

Surface Water Quality in Rajshahi City

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Abstract: In Bangladesh, water pollution is one of the crucial issues for concern. Various scientific reports are indicating that in most parts of the country, ground water is polluted with deadly poison i.e. arsenic. To avoid arsenic contamination, suggested alternative for drinking water is surface water. Therefore, qualitative analysis of surface water is essential. This study is an attempt to analyze some dimensions of surface water quality in Rajshahi City. On the basis of sample analysis it can be said that the surface water of Rajshahi City is not free from other (excluding arsenic) pollutions.

Introduction

The participants on the 1st World Water Forum in Marrakech in 1997 called for a World Water Vision to increase awareness of the water crisis throughout the population and to develop a widely shared plan for bringing about sustainable use and development of water resources (Gallopin & Rijsberman, 2003). Water pollution is one of the common obstacles to achieve the stated objective. All the water bodies even sea, rivers, ponds, canals and underground water are polluted. There are many settlements, cities, jute mills, textiles, sugar mills, tanneries etc on the bank of the water bodies such as ponds, rivers etc, so these settlements and industries release tons of waste in the water bodies directly or through the canals.

The water of Rajshahi City is being polluted through various ways. Toxic and harmful germs are present in the water of the city. Also the level of arsenic is above the human acceptable limit (0.05 mg/l) in various locations of shallow sub-surface water (Rahman,2002, Ghosh,2004). All the surface water bodies are linked with drains which are connected with most of the latrines and waste discharge canal of houses. Beside these, there are 149 industries in the BSIC industrial area of Rajshahi City. From these industries, waste discharges into the surface water. As a result, all the sources of surface water are being polluted by the released wastes. In addition to that insecticides, chemical fertilizers, cow

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dung etc are being used for fish cultivation that also increases the pollution level of surface water of the study area.

Objectives of the study

The main objective of the study is to provide some information about physical, chemical and biological properties of surface water in the study area.

The specific objectives are:

To determine the level of pollutant;

To identify the possible effects of water pollution.

Study area

Rajshahi City-corporation is one of the six city-corporations located in the north-west part of Bangladesh. It lies between $24^{\circ}21'$ and $24^{\circ}26'$ north latitudes and between $88^{\circ}28'$ and $88^{\circ}37'$ east longitudes. The city is bounded on the east, north and west by Paba thana and on the south by the Padma river and the shape of the city is as like an inverted "T" with an area of about 47.78 sq. km (RCC). The maximum length along east-west direction is about 13 km and along north-south is 8 km.

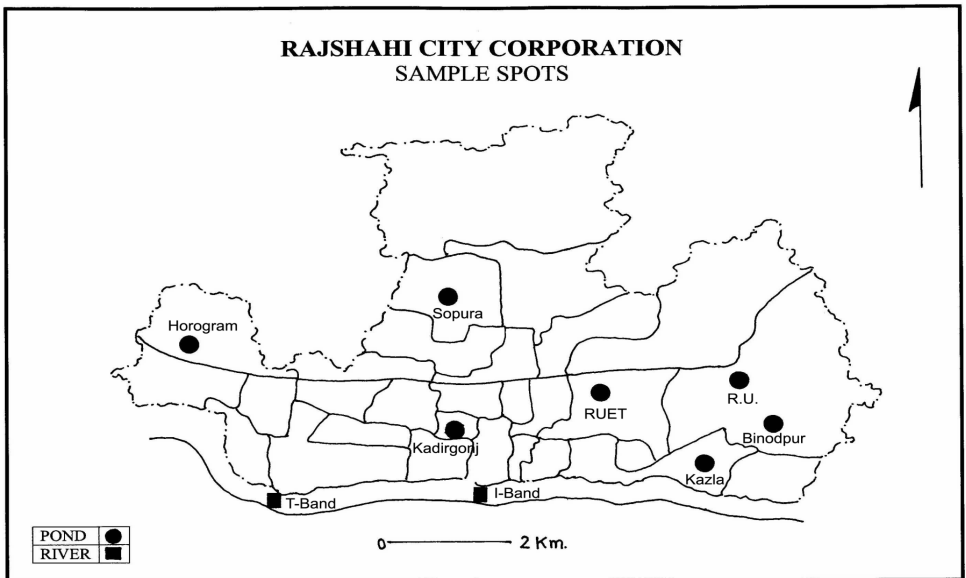


Figure 1.

