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ASSESMENT OF SURFACE WATER QUALITY DURING MONSOON AND POST- MONSOON SEASON OF RUPAHI BEEL OF NAGAON DISTRICT, ASSAM, INDIA

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ABSTRACT

The Wetland in India support subsistence and livelihood to thousands of people through fishing, collecting edible plants, agriculture, irrigation, water transport and commercial fisheries, besides rich biodiversity. In the present study, 20 water samples were collected from 20 sampling stations during Monsoon (June to Aug-2009) and post-monsoon (Sept. to Nov.-2009) season. The relevant parameters such as Temp., pH, TSS, TDS, DO, free CO_2, alkalinity, hardness, chloride, sulphate, phosphate and heavy metals (Mn, Co, Zn, Fe, Cu, Ni, Cr, Cd) were analyzed for water samples by various standard methods.

Key words: Rupahi Beel, Wetland, Seasonal variation, Heavy metals, Biodiversity, Conservation.

INTRODUCTION

The term wetland comprises a broad category of water bodies which include riverine floodplains, swamps, marshes, estuaries, backwaters, lagoons and so on. The Wetlands in India support subsistence and livelihood to thousands of people through fishing, collecting edible plants, agriculture, water transport, irrigation and commercial fisheries, besides rich biodiversity. However, a significant change in their status has been apparent, of late, due to various natural, anthropogenic reasons and human activities. Hence rational management, conservation and careful monitoring of floodplain wetlands are needed to save this vital resource, their fishery, biodiversity, both in terms of biomass production and economic value.

With a view to this, the Rupahi Beel (Longitude $92.61^{//}$ E and Latitude $26.27^{//}$ N) situated at Rupahi under Samaguri revenue circle of Nagaon District (Assam) is chosen as

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the study area. The Beel is approximately 7 Km long and 0.5 Km wide covering an area of around 75 Ha[1]. The surroundings of the Beel are mainly covered by human habitat, agricultural lands etc. and local people uses the Beel for irrigation, bathing, washing clothes, feeding animals and often for drinking purposes. The beel have appeared to develop eutrophic conditions by water hyacinth and it also receives lots of agrochemicals, pesticides, herbicides etc. from the neighboring agrifields during rainy seasons. Hence a rational management, conservation and careful monitoring of this floodplain wetland has become essential.

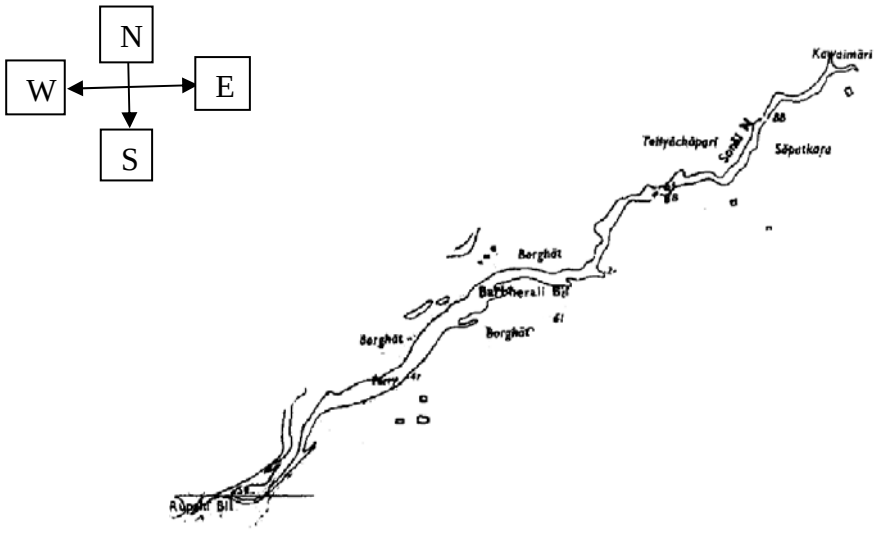

Fig. 1: Map of Rupahi Beel

EXPERIMENTAL

Materials and methodology

In the present study, twenty samples of water were collected from twenty different locations of Rupahi Beel (Longitude 92.61$^{//}$ E and Latitude 26.27$^{//}$ N) during monsoon and post-monsoon season. The water samples from each station are mixed to make a composite representative sample. For DO, water samples were trapped by adding $MnSO_4$ and KI solution. The samples for physical and chemical analysis were collected in pre-cleaned 2 L polyvinyl containers and brought to the laboratory for analysis. Necessary care was taken to prevent contamination of samples during transportation to the laboratory, storage and analysis[2].

