Assessment of Drinking Water Quality At Public Amenities In Kota City

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Abstract- *The only perennial river of Rajasthan is the Chambal River and it is the main source of drinking water for Kota city as well as the district. With the industrialization, urbanization, population increase and wastewater inflow into the river, the water quality of Chambal is getting deteriorated day by day. Looking to recent news articles in different newspapers regarding the deteriorating quality of drinking water at public places like Government hospitals and other places, we decided to carry out a study of drinking water quality at public amenities in Kota city so as to assess the quality of drinking water. To carry out the work, the whole city was divided into different zones and samples were collected from public sources such as bus stand, railway station, hospitals, some open sources and packaged water bottles available in the market for their further assessment in the laboratory. The samples were tested for physical, chemical and biological parameters namely pH, electrical conductivity (EC), total dissolved solids (TDS), total alkalinity, total hardness (TH), Ca Hardness, Mg Hardness, dissolved Oxygen (DO), residual chlorine, chloride, nitrate, total coliforms and faecal coliforms..The results show that most of the physical, chemical, biological parameters of water are within the permissible limits prescribed by Indian Standards. However, some of the samples were found to be beyond the permissible limits and therefore, continuous monitoring of water quality needs to be assessed.*

Keywords- Chambal River, drinking water quality, physico-chemical parameters, biological parameters

I. INTRODUCTION

Water covers some 70% of the Earth's surface. Approximately 97.2% of it is saline, just 2.8% fresh. Potable water is available in almost all populated areas of the Earth, although it may be expensive and the supply may not always be sustainable.

Drinking water, also known as potable water or improved drinking water is water that is safe to drink or to use for food preparation, without risk of health problems. Globally, 89% of people had access to water suitable for drinking. Nearly 4.2 billion had access to tap water while another 2.4 billion had access to wells or public taps. 1.8 billion people still use an unsafe drinking water source which may be contaminated by feces. This can result in infectious diarrhea such as cholera and typhoid among others.

Water is essential for life. The amount of drinking water required is variable. It depends on physical activity, age, health issues and environmental conditions. Contaminated water is estimated to result in more than half a million deaths per year.

Parameters for drinking water quality typically fall under three categories, namely, physical, chemical and microbiological. Physical and chemical parameters include heavy metals, trace organic compounds, total suspended solids (TSS) and turbidity. Microbiological parameters include Coliform bacteria, E. coli, and specific pathogenic species of bacteria (such as cholera-causing Vibrio cholerae), viruses and protozoan parasites.

Physical parameters affect the aesthetics and taste of the drinking water and may complicate the removal of microbial pathogens. Chemical parameters tend to pose more of a chronic health risk through buildup of heavy metals although some components like nitrates/nitrites and arsenic can have a more immediate impact. Microbial pathogenic parameters are typically of greatest concern because of their immediate health risk.

Throughout most of the world, the most common contamination of raw water sources is from human sewage and in particular human faecal pathogens and parasites. It is clear that people in the developing world need to have access to good quality water in sufficient quantity, water purification technology and availability and distribution systems for water. In many parts of the world the only sources of water are from small streams often directly contaminated by sewage.

II. STUDY AREA

The study has been carried out in Kota city, which is located along the banks of the Chambal River in the southern part of Rajasthan. Kota region with the territory of 5203.94 sq km is situated between 24°25′ to 25°51' N latitude and 75°37′ to 77°26′ E longitude in the south east territory of Rajasthan.

III. METHODOLOGY

Sample collection

The samples of water have been collected from different parts of the city. A total of 51 locations in Kota city were identified from where water samples have been collected. The locations selected for collection of water samples include both public and private areas such as bore wells, hand pumps, railway station water taps, and residential colonies under specific regions of Kota etc. The 51 water samples collected for testing are marked as S1, S2, S3.....to S51 for ease of understanding. It has been tried to cover the maximum areas in Kota for water sampling as there are so many recent incidents of contaminated water supply. Also the areas where basic amenities like hospitals, educational buildings, etc are present have also been taken into account as safe water is the basic necessity of the public. Table 1 shows the list of sampling locations with their respective codes.

Sample Analysis

The water quality parameters were measured according to the "Standard Methods for Examination of Waters and Waste Waters, American Publication Health Association", 21st Edition, 2005.