Methodology

To measure the actual level of surface water pollution, samples were collected from purposely selected nine spots (seven from ponds and two from the river Padma) and were analyzed in the different laboratories of the department of Botany, Chemistry and Bio-chemistry in Rajshahi University Campus and in the laboratory of Public Health Engineering Department (DPHE), Rajshahi. Sample ponds are located at Rajshahi University of Engineering & Technology (RUET), Kajla, Kadirgonj, Horogram, Rajshahi University Campus (RU), Binodpur and Sopura and river spots are T-band and I-band (Fig-1). Monthly surface water reports are made from the laboratory analysis of collected water samples. Simple cross-table analysis is adopted for most of the elaboration.

Sources of water pollution and selected parameters for the study

Due to lack of awareness as well as the absence of strong punitive actions, the practice of circulating waste and effluent into water bodies including ponds, canals, creeks and rivers still remains widespread (Junaid and others). Pollution is also caused when silt and other suspended solids, such as soil, wash off ploughed fields, construction and logging sites and eroded pond banks when it rains. The substances, which degrade the quality of water is called water pollutant which causes water pollution. Pollutants are included into the water from various sources. The sources are usually two kinds (Singh, 1991):

1. Natural sources and
2. Anthropogenic sources

Natural sources of water pollutants in the study area include soil erosion and decomposition of plant and animal bodies. Excessive soil erosion in the surrounding area of ponds and catchments area of the Padma increases the sediment load as well as turbidity of water. On the other hand, the anthropogenic sources of water pollution included industrial sources, agricultural sources and urban sources. However the present paper deals with a total of thirteen parameters of water pollution. These are shown in table-1.

Table-1: Parameters of the measurement of water quality

Physical Parameters	Water Temperature in $^{\circ}\text{C}$ (WT) ,Transparence in cm (Trans),Total suspended Solid in mg/l (TSS), Total Dissolved Solid in mg/l (TDS), Electric Conductivity in μ ohm/cm (EC)
Chemical Parameters	Carbon-di-oxide in mg/l (CO_2) ,Dissolved Oxygen in mg/l (DO),Bi-carbonate in mg/l (HCO_3), Chloride in mg/l (Cl), Total Hardness in mg/l (TH), P^{H} value.
Biological Parameters	Phytoplankton in cell/l (Phy), Zooplankton in cell/l (Zoo).

Level of water pollution

The water of the study area is not equally polluted by the all parameters. Pollution level varies from place to place and time to time. Such as the annual mean temperature of water of all spots were within permissible limit (within 25-30^oc) but monthly mean temperature varies from month to month (Table: 2-10). On the other hand the annual mean transparency of water found within permissible (more than 25 cm) limit in RUET, Kadirgonj, Binodpur, Sopura, T-band and I-band and rest of the spots were not free from turbidity pollution. Besides the surface water was free from turbidity pollution for approximately six months (May - October) and rest of the month of the year were polluted. In the case of TSS, all the spots contained more than permissible limit (5 mg/l), such as RUET, Kajla, Kadirgonj, Horogram, Rajshahi University Campus, Binodpure, Sopura, T-band and I-band. In the similar way the annual mean TDS of the entire pond's water of the study area was more than permissible level (higher than 500 mg/l) but river water was in this level. The acceptable level of CO₂ in water is less than 50mg/l which was within this limit in all spots of the study area. Again DO was not found in satisfactory level (4-6 mg/l) in all the spots except Rajshahi University Campus, T-band and I-band. On the other hand, the level of HCO₃ contamination in surface water was in acceptable level (within 600 mg/l). Beside this, the surface water of the study area was free from excess chloride contamination because it was found within acceptable limit (less than 600mg/l) in all spots. Again TH was found within 450mg/l that means the surface water of the study area was free from excess TH contamination. At the same EC was in suitable level (50-1500 μ ohm/cm) in all spots of the study area. Also the surface water of the study area was free from P^H pollution because it was within acceptable level (6.5-9.2). The presence of phytoplankton and zooplankton in the water is harmful for human beings and some times for aquatic life. So it may be said that the surface water of the study area was polluted by these parameters for round the year.