Heavy metals for water were analyzed by using Atomic Absorption Spectrophotometer (Model Perkin-Elmer 2A Analyst 200, USA) at Gauhati University and NERIWALM (Tezpur).

RESULTS AND DISCUSSION

In any aquatic ecosystem, chemical and biochemical reaction rates becomes faster at higher temperature. The temp. of water ranges from 28^0C to 32^0C during monsoon and 19^0C to 22^0C during post-monsoon season.

The pH value of a natural water samples reflects the natural buffering by dissolved CO_3^{2-}, that originate either from the dissolution of atmospheric CO_2 or from the weathering of carbonaceous rocks in the stream catchments[3]. The pH of water determines the solubility and biological availability of chemical constituents such as nutrients and heavy metals. The value ranges from 6.51 to 7.03 (towards basic) during monsoon and 6.66 to 7.06 during post-monsoon season.

The TSS concentration for optimum fish growth are not known but levels in the range of 80 mg/L to100 mg/L is considered, the maximum fish can tolerate on continuous exposure basis if gill damage to be prevented[4] . Maximum concentration reduces sunlight for photosynthesis by bottom vegetation, reduce food for predators, clogging of gills and filter, reduce survival for eggs and young. The TSS concentration varied from 10 to 25 mg/L during monsoon and 10 to 34 mg/L during post-monsoon season.

TDS show the concentration of salts/ions in water. Its concentration varied from 52 to 81 mg/L during monsoon and 66 to 90 mg/L during post-monsoon seasons.

Free CO_2 in water accumulates due to microbial activity and respiration of organisms. Free CO_2 values are considered to be of little significance in assuming production of water[5]. Free CO_2 concentration in Beel are different in different locations due to high and low populations of primary producers (phytoplankton and aquatic macrophytes). Its value ranges from 17.0 to 29.1 mg/L during monsoon and 11.0 to 17.6 mg/L during post-monsoon season.

Alkalinity of water is its capacity to neutralize a strong acid and is characterized by the presence of all hydroxyl ions capable of combining with the hydrogen ions. Alkalinity in neutral water is due to free hydroxyl ions and hydrolysis of salts formed by week acids and strong bases such as carbonates and bicarbonates. The values were found to be 98 to 108 mg/ L in monsoon and 100 to 112 mg/ L in post-monsoon season.

The chemical and biochemical processes undergoing in the water body are largely dependent upon the presence of oxygen[6]. The DO value of at least 5 mg/L is essential for proper growth of coldwater fishes[4]. Ohle[7] reported harmful effects on fishes if oxygen level was below the normal range while Nees[8] reported high oxygen level to be harmful. Ellis[9] observed that DO level below 3 pp min water causes asphyxia and for high fauna a minimum of 5 ppm of DO is essential for optimum growth. The DO level were found to be from 8.23 to 9.84 mg/L during monsoon and 7.81 to 9.64 mg/L during post-monsoon season. The variation may be due to large coverage of water body by water hysenth.

Chloride is toxic to fresh water life at high levels. In fresh water its concentration remains quite low. However, concentration above 150 mg/L are toxic to crops and generally unsuitable for irrigation[10]. The chloride content in the Beel water varied from 7.25 to 9.52 mg/L in monsoon and 8.56 to 10.36 mg/L in post-monsoon season.

Sulphate is the naturally occurring anion found almost in all kinds of water bodies. It may undergo transformations to sulphur or hydrogen sulphide depending largely on the redox potential of the water. It is also an important anion imparting hardness to the water. The concentration of sulphate varied from 11.82 to 13.72 mg/L in monsoon and 12.52 to 14.24 mg/L in post-monsoon season.

The phosphate is generally considered as the critical nutrient for the growth of algae in water. The enrichment of this nutrient leads to the process of eutrophication. The presence of high phosphate concentration is harmful for fish and aquatic life and also harmful for plant growth since they affect the water absorption indirectly and other metabolic process of the plants[2]. The most important sources of phosphates are the discharge of domestic sewage, detergents and agricultural run-off. The phosphate content varied from BDL to 0.13 mg/L during monsoon and BDL to 0.23 mg/L during post-monsoon season.

The major cations imparting hardness are the calcium and magnesium. Hard water was more productive than soft water[11-14]. It is to be noted that hardness content less than 80 mg/L in Beel is not good for pisciculture[3]. The hardness of water was found to be 145 to 163 mg/L in monsoon and 153 to 171 mg/L in post-monsoon season.

