	200	40	30	5mg/l
8	Ammonia (mg/L)	0.53	0.51	0.40	1.5 mg/l
9	Nitrogen (NO_2)(mg/L)	0.10	0.16	0.38	250mg/l
10	Nitrate (mg/L)	3.74	3.16	4.11	250mg/l
11	Sulphate (SO_2)	22.2	24.5	19.7	250mg/l
12	Phosphate (PO_4) mg/L	0.15	0.18	0.19	0.025mg/l
13	BOD (mg/L)	6.8	5.5	2.8	2mg/l
14	Alkalinity (mg/L)	66	90	55	30-500mg/l
15	Chlorides (mg/L)	7	8	5	250mg/l
16	Sodium (mg/L)	85.2	74.8	65.8	250mg/l

C-Charsadda, T- Tangi, S- Shabqadar.

The species distribution for Euglenophyceae showed that 03 species were recorded from tehsil Charsadda and tehsil Tangi each and from tehsil Shabqadar 02 species were recorded. A single species of Xanthophyceae was recorded from tehsil Charsadda and no species were reported from tehsil Tangi and Shabqadar. In the physico-chemical parameters of polluted water temperature of tehsil Charsadda in summer was 33.5 ^{o}C, tehsil Shabqadar 32.2^{o}C and tehsil Tangi 31.5^{o}C (Table 2). During summer season pH values recorded from tehsil Charsadda was 9.08, tehsil Tangi 8.46 and from tehsil Shabqadar was 7.96 (Table 2). Turbidity (NTU) was recorded from tehsil Charsadda which was 425 (NTU), tehsil Tangi with 32 (NTU) and 9.0 (NTU) recorded from tehsil shabqadar in summer season (Table 2). 296 (mg/l) TDS was recorded in summer from tehsil Tangi, from tehsil Shabqadar with a value of 102 (mg/l) and 64 (mg/l) was recorded from Tehsil Charsadda (table.2). In summer season DO (mg/l) recorded from tehsil Charsadda was 7.0 (mg/l), tehsil Tangi 5.5 (mg/l) and 3.0 (mg/l) of DO was recorded from tehsil Shabqadar (table.2). The maximum value of 422 (µS/cm EC was recorded from tehsil Tangi, from tehsil Charsadda 308 (µS/cm) and 296 (µS/cm) was recorded from tehsil Shabqadar in Summer season (table.2). Total suspended solid TSS of 200 (mg/l) from tehsil Charsadda from tehsil tangi with a value of 40 (mg/l) and 30 (mg/l) was recorded from tehsil Shabqadar (Table 2). Ammonia with a value of 0.53 mg/l was recorded from tehsil Charsadda, thesil Tangi with a value of 0.51mg/l and 0.40 mg/l was recorded from tehsil Shabqadar in summer season (Table 2). During summer season Nitrogen (NO_2) 0.38 mg/l was recorded from tehsil shabqadar, tehsil Tangi with a value of 0.16 mg/l and 0.10 mg/l was recorded from tehsil Charsadda in summer season (Table 2). In the analysis of water for Nitrate in summer season, 4.11 mg/l was recorded from tehsil Shabqadar, tehsil Charsadda 3.74 mg/l and 3.16 mg/l of Nitrate was recorded from tehsil Tangi (Table 2). 25.5 mg/l of Sulphate (SO_4) was recorded from tehsil Tangi, tehsil Charsadda with a value of 22.2 mg/l and 19.7 mg/l from tehsil Shabqadar was recorded in summer season (Table 2).

The Phosphate (PO_4) recorded in summer from tehsil Shabqadar was 0.19 mg/l, tehsil Tangi with a value of 0.18 mg/l and 0.15 mg/l was recorded from tehsil Charsadda (Table 2). Alkalinity was recorded in tehsil Tangi with a value of 90 mg/l, tehsil Charsadda with a value of 66 mg/l and 55mg/l was recorded from tehsil Shabqadar in summer season (Table 2). Cl shows in summer season 8 mg/l in tehsil Tangi, tehsil Charsadda 7 mg/l and 5 mg/l was recorded from tehsil Shabqadar (Table 2). The analysis of water for the Na in summer season, 85.2 mg/l recorded from tehsil Charsadda, tehsil Tangi 74.8 mg/l and 65.8 mg/l was recorded from tehsil Shabqadar (Table 2).

