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ASSESSMENT OF RAW WATER QUALITY SUPPLIED TO HYDERABAD FOR DRINKING PURPOSES

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ABSTRACT

Drinking water is an indispensable life supporting ingredient for daily life. The quality of drinking water at all stages while supplied through distribution systems requires some specific monitoring. Present study is based on the assessment of quality of raw water supplied to treatment plants for onward distribution to the city of Hyderabad (Pakistan) serving about 60% of the population and the 40% population is served with untreated water. The major intake for supply of water is from River Indus at Kotri barrage Jamshoro where unexpected and unannounced release of highly contaminated water from Manchhar Lake is received every year, thus creating major threats to public health and aquatic life. The present study was conducted on a regular sampling basis for a period of half of the year. The aim was to assess the quality of raw water at all three stages and observe the changes in the parametric values while collected, stored in the lagoons and distributed to the end user. Spectrophotometer and Multiparameter Meter were used for the analysis of these parameters. The parameters include pH, turbidity, TDS, DO, Iron, Sulphate and Hardness. A critical evaluation of data presented indicated that pH generally ranged from 6.8–7.8; turbidity varied from 60.87 -125 NTU at location#1, 42.2-111 NTU at location #2; , TDS values were found to be ranging between 346– 487 mg/l at location 1 and were reduced in lagoons by 301-404 mg/l at location 2, the DO ranges were found 8.16-9.98 at location 1, 8.01-9.43 at location2. The observed variations in iron were found from 0.59 -1.34 at location1 and were increased in settled water at lagoons with a variation of 0.92-1.65 mg/l. It was further revealed that the turbidity and iron contents of the raw water at two locations were elevated though 16.76% of turbidity was reduced during the storage in lagoons but the iron content remained elevated while comparing with WHO standards.

Keywords: Raw water quality, River Indus, Drinking water, Hyderabad

1. INTRODUCTION

The current investigations on the quality of groundwater of Pakistan and application of the strategies for monitoring it, has given an idea that there is lack of sufficient data availability for raw water supplied for drinking purpose to various cities including Hyderabad [1]. From the very limited Physico- chemical analysis on raw water supplied for drinking purpose to the city of Hyderabad it is indicated that the most critical water quality problem relates to the deterioration of raw water from rivers [2]. The major source for supply of drinking water to the city of Hyderabad is River Indus. The canals from this river are supplying the domestic water to the city having an approximate population of 1.8 million. Due to sudden and spontaneous discharge of highly polluted water from the Manchhar Lake, river water becomes highly contaminated specially at the major intake (Location 1) as shown in figure 1 [3]. From this river at Jamshoro, water is supplied to the lagoons named North and South lagoons of 400 MG for pre settlement and then brought to the treatment plants for further distribution through network. Physico chemical analysis of raw water indicates that the turbidity and iron were elevated at both locations during the study period started from February 2012 to July 2012. Pakistan Council of research in Water

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Resources (PCRWR) concluded that "the only problem" in untreated water supplied to many parts of the city of Hyderabad by Water and Sanitation Authority (WASA) Hyderabad is the presence of excessive turbidity and consequent bacteriological contamination [4]. In 2004, 11 people were known to die, and thousands of children were exposed to diarrhoea in Hyderabad due to contaminated drinking water and that the source was identified as a lake discharging polluted saline water to the river Indus near Jamshoro, location 1 in this study [5]. Based on the reports from World Health Organization (WHO) Pakistan is declared at second amongst 31 Asian countries in annual diarrheal episode among young children [6]. Physico chemical analysis of this study indicates the changes of the various critical parameters of raw water at three important different locations.

2. MATERIALS AND METHODS

A descriptive research study is carried out in accordance with [7, 8] based on the Physico- chemical analysis of the raw water supplied to the city under observation.

To make the samples representative of the entire assessment of raw water quality and the selection of parameters is based on three categories. First category is the raw water taken from the River Indus (Major intake) to the treatment plants and direct supply (untreated water) to some areas (location 1). Second category is the Lagoons water quality (location 2) where the raw water is pumped to store the water for a certain period for settlement and onward supply of treated water through treatment plants; and that the rest of the water is supplied untreated to 40% of the population of the city. Third category is the raw water entering into the inlet of the treatment plants (location 3).