Manganese (Mn) causes organic growth. It is one of the important trace elements essential for organism. The BIS standard is 0.1 mg/L. Mn^{2+} ions are soluble in water and with aeration of water, the form manganese dioxide, which have unpleasant taste as well as colour. The concentration of manganese varied from 0.109 to 0.746 mg/L in monsoon and 0.131 to 0.757 mg/L in post-monsoon season.

The concentration of cobalt (Co) varied from 0.109 to 0.228 mg/L in monsoon and 0.148 to 0.268 mg/L in post-monsoon season.

Zinc (Zn) when present above permissible limit of 0.5 mg/L imparts unpleasant taste to drinking water[16]. Symptoms of Zn toxicity include irritability, muscular stiffness, loss of appetite and nausea. The Zn content is found to be 1.321 to 4.502 mg/L in monsoon and 2.332 to 4.542 mg/L in post-monsoon season. It is not safer for drinking as well as irrigation in the garden areas.

Iron (Fe) is an essential trace element to both animals and plants. Iron may be in the dissolved state or in a colloidal state that may be peptized by organic matter. The BIS and WHO limit in drinking water is 0.3 mg/L in natural water. Water containing iron at a concentration greater than 2.0 ppm causes straining of clothes and plumbing fixtures and impart bad taste and colour to water[6]. Normally iron is only slightly toxic but excessive intake can cause siderosis and damage to organs through excessive iron storage[17]. The iron content is found to be 0.099 to 2.243 mg/L in monsoon and 0.483 to 2.228 mg/L in post-monsoon season. Its concentration is within the limit.

Copper (Cu) is one of the essential elements for humans. The daily requirement for an adult is about 2.0 mg/L. Excess of Cu can cause Wilson's disease. Cu is very toxic to most plants, highly toxic to invertebrates, moderately to the mammals[17]. The range of Cu is found to be BDL to 0.015 during monsoon and 0.041 to 0.184 mg/L during post-monsoon season.

Nickel (Ni) is an essentially trace element. It is very toxic to most plants and moderately to mammals[17]. It may enter water body by industrial wastes. The range of Ni is found to be BDL to 0.106 mg/L in monsoon and 0.041 to o.144 mg/L in post-monsoon season.

Chromium (Cr) is an essential trace metal for animals and humans but essentiality of Cr for plants as a trace element is still disputed. Dissolved concentrations in unpolluted lakes and rivers generally vary from 1-2 g/L as compared to 0.05 to 0.5 g/L in marine water. Hexavalent Cr causes membrane damage, ultra structural changes in cell organelles, impaired metabolic activities and growth retardations. Hexavalent and tetravalent Cr has carcinogenic properties[18].

Cadmium (Cd) is a soft metal and its low concentration is quite toxic to human health. The BIS and WHO limit is 0.01 mg/L in drinking water. The Cd content varied from BDL to 0.024 mg/L in monsoon and 0.026 to 0.056 mg/L in post-monsoon season. This value reflects unhealthy sign of water quality.

Table 1: Physico-chemical parameters of water of Rupahi Beel (Monsoon)

S. No.	Temp. °C	pH	TSS mg/L	TDS mg/L	Free CO_2 mg/L	Alk. mg/L	DO mg/L	Cl^- mg/L	SO_4^{2-} mg/L	PO_4^{3-} mg/L	Hardness mg/L
W 1	30	6.46	12	70	25.6	105	8.82	7.25	13.14	0.05	151
W 2	29	7.02	10	81	24.6	104	9.84	8.24	12.26	0.08	154
W 3	28	6.25	25	60	24.8	102	8.61	9.36	13.08	BDL	151
W 4	31	6.14	24	56	18.5	102	8.72	8.47	11.82	0.11	154
W 5	31	6.72	15	68	17.0	106	8.85	9.18	12.64	0.13	153
W 6	31	6.47	22	60	27.4	99	8.43	9.14	13.52	0.09	146
W 7	32	6.60	23	61	29.1	101	8.92	8.92	13.26	0.12	150
W 8	29	7.02	24	58	25.3	102	8.86	9.34	13.18	0.07	145
W 9	30	6.51	22	60	26.4	102	8.72	9.22	13.32	0.10	152
W 10	30	6.68	16	65	26.4	104	8.64	9.25	13.24	0.06	152
W 11	29	6.59	14	61	27.5	108	8.63	9.36	13.37	0.08	162
W 12	29	6.65	12	65	26.3	98	8.52	9.15	12.45	BDL	163
W 13	29	6.72	17	62	27.2	101	8.82	9.28	12.71	BDL	154
W 14	29	7.02	20	61	23.9	100	8.94	9.36	12.56	BDL	147
W 15	29	7.03	20	56	24.9	101	8.56	9.24	12.48	0.10	163
W 16	29	7.02	24	52	26.6	99	8.81	9.52	12.63	0.07	162
W 17	29	6.48	21	60	22.8	99	8.23	9.14	12.81	0.04	152
W 18	30	6.81	21	58	28.6	98	8.32	9.26	13.24	BDL	155
W 19	30	6.72	21	57	26.9	102	8.46	9.14	13.72	BDL	152
W 20	30	6.66	22	62	26.4	98	8.43	9.27	13.16	BDL	154
Min.	28	6.51	10	52	17.0	98	8.23	7.25	11.82	BDL	145
Max.	32	7.03	25	81	29.1	108	9.84	9.52	13.72	0.13	163
STD	0.978	0.257	4.58	6.175	3.003	2.781	0.334	0.520	0.475	4.483	5.529