Discussions

Research Area

District charsadda has three tehsil, *viz.* tehsil Charsadda, tehsil Tangi and tehsil Shabqadar.

Algal Flora

A total of 34 algal genera which were studied in the polluted water of district Charsadda belong to six algal classes viz; Chlorophyceae, Bacillariophyceae, Cyanophyceae, Euglenophyceae Charyophyceae, Xanthophyceae. Algal genera which were studied viz; *Chara, Chlorella, Chlorococcum, Cladophora, Closterium, Dactylococcus, Hydrodictyon, Microspora, Oedogonium, Rhizoclonium, Schizomeris, Spirogyra, Stigeoclonium , Ulothrix, Sphaerocystis, Fragilaria, Nitzschia, Cymbella, Navicula, Gomphonema, frustulia,Ampora, Diatoma, Chlorococcum, Synedra, Stauroneis, Cymatopleurea, Anomoeoneis, Cooconies, Caloneis, Lyngbya, Oscillatoria, Tribonema, Euglena.* A total of 86 species in district Charsadda were studied. In the research study tehsil Charsadda encompass maximum 64 species, tehsil Tangi was composed on 59 species while tehsil Shabqadar represent 49 species (Table 1). The species of Chlorophyceae which were studied in the research area during summer season in tehsil Charsadda were found in the ratio of 43.93%, tehsil Tangi 47.61% and tehsil shabqadar 48.07%. (Shekhar *et al.,* 2008) found Chlorophyceae (40%) which were dominant at Station I.

At Station II also the Chlorophyceae (36%) were dominant, at station III Chlorophyceae has 24.99%, at station IV Chlorophyceae has 22% and at station V Clorophyceae has 50.26% which was also dominant at the respective station. These observations are also in conformity with earlier finding (Kiran *et al.,* 2006). The study for Bacillariophyceae of tehsil Charsadda in summer season showed 33.33% species, distribution of species in Bacillariophyceae for tehsil Tangi was recorded 31.74%, while distribution of species for tehsil Shabqadar was 34.61%. (Shekhar *et al.,* 2008) found Bacillariophyceae (29.49%) at station I, at station II Bacillariophyceae (25%), at station III Bacillariophyceae 25.70%, at station V Bacillariophyceae (18.09%), and the same observation was also noted by (Kiran *et al.,* 2006). In summer the distribution of species of Cyanophyceae in Tehsil Charsadda were 10.60%, tehsil Tangi 11.11% while Tehsil Shabqadar 9.61%. (Shekhar *et al.,* 2008) found Cyanophyceae (15.50%) at Station I. At Station II Cyanophyceae 21%, at station III Cyanophyceae 32.35%, At Station IV, phytoplankton belonging to Cyanophyceae (33%), at Station V, Cyanophyceae (16.0%). In euglenophyceae the species distribution in Summer are 4.54% in tehsil Charsadda, tehsil Tangi 4.76% and Tehsil Shabqadar 3.84%.For the study of Charyophyceae the distribution of species in summer season in tehsil Charsadda showed 6.06%, tehsil Tangi showed 4.77% and tehsil Shabqadar 3.84%. The species distribution for Xanthophyceae in tehsil Charsadda was 1.51% during summer season, and no species were found in tehsil Tangi and Shabqadar during summer season.

Physico-chemical Parameters

Different physical and chemical parameters of polluted water were shown in Table 3. The maximum temperature which were studied in tehsil Charsadda in summer was 33.5 ˚C, followed by tehsil Shabqadar 32.2˚C, and tehsil Tangi shows minimum temperature 31.5˚C. Ramakrishnan (2003) reported that water temperature increases from December (23.10 °C) in pond II and from January (25.10 °C) in pond I and attains its peak value during July (29.20 °C for pond I and 30.10 °C for Pond II) in both the ponds.