Table-2 Pond's water analysis report (RUET) – 2002

Month	WT	Trans	TSS	TDS	CO ₂	DO	HCO ₃	Cl	TH	EC	P ^H	Phy	Zoo
January	19.7	43.8	100	660	4	1.8	191.5	90.2	126	399.12	8.2	15333	1332
February	24	40.5	75	432	5	1.54	110	31.24	112	347.1	8	2200	2666
March	30.5	26.5	95	495	13.5	2.2	98.5	144.1	194	606.2	8.6	7000	3999
April	29	25.7	40	295	5	1.4	85	41.2	84	362.9	8.5	7333	5333
May	30	22	90	150	12	3.84	93	106.3	88	370.1	8.2	6666	2000
Jun	34	23	140	1880	-	1.9	66	149.1	56	283.4	7.9	13333	4667
July	34.5	33.3	50	280	-	3.3	74	133.5	94	226.6	9	63333	2667
August	30.7	34.8	65	640	19	0.93	33	154.1	136.6	153	8.8	18334	4000
September	30.3	30.8	160	1025	50	0.42	66	285.4	164	129.5	8.8	18667	4666
October	31.1	43.5	73	1345	8.3	0.73	54.3	141.6	122	230.6	8.5	37333	1333
November	27	22.5	110	1080	10	2.02	75	231	108	263.9	8.1	77334	2666
December	21.4	35.7	140	1320	2.7	2.52	99.7	154.8	121.3	285.6	8.4	52000	4000
Mean	28.5	31.8	96.9	825.2	12.21	1.88	87.16	137.1	117.2	304.9	8.5	28222	3277

Table-3 Pond's water analysis report (Kajla) – 2002

Month	WT	Trans	TSS	TDS	CO ₂	DO	HCO ₃	Cl	TH	EC	P ^H	Phy	Zoo
January	19.5	24.8	105.0	1140	12	0.61	180	120.0	158.0	487.4	7.7	55000	3333
February	23.0	14.5	30.0	1100	4	2.6	192	62.5	180.0	612.22	8.1	92000	2000
March	27.8	14.3	20.0	880	10.5	2.7	166.5	82.4	158.0	640.8	8.1	58000	2666
April	25.5	8.0	90.0	975	9	1.5	153.0	65.32	140.0	573.12	8.4	10666	2000
May	31.0	28.5	40.0	1075	3	0.91	225.0	113.6	152.0	731.03	8.2	9333	2000
Jun	33.0	38.0	110	1160	4	0.6	168.0	137.7	124.0	531.33	7.6	114666	4000
July	33.5	23.5	70	600	35	3.32	206.0	161.9	113.0	383.5	9.0	114666	4333
August	32.0	34.8	40	640	6.5	1.9	39.5	143.4	104.0	203.6	8.6	49333	4666
September	33.0	30.0	340	240	9	0.63	72.0	308.14	128.0	246.59	8.7	39334	666
October	30.2	24.13	58	540	19.8	1.8	87.8	117.9	175.0	467.6	8.2	34166	5499
November	26.0	23.0	70	640	27	1.54	149.0	133.5	184.0	537.9	8.1	10666	666
December	21.7	29.0	100	480	11	2.81	162.7	167.6	190.7	541.6	7.6	20222	2444
Mean	28.2	28.4	63.58	789.2	12.6	1.74	141.8	134.5	150.6	496.39	8.2	50671	2689

