Plant Archives Vol. 17 No. 2, 2017 pp. 1139-1145 *ISSN 0972-5210*

ANALYSIS OF WATER, SEDIMENT QUALITY AND TOTAL METALS ACCUMULATION IN AQUATIC VEGETATION AT BHINDAWAS WETLAND, JHAJJAR HARYANA, INDIA

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Abstract

Environmental health of Bhindawas wetland is degraded day by day due to agriculture runoff from surrounding field and water received from flood control drain no. 8 in rainy season. The present study was undertaken to analyse the special variation in physico-chemical water quality, heavy metal content in sediment and macrophytic plants. The water samples were filtered and analysed according to American Public Health Association. The heavy metals in sediment samples and macrophytic plants were analysed by Atomic Absorption Spectrophotometer. Water quality revealed that the turbidity and phosphate were high in the wetland water. Phosphate and nitrate were varies from 0.132-0.26 mg/l and 0.121-0.25 mg/l respectively, which cause eutrophication in the wetland. Other parameters of water were present in the normal range. The pH of 50% sediment samples was alkaline in nature having maximum pH. 8.19. Organic carbon was varied from 0.696 to 1.33%. Soluble and exchangeable cations in sediment present in good quantity. Heavy metal like iron, zinc, copper, nickel, lead, total chromium and cadmium were within the limit as prescribed in Candian sediment standards. It was also noted that *Eichhornia crassipes* is good accumulator for zinc and copper, while *Ipomea aquatica* is excellent absorber of calcium and magnesium in wetland water. *Salvania molesta* was found reach in potassium. The present study will help into formulation of proper environment management plan for wetland.

Key words : Water quality, pollution, sediment, macrophytic plants.

Introduction

Wetlands are those lands which saturated with water, either permanently or temporarily, such that it shows the character of a distinct ecosystem. Wetland is neither truly aquatic nor terrestrial; it is possible that wetlands can be both at the same time depending on seasonal variability. The diversity of wetlands depends upon geographical location, soil or sediment characteristics, dominant plants and water regime. Large geographical area of India supports diverse wetlands with unique characteristics. According the various estimate wetlands occupied 1-5 per cent of geographical area of the country, support about a fifth of the known biodiversity (ISRO, 2010). From beginning of human civilization, wetlands were used for many benefits (Mitsch and Gosselink, 1993). Goods and services from the wetlands can be broadly grouped according to functions (e.g., groundwater recharge, flood control, maintenance of biodiversity), products or uses (e.g., agricultural produce, fish, building materials, fuelwood, wildlife products), and attributes (e.g., aesthetic values, cultural or religious significance). The diversity in functions that wetlands perform makes them incredibly valuable ecosystems (Mitchell, 2001; Yun *et al*., 2017).

Organic and inorganic water pollutants are the major contributing factor to the degradation and contamination of wetland ecosystems (Carpenter *et al*., 1998). The agricultural, industrial and other human activities not only have a high water demand, but they also discharge contaminated agricultural runoff, wastewater from industries and domestic sewage into the aquatic environment, causing eutrophication and water pollution (Jing *et al*., 2008). The present loss rates in India can lead to serious consequences, where poor population depends upon wetlands services (World Development Report, 1994). Wetland loss refers to physical loss in the

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spatial extent or loss in the wetland function. One Km^2 loss in Indian wetland will creates much greater impact than the loss of one Km^2 of wetlands in low population areas of abundant wetlands (Foote *et al*., 1996; Kumar and Dhankhar, 2015).

In wetlands, due to anthropogenic activities, heavy metals present mainly in water, in mud at the bottom, and in plants or other organisms (Raut *et al*., 2017). Their distributions can also change among different compartments. For these reasons, research and study on the distribution, transfer, and transformation of heavy metal pollutants in wetlands are of great importance (Cheng *et al*., 2002; Kumwimba *et al*., 2016). Metals are not permanently bound to sediments but rather are distributed throughout sediment components and associated with them in various ways including ion exchange, adsorption, precipitation and complexation (Mitsch and Gosselink, 1986).