During summer season maximum PH values were recorded in Tehsil Charsadda which was 9.08 followed by tehsil Tangi with a value of 8.46 and minimum PH value were recorded for tehsil Shabqadar which was 7.96. Ramakrishnan (2003) reported in his study that the Ponds were alkaline throughout the period of study. PH of the water bodies ranged from 7.10 to 9.10. Adeyemo *et al.* (2008) observed that pH values are higher during the dry season. A high value of Turbidity (NTU) was recorded in summer in tehsil Charsadda which was 425 (NTU) followed by tehsil Tangi with a value of 32 (NTU) and minimum value of Turbidity 9.0 (NTU) in tehsil shabqadar in summer was recorded. Khan *et al.* (2013) reported that turbidity in water is because of the presence of suspended particles of clay or silt and colloidal organic materials. According to WHO guidelines, maximum acceptable value for turbidity is 5 NTU. Maximum TDS (mg/L) values were recorded in summer in tehsil Tangi which was 296 mg/L, tehsil Shabqadar has a value of 102(mg/L) and minimum value of 64 (mg/L) was recorded in Tehsil Charsadda. Hussain *et al.* (2012) reported that the TDS values ranging from 176 to 296 mg/l, all were below the WHO maximum permissible level of 500 mg/l (Carl and Arens, 2012). In summer season maximum values of DO (mg/L) were recorded in tehsil Charsadda which was 7.0 followed by tehsil Tangi with a value of 5.5 (mg/L) while minimum value which was 3.0 (mg/L) for DO, recorded in tehsil Shabqadar. Mustapha (2008) found that minimum dissolved oxygen (2.4 mg/ L) was observed at station 1 during February and October and maximum value (9.1mg/l) recorded in station 2 during May. The maximum value for EC (µS/cm) were recorded in tehsil Tangi with a value of 422 (µS/cm) during summer season, followed by tehsil Charsadda with a value of 308 (µS/cm) and minimum value of 296 (µS/cm) was recorded for tehsil Shabqadar during Summer season. Patra, *et al.* (2011) stated that Electrical conductivity (EC) in natural waters is the normalized measure of the water's ability to conduct electric current. This is mostly influenced by dissolving salts present in the water body.

The conductivity and salinity of the samples of water presented values ranging between (1923µs/cm) (1.2%) respectively in station 1 in April to (754µs/cm) (0.4%) respectively in station 3 in February. The maximum value for Total suspended solid TSS (mg/L) in summer was recorded in tehsil Charsadda with a value of 200 (mg/L), followed by tehsil tangi with a value of 40 (mg/L) and minimum value of 30 (mg/L) was recorded for tehsil Shabqadar. Hussain *et al.* (2012) stated that TSS is the proportion of total solids retained by a filter. The values of TSS ranged from 2-89mg/l. The WHO, 2004 recommended value for TSS is 5 mg/l. In summer highest value of Ammonia which was 0.53 mg/L was found in tehsil Charsadda, followed by thesil Tangi with a value of 0.51mg/L and minimum value of 0.40 mg/L was found in tehsil Shabqadar during season. Gupta *et al.* (2011) stated that Presence of ammonia in water is a significant indication of pollution due to untreated domestic, industrial and sewage effluents. In his investigation ammonia content in water samples was varied from 0.12 to 0.75 mg/L, which indicate that water is moderately polluted. During summer, maximum value of Nitrogen (NO_2) 0.38 mg/L was found in tehsil shabqadar, tehsil Tangi with a value of 0.16 and minimum value of 0.10 mg/L were recorded in tehsil Charsadda during season of the year in research area. In the analysis of water for Nitrate during summer season highest value of 4.11 mg/L was found in tehsil Shabqadar, followed by tehsil Charsadda with a value of 3.74 mg/L and minimum value of 3.16 mg/L of Nitrate was found in tehsil Tangi during study (Table.3). The maximum value of 25.5 mg/L for the Sulphate (SO_4) were found in tehsil Tangi, followed by tehsil Charsadda with a value of 22.2 mg/L and minimum value of 19.7 mg/L in tehsil Shabqadar found during summer season of the study. Ramakrishnan (2003) stated that Nutrient salts like Nitrate – N, Phosphate - P and calcium attained its maximum values during the rainy months due to inflow of rain water and its minimum value was observed during summer months. Hussain *et al.* (2012) described that Sulphates in domestic water contribute to permanent hardness.