Table-4 Pond's water analysis report (Kadirgonj) – 2002

Month	WT	Trans	TSS	TDS	CO ₂	DO	HCO ₃	Cl	TH	EC	P ^H	Phy	Zoo
January	19.6	28.5	55	500	6.0	0.69	286.5	119.9	234.0	179.1	7.8	19600	7999
February	18.5	16	85	1320	5.0	0.35	314.0	116.4	238.0	1038.2	8.2	5333	4000
March	27.7	16.5	102	206	-	1.98	254.0	214.5	326.0	1262.7	8.8	1400	999
April	25.1	17	90	1220	-	2.03	110.0	275.5	378.0	975.5	8.6	8667	2666
May	32.5	30.5	20	300	6.0	1.33	301.0	231.5	140.0	1151.2	8.4	29334	4666
Jun	33	31	30	160	-	0.3	340.0	257.0	280.0	1267.6	7.9	13333	4000
July	30.1	28	60	760	-	1.95	248.0	242.8	161.0	598.7	8.9	19001	4666
August	30.5	32	160	1750	9.0	0.4	105.0	254.2	176.0	262.4	8.9	6889	1666
September	29	23.9	70	750	8.0	0.98	117.0	252.8	208.0	542.5	8.7	112666	2000
October	29.5	25.9	100	850	14.3	0.3	101.5	176.1	206.0	600.6	8.3	107333	1333
November	24.1	32.5	80	960	33	1.39	211.0	218.7	200.0	827.8	7.5	5800	666
December	19.9	33.3	123	1587	9.5	0.84	145.0	214.4	205.3	848.9	8.1	149999	1555
Mean	26.6	27.5	81.3	863.6	7.56	1.05	211.1	214.5	229.1	852.9	8.3	62363	3018

Table-5 Pond's water analysis report (Horogram) – 2002

Month	WT	Trans	TSS	TDS	CO ₂	DO	HCO ₃	Cl	TH	EC	P ^H	Phy	Zoo
January	18.6	21.3	115	220	12	0.24	321.5	93.7	192	748.6	7.8	196000	7999
February	18	15.5	30	1250	3	1.75	264	110.7	224	824.3	8.3	5333	4000
March	25	18	100	1100	10	1.33	187.5	185.3	232	906.6	8.7	14000	999
April	22	22	40	975	16	0.77	121	235.7	196	8059	8.6	8667	2666
May	32.1	27	20	1705	-	0.21	402	301.0	192	1038.8	8.2	29334	4666
Jun	31	14.5	90	450	3	0.3	354	245.7	140	905.5	7.5	13333	4000
July	30.5	21.5	80	520	19	0.14	225.5	212.3	230	418.6	8.6	19001	4666
August	30	26.5	45	370	45.5	0.28	99	198.11	160	330.2	8.6	86889	1666
September	29	29.5	80	600	16	0.3	140	173.24	180	280.6	8.6	112666	2000
October	28.6	27.4	48	473	16.8	0.31	87.5	132.7	173	541.3	8.3	107333	1333
November	24	24.5	60	680	25	0.56	192	272.4	212	693.3	8.2	5800	666
December	19.5	27.5	180	440	16	0.54	275.7	172.8	200	741.4	8.4	149999	1555
Mean	24.8	22.9	74	733.6	16.6	0.56	22.5	194.5	194.3	694.6	8.3	62362	3018

Table-6 Pond's water analysis report (Rajshahi University Campus) – 2002

Month	WT	Trans	TSS	TDS	CO ₂	DO	HCO ₃	Cl	TH	EC	P ^H	Phy	Zoo
January	14.75	18.65	100	770	8.5	5.16	317.5	105.08	215	893.41	8.45	100666	2735
February	20.75	16	66	728	1.5	7.04	259	162.63	275	793.48	8.35	9666	1452
March	23.87	17.5	85	1160	5	5.04	148.75	230.4	305	941.07	8.7	11333	2531
April	29.6	26.25	30	637.5	11	4.29	211	233.61	168	978.58	8.8	19000	3175
May	32.5	29	25	932.5	-	3.49	371	279.1	236	1153.28	8.85	21333	3875
Jun	30.1	21.25	75	605	1.5	2.82	301	244.26	150.5	1204.85	9.05	16167	4256
July	31.25	24.75	120	1135	14	2.65	165.25	233.25	203	340.5	8.4	52945	4302
August	32	29.25	57.5	560	26.5	2.65	108	225.45	184	436.35	8.6	99777	3999
September	31.5	26.7	90	725	25.15	3.81	120.75	174.67	192	480.6	8.15	109999	997
October	28.5	26.6	64	716.5	24.6	3.66	149.15	175.7	186	684.55	8.15	56566	1574
November	23.45	28.5	91.5	1133.5	17.25	4.88	160.5	243.4	208.65	776.11	7.8	77899	1238
December	21.75	30.4	117.5	470	11	3.62	181.1	146.35	217	760.26	8.3	172999	2237
Mean	26.57	24.57	76.79	797.75	11.33	4.09	216.08	204.49	211.67	986.92	8.46	62363	2698