BDL: Below Detectable Limit; Min: Minimum; Max: Maximum; STD: standard Deviation

Table 2: Physico-chemical parameters of water of Rupahi Beel (Post-monsoon)

S. No.	Temp. ^{o}C	pH	TSSm g/L	TDS mg/L	Free CO_2 mg/L	Alk. mg/L	DO mg/L	Cl^- mg/L	SO_4 mg/L	PO_4^{3-} mg/L	Hardness mg/L
W 1	20	6.66	20	80	17.6	106	8.42	8.56	14.08	0.13	160
W 2	21	7.03	10	90	17.6	107	9.64	8.57	13.24	0.13	164
W 3	21	7.04	30	70	17.6	106	8.16	9.94	13.56	BDL	158
W 4	22	6.69	34	66	12.3	108	8.42	9.18	12.52	0.13	164
W 5	19	7.02	20	80	11.0	110	8.41	9.52	13.61	0.23	162
W 6	19	6.67	26	74	17.4	104	8.06	9.34	14.24	0.21	153
W 7	21	7.00	28	72	17.2	108	8.63	9.42	13.86	0.15	157
W 8	22	7.02	30	70	16.4	108	8.66	10.36	13.64	0.12	155
W 9	20	7.01	25	75	16.2	107	8.52	9.81	13.91	0.14	162
W 10	20	6.98	22	78	16.2	110	8.34	9.61	13.81	0.11	160
W 11	20	6.98	23	77	16.5	112	8.35	9.86	13.85	0.12	168
W 12	21	6.99	18	82	16.2	100	8.22	9.81	13.24	BDL	168
W 13	21	6.98	20	80	17.1	104	8.64	10.14	13.46	BDL	158
W 14	21	7.04	26	74	17.09	104	8.67	10.17	12.94	0.13	156
W 15	22	7.06	25	75	17.09	104	8.16	9.86	12.92	0.14	171
W 16	22	7.06	31	69	16.6	102	8.43	9.91	13.22	0.11	168
W 17	22	6.99	28	72	16.8	103	7.92	9.54	13.42	0.10	162
W 18	20	6.98	27	73	16.8	103	7.81	9.84	14.05	BDL	164
W 19	20	7.02	26	74	16.8	106	7.91	9.63	14.02	BDL	160
W 20	20	7.01	28	72	16.4	104	8.04	9.82	13.63	BDL	162
Min.	19	6.66	10	66	11.0	100	7.81	8.56	12.52	BDL	153
Max.	22	7.06	34	90	17.6	112	9.64	10.36	14.24	0.23	171
STD	0.978	0.126	5.441	5.441	1.685	3.001	0.397	0.465	0.446	0.036	4.772

BDL: Below Detectable Limit, Min: Minimum, Max: Maximum, STD: Standard Deviation

Table 3: Heavy metal content in Beel water (Monsoon)