The range of sulfates concentration in the samples was 19.78-103.86 mg/l lying below the WHO standard recommended value of 250mg/l the high concentration of sulfates in the water might be due to leaching of sulfate fertilizers to the water table. The highest value for the Phosphate (PO_4) were recorded in summer in tehsil Shabqadar with a value of 0.19 mg/L, followed by tehsil Tangi with a value of 0.18 mg/L and minimum value of 0.15 mg/L was recorded in tehsil Charsadda. Shah and Hussain (2014) stated that among the five major areas selected for total phosphates analysis, the area Thana was observed with lowest TP as 1.4 mg/L and highest 3 mg/L for stagnant water. Similarly, the running water ranged between 0.1 and 0.7 mg/L while waste water was found to be highest with the lowest as 3.1 mg/L and highest as 4.8 mg/L. The other area Batkhela showed close comparison with Thana in range of TP.

The highest value for the B. O. D was recorded in summer for tehsil Charsadda and Tangi with a value of 6.8 mg/L and 5.5 mg/L respectively while the lowest value were recorded for tehsil Shabqadar which was 2.8 mg/L. Gupta *et al.* (2011) reported the values of biological oxygen demand which is a indicator of bi-oxidisable organic substances was varied from 1.20 to 12.20 mg/L observed values clearly indicate that river water of the study was moderately polluted by organic wastes. The maximum value for the Alkalinity were recorded in tehsil Tangi with a value of 90 mg/L, followed by tehsil Charsadda with a value of 66 mg/L and lowest value of 55mg/L was recorded in tehsil Shabqadar during summer season of the study. Hussain *et al.* (2012) reported alkalinity range of 128-180mg/L for the samples, lying below the WHO maximum permissible level of 500mg/L but substantially higher than its WHO desirable level of 30mg/L. The study for Cl shows that in summer season maximum value of 8 mg/L was recorded in tehsil Tangi, followed by tehsil Charsadda with a value of 7 mg/L and minimum value of 5 mg/L was recorded in tehsil Shabqadar in the research area. Hussain *et al.* (2012) stated that Chlorides were present in all the samples of water.

The value for chloride concentration indicates a range of 21.99-87.97 mg/L in these samples. The analysis of water for the Na during summer season shows that maximum concentration of sodium (Na) was found in tehsil Charsadda with a value of 85.2 mg/L, followed by tehsil Tangi with a value of 74.8 mg/L and the minimum concentration of sodium (Na) which 65.8 mg/L was recorded in tehsil Shabqadar during study. Gupta *et al.* (2011) reported that Sodium concentration in all the analyzed samples in pre-monsoon season was varied from 16.7 to 34.6 mg/L slightly high concentration in surface water of river was may be due to addition of untreated industrial and domestic waste.

Conclusion

A total of 34 algal genera and 86 species which were studied in the polluted water of district Charsadda and belong to six different classes of algae. In the research study tehsil Charsadda encompass maximum 64 algal species, tehsil Tangi was composed on 59 species, while tehsil Shabqadar represent 49 species which belongs to different genera af algal flora. The largest genus was found *Spirogyra* which was coposed on 16 species.

In district Charsadda the physico-chemical parameters of water quality were studied in the research area. Physico-chemical parameters; Temperature PH, Turbidity, DO, TSS, Ammonia and BOD was found beyond the WHO recommended standard limits and the rest of the parameters were found with in the limits of WHO recommended standard limits.