Table-7 Pond's water analysis report (Binodpur) – 2002

Month	WT	Trans	TSS	TDS	CO ₂	DO	HCO ₃	Cl	TH	EC	P ^H	Phy	Zoo
January	17.25	34.3	102.5	900	8	3.21	185.75	105.2	142	443.37	8.4	35166	1332
February	21	27.5	52.5	766	4.5	5.06	151	46.87	146	479.6	8.35	57000	2333
March	23.25	20.4	57.5	687.5	12	3.32	132.5	113.25	176	623.5	8.55	32500	3332
April	28.85	16.9	65	635	7	4.67	119	53.26	112	468.04	8.85	8999	3666
May	32.5	25.25	65	612	7.5	3.84	159	109.95	120	520.58	8.6	7999	2601
Jun	30.65	30.5	225	152	-	4.78	117	148.42	90	407.36	9.15	63999	4333
July	31.55	28.4	60	440	17.5	2.37	90	147.7	103	305.05	8.5	88999	3500
August	32.0	34.8	52.5	640	12.75	2.19	36.25	148.76	117	178.3	8.5	33833	4333
September	30.25	30.4	25	632.5	34.5	1.67	69	296.77	146	188.06	8.3	29000	2666
October	28.25	33.81	65.5	942.5	14.05	2.61	71.05	129.77	140	349.1	8.4	35749	3416
November	24.35	22.75	90	860	18.5	2.09	112	182.25	146	400.88	8.1	44000	1666
December	20.75	32.35	120	900	6.35	2.30	131.18	161.2	155	413.6	8.15	36111	3222
Mean	26.27	28.11	100.46	680	11.88	3.17	116.54	136.53	132.75	398.12	8.48	39446	2983

Table-8 Pond's water analysis report (Sopura) – 2002

Month	WT	Trans	TSS	TDS	CO ₂	DO	HCO ₃	Cl	TH	EC	P ^H	Phy	Zoo
January	17.16	25.91	108.5	936.66	9.5	2.99	227.75	120.26	171.66	608.06	8.18	63610	1800
February	21.58	19.33	49.5	864.66	3.5	4.9	200.66	90.66	200.33	628.4	8.26	52888	1928
March	24.97	17.4	54.16	909.16	9.1	3.68	149.25	148.35	213	735.12	8.45	33944	2843
April	27.98	17.05	61.66	749.16	9	3.48	161	117.39	140	673.24	8.68	12888	2947
May	32	27.58	43.33	873.3	3.5	2.74	251.66	167.45	169.3	801.63	8.55	12888	2825
Jun	30.88	29.88	136.36	639	2.1	2.73	195.5	176.80	121.5	714.51	8.6	64944	4196
July	32.43	27.71	83.3	725	22	2.78	120.4	181.03	139.66	343.30	8.63	85536	4045
August	32.01	32.95	50	613	12.25	2.24	61.25	172.54	135	272.72	8.56	60981	4333
September	31.58	29.03	151.66	532	19.55	2.03	87.25	256.86	155	305.08	8.38	59444	1444
October	28.98	28.18	62.5	733	19.48	2.69	102.61	141.12	167	500.4	8.25	42160	3496
November	24.6	24.75	83.83	877.66	20.91	2.83	140.5	186.46	179.55	571.63	8	44188	1190
December	21.4	30.58	112.5	616	9.45	2.91	191.66	158.38	187.56	571.82	8.01	76444	2634
Mean	27.13	25.86	83.13	755.81	11.70	3	157.44	160.03	164.96	560.49	8.38	50826	2806