Sample No.	Mn mg/L	Co mg/L	Zn mg/L	Fe mg/L	Cu mg/L	Ni mg/L	Cr mg/L	Cd mg/L
W 1	0.746	0.202	4.132	2.234	0.024	0.106	BDL	0.024
W 2	0.246	0.218	4.502	1.053	0.327	0.103	BDL	0.014
W 3	0.109	0.215	1.143	0.583	0.020	0.025	BDL	BDL
W 4	0.162	0.192	1.321	1.032	0.015	0.018	BDL	BDL
W 5	0.233	0.131	2.732	1.026	BDL	0.017	BDL	0.012
W 6	0.220	0.142	2.830	1.224	0.025	0.029	BDL	BDL
W 7	0.303	0.109	2.884	1.023	0.032	0.022	BDL	0.014
W 8	0.181	0.142	3.106	1.242	0.045	0.032	BDL	0.024
W 9	0.280	0.185	3.415	1.452	0.032	0.012	BDL	0.018
W 10	0.315	0.176	4.056	1.158	0.025	0.041	BDL	0.014
W 11	0.128	0.164	4.301	1.036	0.022	0.032	BDL	0.014
W 12	0.125	0.184	4.122	0.428	0.035	0.062	BDL	BDL
W 13	0.118	0.133	2.916	0.254	0.016	0.033	BDL	0.012
W 14	0.227	0.128	2.824	0.099	0.023	0.024	BDL	0.016
W 15	0.242	0.136	2.734	0.104	0.027	0.012	BDL	0.012
W 16	0.208	0.201	2.266	0.626	0.028	0.013	BDL	BDL
W 17	0.293	0.228	3.827	1.206	0.042	BDL	BDL	0.021
W 18	0.257	0.130	3.631	1.423	0.025	BDL	BDL	0.017
W 19	0.232	0.123	3.551	1.085	0.023	0.013	BDL	BDL
W 20	0.245	0.118	3.684	1.246	BDL	0.014	BDL	0.024
Min.	0.109	0.109	1.321	0.099	BDL	BDL	BDL	BDL
Max.	0.746	0.228	4.502	2.234	0.015	0.106	BDL	0.024
STD	0.133	0.037	0.914	0.510	0.071	0.028	-----	0.004

BDL: Below Detectable Limit, Min: Minimum, Max: Maximum, STD: Standard Deviation

Table 4: Heavy metal content in Beel water (Post-monsoon)

Sample No.	Mn mg/L	Co mg/L	Zn mg/L	Fe mg/L	Cu mg/L	Ni mg/L	Cr mg/L	Cd mg/L
W 1	0.757	0.221	4.177	2.334	0.184	0.144	BDL	0.056
W 2	0.256	0.275	4.542	1.151	0.077	0.144	BDL	0.040
W 3	0.131	0.245	1.172	0.692	0.052	0.055	BDL	0.026
W 4	0.175	0.224	1.350	1.235	0.055	0.058	BDL	0.028
W 5	0.253	0.181	2.778	1.268	0.044	0.048	BDL	0.040
W 6	0.228	0.182	2.877	1.680	0.065	0.089	BDL	0.027
W 7	0.322	0.145	2.934	1.365	0.096	0.081	BDL	0.051
W 8	0.312	0.196	3.145	1.945	0.105	0.067	BDL	0.055
W 9	0.304	0.221	3.445	2.142	0.096	0.046	BDL	0.048
W 10	0.365	0.212	4.116	2.188	0.122	0.131	BDL	0.034
W 11	0.188	0.202	4.332	2.066	0.087	0.130	BDL	0.035
W 12	0.166	0.211	4.156	1.089	0.109	0.142	BDL	0.029
W 13	0.142	0.183	2.956	0.995	0.056	0.103	BDL	0.043
W 14	0.267	0.168	2.864	1.105	0.083	0.101	BDL	0.046
W 15	0.262	0.175	2.786	1.190	0.067	0.055	BDL	0.041
W 16	0.244	0.223	2.332	1.262	0.078	0.065	BDL	0.029
W 17	0.331	0.268	3.867	2.109	0.122	0.041	BDL	0.043
W 18	0.318	0.166	3.673	2.228	0.104	0.048	BDL	0.047
W 19	0.290	0.168	3.611	2.086	0.057	0.054	BDL	0.028
W 20	0.289	0.148	3.734	1.986	0.045	0.062	BDL	0.053
Min.	0.131	0.148	2.332	0.483	0.044	0.041	BDL	0.026
Max.	0.757	0.268	4.542	2.228	0.184	0.144	BDL	0.056
STD	0.130	0.036	0.915	0.514	0.033	0.036	------	0.009

BDL: Below Detectable Limit, Min: Minimum, Max: Maximum, STD: Standard Deviation

CONCLUSION

The experiment result reveals that most of the water quality parameters are within the tolerance level as prescribed in IS 2296. However, TDS and DO values in some location are not so good for fish as well as aquatic life. This may be due to washing clothes and other activities by local people and many parts are covered by waterhycent. The concentrations of heavy metals are not negligible. The order of their content are Zn > Fe > Mn > Co > Cu = Ni > Cd > Cr.

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