Recommendation

Molecular study are further needed for classification of algae of the research area. Study are needed to corelate the presence or absence of a particular species with the physico-chemical parameters one by one. Further study are required to explore indicator species of the research area.

References

Adefemi SO, Awokunmi EE. 2010. Determination of physico-chemical parameters and heavy metals in water samples from Itaogbolu area of Ondo-State, Nigeria, African Journal of Environmental Science and Technology. **4(3),** 145-148.

Adeyemo OK, Adedokun OA, Yusuf RK, Adeleye EA. 2008. Seasonal changes in physico-chemical parameters and nutrients load of River sediments in Ibadan City, Nigeria. Global NEST Journal. **10(3),** 326 -336.

Adeyeye EI. 1994. Determination of heavy metals in *Illisha africana*, associated Water, Soil Sediments from some fish ponds, International Journal of Environmental Study. **45**, 231-240.

Ali AL. 2010. Seasonal variation in physico-chemical properties and zooplankton biomass in Greater Zab River, Iraq Jordan. Journal of Biological Sciences. **3**, 115–120.

Ali M, Salam A, Ahmed N, Khan B, Khokhar MY. 2004. Monthly Variation in Physico Chemical Characteristics and Metal Contents of Indus River at Ghazi Ghat, Muzaffargarh, Pakistan. Pakistan Journal of Zoology. **36(4),** 295-300.

Annalakshmi G, Amsath A. 201. An assessment of water quality of river Cauvery and its tributaries Arasalar with reference to physico-chemical parameters at Tanjore DT, Tamilnadu, India. International Journal of Applied Biology and Pharmaceutical Technology **3(1),** 269-279.

APHA, AWWA, WPCF. 1995. Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Washington DC.

Simpi SMB, Hiremath KNS, Murthy KN, Chandra S, Anil N, Patel ET, Puttiah. 2011. Analysis of Water Quality Using Physico-Chemical Parameters Hosahalli Tank in Shimoga District, Karnataka, India, Global Journal of Science Frontier, Research **1(3).**

Chekryzheva TA. 2014. Anthropogenic changes in phytoplankton in lakes of the Kenti River System (Republic of Karelia) Water Resour. **41,** 431–438.

Chitmanat C, Traichaiyaporn S. 2010. Spatial and temporal variations of physical chemical water quality and some heavy metals in water, sediments and fish of the Mae Kuang River, Northern Thailand. International Journal of Agriculture and Biology. **12(6),** 816-820.

De PK. 1939. The Role of Blue Green Algae in Nitrogen Fixation in Rice Fields. Proc. Roy. Soc. London. **127**. 121 – 129.

Desikachary TV. 1959. Cyanophyta, Indian Council of Agriculture Research, New Dehli.

Edler L, Elbrächter M. 2010. The Utermöhl method for quantitative phytoplankton analysis: Microscopic and molecular methods for quantitative phytoplankton analysis. Paris: UNESCO Publishing, 12-13.

Gupta N, Nafees SM, Jain MK, Kalpana S. 2011. Physico-chemical assessment of water quality of River Chambal in Kota city area of Rajasthan state (India). Rasayan Journal of Chemistry. **4(2),** 686-692. www.rasayanjournal.com

Hurlbert SH. Ecology, 1971, **52,** 577-586.

Hussain F, Shah SZ. 2014. Direct effects of phosphates concentration on the microalgal growth in malakand Pakistan. Pakistan journal of Weed Sciences Research **20(2),** 199-206.

Hussain J, Jehangir S, Wahid H, Roshan A, Leandro JS, Wilson A L, Ikhtiar K, Iracema AN. 2012. Evaluation of the quality of drinking water of Mardan District, KPK, Pakistan. American-Eurasian Journal of Agricultural & Environmental Sciences. **12 (8),** 1047-1051.

Jafari N, Nabavi, SM, Akhavan M. 2011. Ecological investigation of zooplankton abundance in the river Haraz Northeast Iran. Archives of Biological Sciences. Belgrade, **63**, 785–798.