Table 1: List of Sampling Locations with their Sample Code

S. No.	Location of Sample collection	Sample Code
1	Railway Station (Platform 1 Tap water, water cooler)	S1-S5
2	Packaged Bottle	S6-S9
3	Dadabari(Water Cooler With Or Without RO)	S10-S12
4	R.K.Puram (Water Cooler And Tap Water)	S13-S14
5	Nayapura (Standpots)	S15-S19
6	RTU (Rawatbhata Road) (water cooler and pot)	S20-S24
7	Borkhera(pot and water cooler)	S25-S26
8	KotriGoverdhanpura (govt. tap)	S27
9	Tipta(water cooler and public tap)	S28-S29
10	SarasParlour (Rawatbhata Road) (water cooler)	S30
11	Medical College (water cooler)	S31
12	Talwandi (water cooler)	S32
13	Teen batti Circle (water cooler)	S33
14	Rajiv Nagar	S34
15	Rangbari	S35
16	Mahaveer Nagar (tap water)	S36
17	Mahaveer Nagar 2 (tap water)	S37
18	Mahaveer Nagar 3 (tap water and borewell)	S38, S48
19	Atwal Nagar (water cooler with RO)	S39, S41
20	BardaBasti(Borewell)	S40
21	Manpura (borewell)	S42
22	NayaNohra (Rural area)	S43
23	Tather (Rural area)	S44
24	Samriddhi Nagar	S45
25	Kansuwa (Rural area)	S46
26	Mahaveer Nagar Extension (borewell)	S47
27	Mandana Rural area (borewell)	S49
28	Rangpur (borewell)	S50
29	Gangaycha (borewell)	S51

IV. RESULTS & DISCUSSION

The physico-chemical and microbiological parameters including pH, electrical conductivity, total dissolved solids, Ca and Mg hardness, total hardness, dissolved oxygen, residual chlorine, chlorides, nitrates, total coliform and fecal coliform were analyzed in the environmental laboratory and microbiology laboratory respectively. The results obtained are represented in the form of table 2 below. All measurements are in mg/l except pH and EC. The EC is measured in µS/cm. The drinking water quality standards as prescribed by the Bureau of Indian Standards (BIS), Indian Council of Medical Research (ICMR) and World Health Organization (WHO) are shown in table 3.

Table 2: Physico-chemical Parameters of Water samples collected from Public Amenities in Kota city

Sample Code	pH	EC	TDS	Total alkalinity	C_a hardness	Mg hardness	Total hardness	DO	Residual Chlorine	Chloride	Nitrate
S1	8.0	1599	991	520	50	100	150	6.9	1.0	102.66	35
S2	8.0	1589	985	54	54	84	138	6.68	0.6	115.05	40
S3	7.6	108	66.84	40	0	0	6	7.4	0.8	12.39	8
S4	8.0	1582	981	546	54	86	140	6.23	0.5	116.82	40
S5	8.2	1366	847	500	44	66	110	7.02	0.1	97.35	38
S6	6.7	83	51.46	20	10	8	18	6.82	0	10.62	7
S7	6.6	98	60.76	30	4	8	12	6.74	0	8.85	5
S8	6.7	113	70.06	48	14	18	32	8.06	0	12.39	8
S9	6.8	114	70.80	40	18	10	28	7.09	0	12.39	7
S10	7.6	339	210.18	110	60	50	110	7.57	0.2	40.71	35
S11	7.6	289	179	106	54	44	98	7.51	0	33.63	30
S12	7.6	341	211.42	112	68	32	100	7.66	1.0	35.4	25
S13	7.7	353	218	112	70	42	112	5.76	0	38.94	38
S14	7.6	363	225	114	76	40	116	4.91	0	42.48	40
S15	8.7	347	215.14	124	70	40	110	8.94	0.1	35.4	10
S16	7.5	355	220.1	110	70	40	110	7.38	1.0	35.4	10
S17	7.7	352	218.24	116	68	42	110	6.74	0.2	35.4	10
S18	7.7	355	220.1	110	60	50	110	7.3	0.2	40.71	20
S19	8.7	318	197.16	108	66	34	100	8.42	0	31.86	10
S20	8.1	339	210.18	110	64	40	104	6.38	0	40.71	25
S21	8.2	375	232.5	116	70	46	116	6.52	0.1	40.71	27
S22	8.0	335	207.7	100	70	34	104	6.9	0	46.02	30
S23	7.9	337	208.94	116	64	36	100	7.35	0.1	40.71	32
S24	7.9	350	211.42	110	60	40	100	6.56	0	58.41	40
S25	7.7	346	214	104	62	48	110	7.56	0.2	38.94	27
S26	7.8	351	218	112	72	36	108	7.23	0.1	40.71	25
S27	7.9	316	195	124	66	32	98	7.38	0.6	31.86	20
S28	7.7	346	214	110	64	38	102	7.24	0.2	40.71	28
S29	7.8	341	211.42	90	66	26	92	7.18	0.5	35.4	25
S30	7.6	356	220.72	62	60	40	100	7.19	1.0	44.25	23
S31	8.1	349	216.38	46	66	42	108	5.39	0	37.17	25
S32	7.3	380	235.6	125	74	52	126	6.2	0	45	23
S33	7.5	388	241	127	80	50	130	6.5	0	49	30
S34	7.5	439	272	112	90	40	130	5.9	0	46.02	35
S35	7.5	385	239	130	74	66	140	6.5	0	45	25
S36	7.5	388	240	149	76	52	130	6.5	0	44.25	20
S37	7.6	385	239	128	74	52	126	6.25	0	44.25	25
S38	7.6	385	239	128	74	52	126	6.25	0	44.25	23
S39	6.6	114	70.68	48	16	18	34	8	0	12.39	10
S40	7.0	1065	660.3	232	196	58	254	3.8	0	148.68	40
S41	7.5	2129	1320	128	104	12	116	5.97	0	47.79	35