Sustainable food production and potable water availability for humans and livestock required healthy wetlands in India. They are also necessary for the continued existence of India' diverse populations of wildlife and plant species; a large number of endemic species are wetland dependent.

In present study, we were assessed the environmental health of the Bhindawas wetland, which is situated in Jhajjar district of Haryana. Environmental quality of Bhindawas wetland is degraded day by day due to it received polluted water from surrounding agriculture fields and flood control drain no. 8. Lake is infested specially by aquatic plants. The other major problems in lake are eutrophication, siltation, ecological succession. Keeping in view of the problems associated with Bhindawas wetland the present study was undertaken to find out the variation in physico-chemical water quality, sediment quality specially heavy metal content and accumulation of element in different macrophytes.

Materials and Methods

Study area

Bhindawas bird sanctuary is a low-lying area in district Jhajjar (Haryana), India. It is located at a distance of 15 Km from Jhajjar town and 80 Km from Delhi at 76^0 32' East and $28^0$32' West. The wetland and birds, including migratory birds are the main attraction of the complex. The sanctuary is spread over an area of 1074 acres which makes it considerably larger. The peripheral embankment is man made and basically constructed to store the escaped water of Jawaharlal Nehru Canal through an escape channel at the time of power failure of life canal system. The Bhindawas wetland is being used by the migratory and native birds of about 250 species. The area was declared as wildlife sanctuary by the Haryana Government in 1985 for the purpose of protecting and developing wildlife. The sanctuary is surrounded by 5 villages – Kanwash, Nawada, Sajapur, Chadwana and Radhuwas. Residents of these villages are using water from this wetland for various agricultural and domestic purposes. Excess water of wetland is siphoned off in the drain no. 8. At present, however, the bird sanctuary is facing the danger from the water hyacinth which impair the quality of the water making it unfit for human consumption, cause water borne diseases, increase eutrophication, silting and gradually drying up the water bodies.

Water sampling and analysis

Total nine sample of water were collected from the different part of wetland including canal inlet to lake, outlet of lake, drain No. 8 upstream and downstream to lake Outlet. Sampling and analysis of the water were done in May 2011. From each site, field data like dissolved oxygen and pH were measured in forenoon at the sites. The pH was measured using Systonic soil and water testing kit. Dissolved oxygen was estimated by the modified Winklers method. For the analysis of other parameters, surface water samples were collected in clean Jerry canes and kept in an ice box and transported immediately to the laboratory. The water samples were filtered using a Millipore filtering system and analyzed according with Standard Methods of Examination of Water and Waste as prescribed by American Public Health Association (APHA, 2000).

Sediment and macrophytic plant sampling and analysis

Six sampling locations were selected for sediment samples collection from the different site of wetland in the month of May, 2011. Four sampling location were selected randomly from different part of wetland and two sampling location from the drain no. 8, include up and down stream. At each location, sediment samples were collected from 0-10 cm depth below the sediment surface in the shallow water area. The field samples of sediments were spread out on a tray for air drying. The dried samples sieve by using 2 mm sieve and store in air tight polythene beg. Sieved sediment were used for analysis of pH, organic carbon, phosphorous, nitrogen, potassium, C/N ratio, magnesium, calcium, ignition loss, Na, Fe, Ni, Cu, Zn and Pb. All samples were analysed according to Allen (1989).

Six species of macrophytic plant viz., *Lemna minor*, *Eichhornia crassipes*, *Typha latifolia*, *Salvania molesta*,

Polygonum glabrum and *Ipomea aquatica* were collected from the different parts of wetland in the month of May 2011. Plant tissue was cleaned to remove dust by washing the plants with de-ionized water. Plant sample was immediately dried in an oven to stop enzymatic activity at 65°C for 24 hours. Mechanical grinding was done to produce a material suitable for analysis. Stainless steel mill was used for grinding and grounded material was passed though a 60 mesh sieve. Sieved samples were used for analysis of phosphorous, nitrogen, potassium, magnesium, calcium Na, Fe, Ni, Cu, Zn and Pb. All samples were analysed followed the method of Allen (1989).