Jayalakshmi V, Lakshmi N, Charya MAS. 2011. Assessment of physicochemical parameters of water and waste waters in and around Vijayawada. International Journal of Research Pharmaceutical and Biomedical Sciences. **2(3),** 1040-1046.

Khan N, Syed TH, Abdus S, Nargis J, Kyong SK. 2013. Physicochemical investigation of the drinking water sources from Mardan, Khyber Pakhtunkhwa, Pakistan. International Journal of Physical Sciences, **8(33),** 1661-1671.

Kiran BR, Babu KH, Kumar MR, Puttaiah ET. Kamath CD. 2006. Water quality assessment of Bhadra River with special reference to industrial pollution. Indian Journal of Environmental Protection. **26**, 148-152.

Leghari MK, Leghari MY, Leghari SM. 2004. Water chemistry and its relation with algae of Rawal dam, Islamabad and Wah garden District Attock, Sindh University Research Journal- SURJ (Science Series). **36(2),** 29 – 48.

Mercado ML, Hydrobiologia. 2003. **495,** 103-117.

Mishra P, Patel RK. 2005. Some aspects of the quality of water in and around Rourkela, thesis.

Murhekar GH. 2011. Assessment of physico-chemical status of ground water samples in Akot city. Research Journal of Chemical Sciences. **1(4),** 117-124.

Mustapha MK. 2008. Assessment of the Water Quality of Oyun Reservoir, Offa, Nigeria, Using Selected Physico-Chemical Parameters. Turkish Journal of Fisheries and Aquatic Sciences. **8**, 309-319.

Ogbuagu DH, Ayoade AA. 2012. Seasonal dynamics in plankton abundance and diversity of a freshwater body in Etche, Nigeria Environent and Natural Resources Research. **2**. 48–59.

Patra AK, Sengupta S, Datta T. 2011. physico-chemical properties and Ichthyofauna diversity in karala river, A tributary of Teesta River at Jalpaiguri District of West Bengal, India. International Journal of Applied Biology and Pharmaceutical Technology. **2**, 47-58.

Prescott GW. 1962. Algae of the Western Great Lakes area. W. M. C. Brown Company, Dusuoue, Iowa, 1-1000.

Ramakrishnan N. 2003. Bio-monitoring approaches for water quality assessment in two waterbodies at Tiruvannamalai, Tamilnadu India. Chennai: Department of Geography, University of Madras and Faculty of Environmental Studies, York University. 374 – 385.

Saladia PK. 1997. Hydrobiological studies of Jait Sagar Lake, Bunch (Rajastan). Thesis submitted to MDS University, Ajmer, India.

Sedamkar E, Angadi SB. 2003. Poll. Res. **22(3),** 411-422.

Shekhar STR, Kiran BR, Puttaiah ET, Shivaraj Y, Mahadevan KM. 2008. Phytoplankton as index of water quality with reference to industrial pollution. J. Env. Bio. **29(2),** 233-236.

Singh RN. 1950. Reclamation of User Lands in India through Blue Green Algae. Nature. London. **165,** 325-326.

Stevenson RJ, Pan Y. 1999. Assessing environmental conditions in rivers andstreams using diatoms. In: Stoermer, E. F. Smol, J P (Eds.) the diatoms. Applications forthe environmental and earth sciences. Cambridge University Press, Cambridge.11-40.

Swift E. 1967. Cleaning Diatom Frustules with Ultraviolet Radiation and Peroxide. Phycologia **6(2),** 161-163.

Tiffany LH, Britton ME. 1952. The Algae of Illinois. Chicago Univ. Press, Chicago, 407.

Trivedy RK, Goel PK. 1984. Environmental Publications India. 215.

Uma BH, Kim YS. 2009. Review: A chance for Korea to advance algal biodiesel, JIEC-156; No of Pages 7.

World Health Organization (WHO). 2004. Guidelines for drinking water quality, 3rd Edition. World Health Organization, Geneva. Articals/pdf). www.ayqrt.Net/Publish

Wu J. Hydrobiologia. 1999. **397,** 79-87.