Table-9 River's water analysis report (T-band) – 2002

Month	WT	Trans	TSS	TDS	CO ₂	DO	HCO ₃	Cl	TH	EC	P ^H	Phy	Zoo
January	16	15	90	350	2.2	6.5	85	17.0	162	122	7.9	10476	577
February	16	15	30	120	1.5	6.6	92	45.4	140	174	7.8	8730	639
March	16	16.5	30	116	2.5	3.03	85	42.1	166	187	7.7	8830	388
April	18	16	35	60	3	4.5	90	40.5	150	187	7.7	6014	776
May	26.8	68.5	20	10	1.0	3.0	185	35.8	172	199	8.5	8536	582
Jun	27	69	30	85.5	1.1	3.49	113	48.2	150	187	8.4	7372	194
July	31	46.5	75	190	0.9	4.83	79	36.9	146	205	8.3	7954	1164
August	30	26	120	200	1.3	6.35	74.5	39.7	138	212	8.4	6790	776
September	30	16	180	200	4.0	6.56	45	18.4	120	222	7.8	12222	955
October	31	15.5	250	500	2.0	5.44	73	31.3	100	222	7.8	6014	1356
November	28	13	200	550	3.5	6.63	80	31.2	126	222	7.7	10670	1356
December	25.5	16	110	400	2.0	9.3	80	28.4	142	163	8.1	10088	388
Mean	24.6	27.7	97.5	231	2.5	5.52	90.1	36.2	141	191	8	8641	699

Table-10 River's water analysis report (I-band) – 2002

Month	WT	Trans	TSS	TDS	CO ₂	DO	HCO ₃	Cl	TH	EC	P ^H	Phy	Zoo
January	15	18	80	340	2.6	8.37	86	23.3	186	111.19	7.7	3880	1164
February	16	19	38	110	1.7	7.32	95	56.2	136	170	7.6	5044	194
March	16	20	30.5	100	2.5	4.81	87	40.2	147	177.5	7.8	3880	-
April	17	20	40	50	2.8	5.5	65	36.7	157	187.06	7.7	2910	194
May	27	68.5	25	20	1	4.53	180	39.9	180	187.06	8.5	9118	1164
Jun	27	68	20	80	1.3	5.93	120	38.4	134	191.04	8.5	7372	-
July	28	44	80	200	0.8	6.66	76.2	26.8	145	205.76	8.3	6596	970
August	31	30.5	130	210	1.3	8.93	70	38.3	108	222.08	8.2	6596	582
September	32	20.5	200	210	2.0	8.28	40.3	25.6	100	222.08	7.7	6984	388
October	30	15.5	260	450	2.1	3.9	68	22.7	134	224.47	7.7	3298	388
November	27	12.5	230	500	4.0	6.98	81	28.4	128	210.14	7.8	5238	778
December	24.5	15	120	390	2.5	6.14	85	34.1	150	163.37	8	5626	388
Mean	24.2	29.3	147.5	203	2.75	6.44	52.5	33.4	142.1	177.41	7.9	5949	512

Effects of water pollution

Due to lack of resources, modern technology and awareness not much is being done to trap the harmful pollutants and reuse of surface water. As a result the surface water of Rajshahi city is not suitable for drinking and cooking purpose. Excess turbidity in water makes obstacle to enter the sunlight into deeper part of the water that is very harmful to aquatic organisms as it affects the respiration ability of fish and other invertebrates that reside in water. Many type of fishes and bottom-dwelling animals cannot survive when levels of dissolved oxygen drop below 2 to 5 ppm. When this occurs, it kills aquatic organisms in large numbers, which leads to disruptions in the food chain. However, presence of large number phytoplankton and zooplankton and untreated sewage can cause various water born diseases.

Conclusion and Suggestion

From the above discussion it may be said that surface water (both ponds and river water) of Rajshahi City is not suitable for drinking and cooking purposes. It can be used for irrigation, fish cultivation and other external uses. Therefore the dwellers of this city have to depend on arsenic free tube-well water as source of safe and potable water. For this purpose DPHE and city corporation should come forward to identify the arsenic contaminated and arsenic free tube-well of the study area.

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