Metal analysis

For the release of mineral elements from sediments, wet oxidation digestion of samples was carried out. 1.0 g sample of air dried sediments was weighted in digestion tube and 3 ml conc. HNO_3 was added. Samples were digested on electrically heated hot plate place in fume chamber for 1 h at 145^{0}C. Then 4 ml of $HClO_4$ was added and heated it at 240^{0}C for one hour. Macrophytic plants digest by oxidizing acids like HNO_3-H_2SO_4-$HClO_4$, tri-acid mixture. Tri-acid mixture was prepared containing mix of AR grade conc. HNO_3, H_2SO_4 and $HClO_4$ in the ratio of 10:1:4 and cooled. 1.0 g of dried and processed plant sample was transferred to a 250 ml conical flask and 5 ml of conc. H_2SO_4 was added. Glass funnel on the flask was kept and place it on a water bath and heated at 100^{0}C for about 30 minute and cooled. 5 ml of tri-acid mixture was added in cooled sampled. Then sample was heated at 180-200^{0}C on hot plate until the dense white fumes were evolved and transparent white contents are left. Cooled it and 50 ml of double distilled water was added and filtered into 100 ml volumetric flask, giving 3-4 washing. The concentration of Ca, Fe, Cu, Zn, Cd, Ni, Pb, Cr were determined by Z-6100 polarized Zeeman atomic absorption spectrophotometer (Hitachi).

Results and Discussion

Analysis of water quality

Study of water environment is one of the most important things for the assessment of environmental status of Bhindawas wetland. Various source of special variation in water quality include the agriculture runoff and water contamination with flood control drain No. 8.

The data on physical and chemical properties of water samples have been given in table 1.

Physical characteristics

Wetland and drain no. 8 water was colourless. The pH of the sample was in the range of 7.55 to 7.82 with an average and standard deviation of 7.68±0.08. The electrical conductivity (EC) was in the range of 216 to 1319 µ mho/cm with an average and standard deviation of 587±338 µ mho/cm. The turbidity values were found from 7 to 29 NTU. Range of total suspended solids (TSS) and total dissolved solids (TDS) from 18.6 to 60.4 mg/l and 142 to 875 mg/l, respectively.

Chemical characteristics

Total alkalinity was ranged from 150 to 576 mg/l with an average and standard deviation of 248±134 mg/l. The major anions chloride, bicarbonate and sulphate were ranged from 24 to 126 mg/l, 183 to 666 mg/l and 25 to 142 mg/l, respectively. Whereas average and standard deviation of these anions were 92.5±32.4 mg/l, 298±153 mg/l and 56.5±37mg/l, respectively. Carbonate was not detected from any of sites. The major cations calcium, magnesium, potassium and sodium were ranged from 35 to 131 mg/l, 12 to 60 mg/l, 23 to 63 mg/l and 16 to 98 mg/l respectively. Whereas average and standard deviation of these cations were 65±30 mg/l, 29±13.8 mg/l, 23±63 mg/l and 44±25.2 mg/l, respectively. The total hardness ranged from 136 to 576 mg/l with an average and standard deviation of 282±130 mg/l. Dissolved oxygen was in the range of 5.6 to 7.2 mg/l with S6 recorded the highest value, it could be due to inlet water with no organic contamination with good aeration and S8 recorded the lowest value due to organic contamination in drain. The major nutrients phosphate and nitrate were ranged from 0.132 to 0.260 mg/l and 0.121 to 0.25 mg/l, respectively. Whereas average and standard deviation of these nutrients were 0.199±0.053 mg/l and 0.295±0.311 mg/l, respectively.