Figure 1: showing the satellite view of the locations Sampling Frequency & Equipment In this study, 120 samples are analysed for 03 selected locations started from the month of February to July 2009. The 06 months comprehensive descriptive study was planned in a way to cover both seasonal changes of summer and winter. The sampling frequency is shown in Table 1. Spectrophotometer DR 2700 (HACH) and SensIon 59 Multiparameter Meter (HACH) were used in this research work.

Table 1: Sampling Frequency

No.	Month	Week	Observations
1	February 2012	1	02
2	March 2012	4	09
3	April 2012	4	08
4	May 2012	4	09
5	June 2012	4	09
6	July 2012	2	03
Total samples on each location			40
No. of observations = 03 x 40			Total 120

3. RESULTS AND DISCUSSIONS

The present study revealed that the values of the parameters at location 2 and location 3 are almost same as the mean values were found similar for these locations. Therefore the observations at location 1 and 2 are presented and discussed. The pH values of the samples at L1 and L2 are presented in fig 2and 3 respectively. In this study, the mean values at location 1 and location 2 are 7.37 and 7.40 lying with the normal ranges available from WHO guidelines. Kandhar [9] reported the pH of river water as 7.98. According to PCRWR "National Water Quality Monitoring Program" (2011) pH variation of river water at this location is 7.30 [10]. Therefore our results are consistent with both of these results for this parameter. The statistical comparative values for pH are shown in Table 2.

Table 2: Comparative Values of pH

S.No.	Author		Kandhar		PCRWR	
	Min	Max	Min	Max	Min	Max
L1	6.8	7.9	---	7.98	---	7.30
L2	6.9	7.8	---	---	---	---

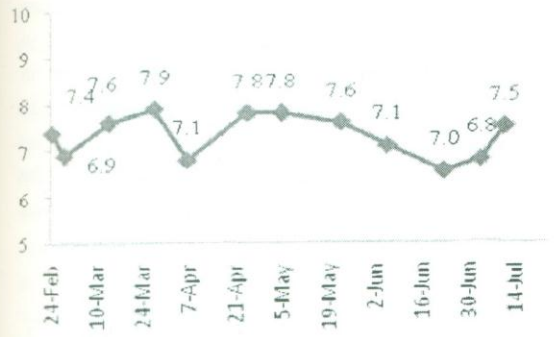

Figure 2: pH values at Location 1

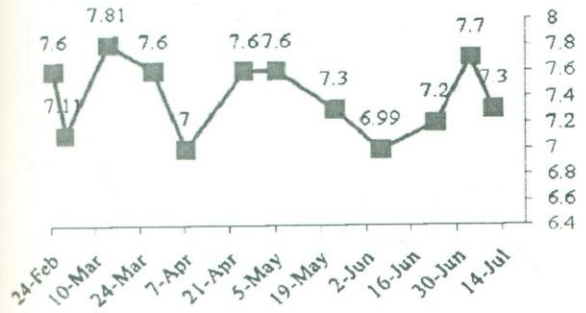

Figure 3: pH values at Location 2

One of the important parameter of raw water is turbidity which was assessed on location1 and location 2 against the dates of the experimental study as shown in figure 4 and 5. The minimum value at location 1 is observed as 60.87 NTU in the month of February (winter season) and the maximum value is 125 NTU in the month of March. However the mean value at L1 is observed as 91.2 with standard deviation of 19.54. The results of PCRWR study shows the mean value of River water as 86 NTU which confirms the raw water variation at this location. The values of turbidity on Location 2 show a minimum value of 42.4 NTU on 28th February while the maximum value is observed as 111NTU on 28th March indicating mean value of 74.49. It shows a trend of increase in turbidity from February to March. Generally the turbidity level in winter and summer seasons is different. The comparative values of turbidity are given in Table 3

Table 3: Comparative Values of Turbidity

S.No.	Author		Kandhar		PCRWR	
	Min	Max	Min	Max	Min	Max
L1	60.87	125	---	---	---	7.30
L2	42.2	111	---	---	---	86