S42	7.6	2123	1316.3	506	130	320	450	5.98	0	221.25	42
S43	7.5	1546	958.52	430	118	90	208	5.91	0	145.14	40
S44	7.0	1998	1238.8	326	372	264	636	0.82	0	49.56	30
S45	7.8	2017	1250.5	676	56	234	290	5.63	0	185.9	40
S46	7.0	372	230	124	66	54	120	5.95	0	46.02	25
S47	7.3	860	533	335	190	98	288	1.9	0	40	35
S48	7.2	849	526	332	186	98	284	1.88	0	74.34	30
S49	8.0	3580	2220	630	430	220	650	5.98	0	235	101
S50	8.2	5276	3271	720	345	385	730	5.8	0	242	225
S51	8.0	4306	2670	670	325	355	680	5.8	0	225	1098

Table 3: Drinking Water Quality Standards (mg/l)

S. No.	Parameter	As per BIS	As per ICMR	As per WHO
1	pH	6.5-8.5	7.0-8.5	6.5-9.5
2	EC (µS/cm)	-	-	1400
3	TDS	2000	500	600
4	Alkalinity	600	200	-
5	Total Hardness	600	600	500
6	Ca Hardness	200	200	100
7	Mg Hardness	100	200	150
8	Dissolved Oxygen	5	5	-
9	Chloride	1000	200	250
10	Nitrate	45	50	45
11	Residual chlorine	0.2	-	-
12	Total coliforms	10/ 100ml	-	-
13	Fecal coliforms	NIL	-	-

The results indicate that pH values of most of the samples are within permissible limits. Very low EC values have been obtained for those samples collected from packaged bottles, whereas very high EC values belong to those samples which have collected from bore wells i.e. ground water and so is the case with total dissolved solids, alkalinity, hardness, chlorides and nitrates. Free residual chlorine has been found in only those samples which have been taken from the distribution system of public supply by the public health engineering department.

Most importantly, out of the samples tested for microbiological parameters, eight samples (S13, S14, S31, S40, S42, S44, S45 and S46) have shown positive results for total coliforms and fecal coliforms, which is a very serious issue and needs immediate attention of the concerned authorities.

V. CONCLUSION

As far as the drinking water quality is concerned, different physicochemical parameters like pH, EC, TDS, hardness, dissolved oxygen, conductivity, alkalinity, residual chlorine, chloride and nitrate were analyzed along with microbiological parameters. It has been observed that at Kota Railway station, a few sampling sites were found to exceed limits of TDS, alkalinity and hardness, especially sample S1 and S4. A few samples, especially, S40, S42 and S44 as these water samples were collected from bore well; they exceed limits of TDS, alkalinity, hardness and chloride. Bore well and hand pump water samples S45, S47 and S48 were found to exceed the limits, some even by big margins. Samples S49, S50, and S51 exceed the limits of EC, TDS, hardness, chloride and nitrate. These samples are collected from shallow tube wells and ground water bodies which can be one of the reasons of getting high amounts of nitrate in these samples. Most importantly, some of the samples (S13, S14, S31, S40, S42, S44, S45 and S46, namely Bombay Yojana, Medical college, Bardabasti, Manpura, Tather, Samriddhi Nagar and Kansua respectively) showed the positive results for total coliform and fecal coliform. It is a sign of severe pollution of drinking water sources and needs to be monitor and rectified at the earliest.

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