Except turbidity and bicarbonates, all the parameters were within the permissible limit as prescribed by BIS (1991). Turbidity was found higher at six sites (more than 10 NTU), where bicarbonate was higher than given limit (600 mg/l) at S1 site. The average phosphate level in the Bhindawas wetland was 0.199 mg/l, which revealed that wetland come under hypertrophic category. This was further conformed by categories of water bodies based on phosphate given by Smith *et al.* (1999). They suggested that the mean total phosphorus concentration less than 0.010 mg/l is characterized as oligotrophic status, ranging from 0.010 to 0.030 mg/l is mesotrophic status, ranging from 0.030 to 0.040 mg/l is eutrophic status and more than 0.040 mg/l is hypertrophic status.

Sediment quality

Six sediment samples marked as inlet of wetland (SS1), near Bilochpura (SS2), drain no. 8 upstream to lake outlet (SS3), near watch tower (SS4), Drain no.8

Table 1 : The Physico-chemical characterstics of Bhindawas wetland water.

S.no.	Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9	Mean±S.D (Range)
1.	Colour	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	———
2.	pH	7.80	7.68	7.72	7.70	7.62	7.55	7.60	7.82	7.70	7.68±0.08(7.55-7.82)
3.	EC (µ mho/cm)	1319	329	540	579	247	216	680	701	674	587±338(216-1319)
4.	Turbidity (NTU)	29	18	27	9	18	29	07	10	11	17.5±8.91(7-29)
5.	TSS (mg/l)	60.4	34.4	51.5	18.6	35	56.4	19.4	22.4	25.2	35.9±16.3(18.6-60.4)
6.	TDS (mg/l)	857	215	354	379	161	142	446	458	441	383±216(142-875)
7.	Chloride (mg/l)	126	71	102	101	68	24	117	114	110	92.5±32.4(24-126)
8	Alkalinity (mg/l)	576	154	166	204	160	150	260	292	270	248±134(150-576)
9.	HCO_3 (mg/l)	666	188	202	248	195	183	317	356	329	298±153(183-666)
10.	T. Hardness (mg/l)	576	168	242	280	182	136	322	330	304	282±130(136-576)
11.	Ca^{++} (mg/l)	131	35	54	66	42	35	82	78	62	65±30(35-131)
12.	Mg^{++} (mg/l)	60	19	26	28	19	12	28	33	36	29±13.8(12-60)
13.	K^+ (mg/l)	63	33	23	30	34	25	40	37	38	35.8±11.6(23-63)
14.	DO (mg/l)	6.4	6.2	6.6	6.2	6.8	7.2	6.6	5.6	6.0	6.4±0.46(5.6-7.2)
15	Sulphate (mg/l)	142	30	41	69	29	25	81	45	47	56.5±37(25-142)
16.	Phosphate (mg/l)	.143	0.243	0.262	0.185	0.162	0.163	0.132	0.238	0.268	0.199±0.053(0.132-0.26)
17.	Nitrate (mg/l)	0.179	0.132	0.169	0.121	0.162	0.180	0.143	0.252	0.184	0.295±0.311(0.121-0.25)
18.	Sodium (mg/l)	98	33	16	46	27	18	48	57	55	44.2±25.2(16-98)

S1=Near Bilochpura village, S2=Between Bilochpura and Chadwana village, S3=Near Chadwana village S4=Near Sahajapur village, S5=Near Raduwas village, S6=Wetland inle,t S7=Wetland outlet, S8=Drain No.8 upstream to wetland, S9=Drain No.8 downstream to wetland.

downstream to lake outlet (SS5) and near Chadwana (SS6). Results of physical-chemical properties of sediment samples have been given in table 2.

The pH of 50% sediment samples were alkaline in nature having maximum pH. 8.19 at SS1 to minimum pH 6.5 at SS6. Whereas, the mean and standard deviation were 7.41±0.78, respectively. EC of SS5 site was found maximum 858 µmho/cm to minimum 363 µmho/cm at SS4 site. Organic carbon was varied from 0.696 to 1.33% with mean and SD of 1.01±0.27%, whereas TN and C/N were varied from 0.056 to 0.123% and 9.7 to 20.03, respectively. Concentration of total phosphorus was ranged from 280 to 720 mg/kg with an average and SD of 426±161 mg/kg. Soluble Na^+, K^+, Ca^{2+} and Mg^{2+} were ranged from 15 (SS2) to 30 (SS1), 20 (SS4) to 31 (SS3), 240 (SS1) to 480 (SS5) and 88 (SS3) to 145 (SS5) mg/kg, respectively. The exchangeable sodium, potassium, calcium and magnesium were ranged from 40 to 90, 116 to 186, 600 to 1220 and 194 to 290 mg/kg, respectively. Heavy metals like iron, zinc, copper, nickel, lead, total chromium and cadmium were ranged from 1444 to 1993, 31.1 to 85.09, 16.75 to 27, 9.96 to 25.75, 27.86 to 69.6, 20.5 to 38.6 and 0.32 to 0.98 mg/kg respectively, whereas means and SD were from 1826±210, 55.8±22.3, 21±3.6, 16.1±5.8, 49.7±17.4, 28.5±6.1 and 0.78±0.24 mg/kg, respectively (table 2).

Value of pH in 50% samples were recorded slightly alkaline in nature, it could be due to the presence of high calcium and magnesium at these sampling sites. 50% samples were slightly acidic, it might due to the decomposition of organic matter produced the CO_2 and carbonic acid, which reduce the pH. EC was found maximum at SS5 (drain no.8 downstream to wetland outlet), it could be due the decomposition of organic matter with time increase the electrical conductivity of this site. Organic carbon found maximum at SS3 (drain no.8 upstream to wetland outlet) site followed by S6 (near chadwana village), it could be due to the more macrophytes were present at these locations and after death and decay they increase the organic carbon of the sediments. Rodríguez-Barroso *et al*. (2010) reported that distribution of organic carbon is mainly dependent on the sediment grain size due

Table 2 : Sediments quality of Bhindawas wetland**.**

S.no.	Parameters	SS1	SS2	SS3	SS4	SS5	SS6	Mean ±S.D (Range)
1.	pH (1:2)	8.19	8.02	8.10	6.95	6.67	6.50	7.41±0.78(6.5-8.19)
2.	EC (1:2) (µmho/cm)	498	565	814	458	858	597	631±166(458-858)
3.	%age Organic Carbon	0.696	0.846	1.335	1.194	0.790	1.222	1.01±0.27(0.696-1.335)
4.	%age T. Nitrogen	.056	0.082	0.0912	0.123	0.0734	0.061	0.08±0.02(0.056-0.123)
5.	C/N	12.42	10.31	14.6	9.7	10.76	20.03	12.9±3.8(9.7-20.03)
6.	Soluble Na^+ (mg/kg)	30	15	24	17	22	18	21±5.51(15-30)
7.	Soluble K^+ (mg/kg)	30	28	31	20	22	26	26.1±4.4 (20-31)
8.	Soluble Ca^{2+} (mg/kg)	240	256	416	260	480	288	323±99.8(240-480)
9.	Soluble Mg^{2+} (mg/kg)	142	135	88	94	145	133	122±25.1(88-145)
10.	Exchangeable Na^+ (mg/kg)	75	90	75	60	45	40	64.1±19.3(40-90)
11.	Exchangeable K^+ (mg/kg)	143	186	150	116	143	150	148±22.4(116-186)
12.	Exchangeable Ca^{2+} (mg/kg)	980	1220	700	760	640	600	816±238(600-1220)
13.	Exchangeable Mg^{2+} (mg/kg)	254	196	254	290	238	194	237±37.1(194-290)
14.	Phosphorus (mg/kg)	385	280	325	350	720	500	426±161(280-720)
15.	Iron (mg/kg)	1892	1993	1444	1726	1979	1923	1826±210(1444-1993)
16.	Zinc (mg/kg)	74.66	85.09	36.05	31.10	42.14	66.03	55.8±22.3(31.1-85.09)
17.	Copper (mg/kg)	27	23.25	16.75	19	20.75	19.5	21.0±3.6(16.75-27)
18.	Nickel (mg/kg)	18.18	25.75	14.84	9.96	10.48	17.87	16.1±5.8(9.96-25.75)
19.	Lead (mg/kg)	69.6	59.65	35.82	27.86	39.8	65.57	49.7±17.4(27.86-69.6)
20.	T. Chromium (mg/kgl)	30.5	24.4	20.5	27.5	29.8	38.6	28.5±6.1(20.5-38.6)
21.	Cadmium (mg/kg)	0.86	0.32	0.98	0.92	0.72	0.88	0.78±0.24(0.32-0.98)

to the higher surface area of finer fractions of the sediment more organic carbon adsorbed by the finer sediment. Although, texture of the sediment was not determine in the present study, but by the visual observation, it was observed that clay content was more in the sediment of study area. So sediment has greater capacity to absorbed organic carbon and the heavy metals. The total nitrogen was maximum at S4 (near watch tower) with minimum CN ratio, it was due the this site covered by higher plants and lot of litter was produced. Phosphorus was found maximum at the SS5 (drain no. 8 downstream of wetland outlet). Study area also received the runoff from the surrounding area in the rainy season and agricultural runoff from agricultural activities is also a kind of sources to contribute wetland pollution. Mitsch and Gosselink (2000) also stated that if drainage is from agricultural fields, higher concentrations of nutrients might be expected. Jordan *et al*. (2003) also stated that throughout the world, fluvial discharges of nutrients have increased due to increasing fertilizer applications to crop lands.

A comparison with Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (2002) for Interim freshwater was also made, indicating that there may be some ecotoxicological risk to benthic organisms in these sediments. Safe limit of heavy metal according to CSQG are Zn 123mg/kg, Cu 35.7 mg/kg, Pb 35 mg/kg, Cr 37.3 mg/kg and Cd 0.6 mg/kg. Whereas, the average values of these heavy metals in the study area were Zn 55.8 mg/kg, Cu 21 mg/kg, Pb 49.7 mg/kg, Cr 28.5 mg/kg and 0.78 mg/kg. In the study area Cd and Pb were found at higher side that the safe limit of given by CSQG.

Elemental analysis in macrophytic plants

The concentration of nitrogen varied from 0.728 in *Eichhornia crassipes* to 5.936% in *Salvania molesta*. Total phosphorus varied from 863 in *Eichhornia crassipes* to 2422 mg/kg in *Typha latifolia*. Total sodium, potassium, calcium and magnesium were found from 1200 (*Polygonum glabrum*) to 6800 (*Typha latifolia*), 1200 (*Eichhornia crassipes*) to 55600 (*Typha latifolia*), 28068 (*Lemna minor*) to 48153 (*Ipomea aquatic*) and 5043 (*Eichhornia crassipes*) to 21951 mg/kg (*Ipomea aquatic*), respectively. Iron and zinc varied from 85 in *Eichhornia crassipes* to 977 mg/kg in *Ipomea aquatica* and 50 in *Salvania molesta* to 197 mg/kg in *Eichhornia crassipes*, respectively, whereas mean and SD of these two metals were 365±315 mg/kg and 115±60.3 mg/kg, respectively. Copper was varied from 10.5 in *Polygonum glabrum* to 34 mg/kg in *Eichhornia crassipes* with mean and SD of 20.2±8.7 mg/kg (table 3). Other heavy metal like nickel, lead, total chromium and cadmium were not detected in these macrophytic plants.

It was concluded that *Eichhornia crassipes* is good

Table 3 : Elements in various macrophytic plants of Bhindawas wetland.

S. no.	Parameters	*Lemna minor*	*Eichhornia crassipes*	*Typha latifolia*	*Salvania molesta*	*Polygonum glabrum*	*Ipomea aquatica*	Mean ± S.D (Range)
1.	%age T. Nitrogen	1.432	0.728	2.321	5.936	1.176	0.934	2.09±1.96(0.728-5.936)
2..	T. Sodium (mg/kg)	1600	2000	6800	1600	1200	6400	3266±2597(1200-6800)
3.	T. Potassium (mg/kg)	2600	1200	55600	24000	12000	4800	16700±20829(1200-55600)
4.	T. Calcium (mg/kg)	28068	35323	29304	28733	31236	48153	33469±7654(28068-48153)
5.	T. Magnesium (mg/kg)	13641	5043	12852	10065	14088	21951	12940±5543(5043-21951)
6.	Phosphorus (mg/kg)	1638	863	2422	1981	1265	1216	1564±568(863-2422)
7.	Iron (mg/kg)	288	85	188	373	280	977	365±315(85-977)
8.	Zinc (mg/kg)	173	197	120	50	95	56	115±60.3(50-197)
9.	Copper (mg/kg)	27	34	19	14.5	10.5	16.5	20.2±8.7(10.5-34)
10.	Nickel (mg/kg l)	ND	ND	ND	ND	ND	ND	——
11.	Lead (mg/kg)	ND	ND	ND	ND	ND	ND	——-
12.	T. Chromium (mg/kg l)	ND	ND	ND	ND	ND	ND	——-
13.	Cadmium (mg/kg)	ND	ND	ND	ND	ND	ND	——-

ND: Not detected.

accumulator for zinc and copper, while *Ipomea aquatica* is excellent absorber of calcium and magnesium. *Salvania molesta* is found reach in potassium. The study revealed that *Eichhornia crassipes*, *Polygonum glabrum* and *Ipomea aquatica* were contain the lowest amount of 7.2 g/kg, 9.3 g/kg and 11.7 g/kg of nitrogen respectively, a value lower than the growth limiting value of 13 g/kg as established by Gerloff (1975). Nitrogen is the basic nutrient and makes up 1-4% of body weight of plants and it forms chlorophyll, amino acids, proteins, alkaloids and protoplasm. In the plant sap ammonia, nitrates and nitrites are found only in traces or very small quantities. The concentration of P in the examined plants was higher than the critical lower growth limit of 1000 mg/kg prescribed by Gerloff (1975) except *Eichhornia crassipes*. This indicates that P was not limiting the growth of the investigated plants. The present study revealed that the average value of potassium was 16700 mg/kg or 1.6% in the different microphytes. Where the critical limit according to the Gupta (2000) was below 0.2%. Although, the potassium concentration in *Eichhornia crassipes* was 0.12%, which come under the critical level. Calcium average in the macrophytes was 33469 mg/kg or 3.3% . The critical limit for calcium is 0.2% (Gupta, 2000).

Similar study on heavy metal in 45 macrophyte was conducted by Vardanyan and Ingole (2006). They observed the accumulation of 14 elements was in order of Ca>Mg>Fe>Al>Mn>Ba>Zn>Ti>Cu>Cr> Co>Ni>Pb >Cd. While in the present study whole plants were taken for the metal analysis. The accumulation of 11 elements in present study was in order of Ca>K>Mg>Na>Fe>Zn >Cu, where the Ni, Pb, Cr and Cd were not detected in the macrophytes in Bhindawas wetland.

Conclusion

Water quality of the wetland showed the variation. Dissolved oxygen level was maximum at water inlet. Water quality of drain no. 8 was more degraded than wetland and improved by the dilution from the wetland outlet. Ionic concentration was minimum at the water inlet of wetland. Phosphate level in water remains higher side at all the sites, which make the wetland hypereutrophic in nature. Most of the parameters were below the permissible limit given by BIS except turbidity. Sediment study revealed that Cd and Pb were found at higher side that the safe limit of given by CSQG. Nickel, lead, total chromium and cadmium were not detectable amount in the macrophytic plants.

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