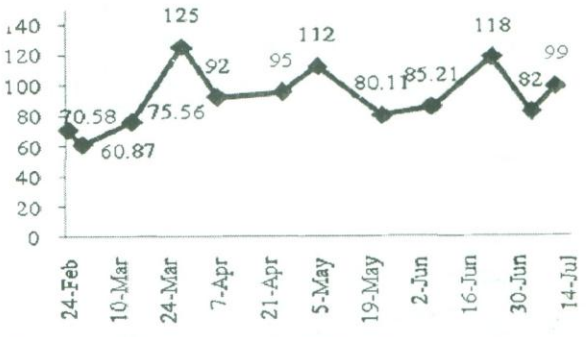

Figure 4: Turbidity values (NTU) at Location 1

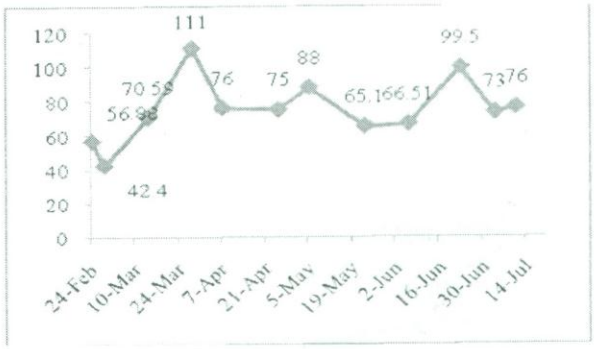

Figure 5: Turbidity values (NTU) at Location 2

TDS is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular (Colloidal solution) suspended form. Measured values of TDS at location 1 and 2 are shown in graphical form in the figure 6 and 7. At location 1 the mean value of TDS is 423.416 mg/l varying 346-487 mg/l. (PCRWR, 2012) reported TDS at 277 mg/l.

The mean value of TDS at Location 2 is 352.5 mg/l (301-404 mg/l). The TDS values dropped in the lagoons at this location. A decrease of 16.76% in TDS is found in the Lagoon water as the mean value of TDS is found as 352.5 mg/l. Kandhar (1998) has reported TDS value of 188 mg/l for this location. Since the mean value of TDS is below 500 mg/l so, as far as TDS concentration is concerned it can be recommended as safe for drinking according to WHO guide lines. The presence of dissolved solids in water may affect its taste. The palatability of drinking water has been rated by panels of tasters in relation to its TDS level, expressing that TDS less than 300 mg/l is "Excellent". TDS between 300 mg/l and 600 mg/l is "Good" and between 600 and 900 mg/l is "FAIR" [11]. Comparative TDS Values are shown in Table 4.

Table 4: Comparative Values of Total Dissolved Solids

S.No.	Author		Kandhar		PCRWR	
	Min	Max	Min	Max	Min	Max
L1	346	487	-	152	277	7.30
L2	301	404	-	188	---	86

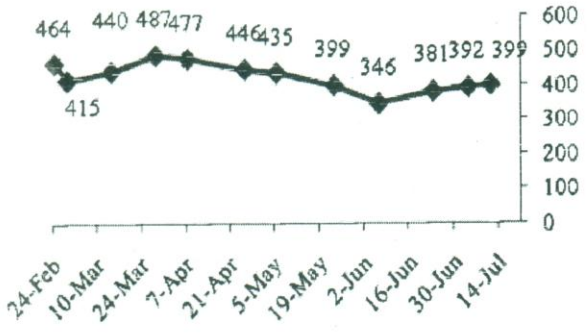

Figure 6: TDS (mg/l) values at Location 1

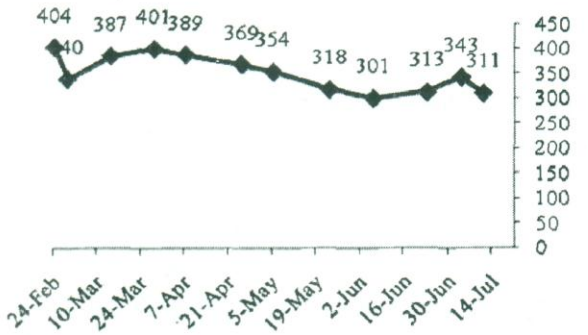

Figure 7: TDS (mg/l) values at Location 2

In drinking water supplies, iron salts are unstable and are precipitated as insoluble iron hydroxide, which settles out as a rust colored silt. If the content of iron exceeds 0.3 mg/l, staining of laundry and plumbing may occur [12].

The experimental values of Iron (Fe) on both Locations1 and 2 are shown in Figures 8 and 9 respectively. Statistics of Iron on location 1 includes mean value of 0.86 mg/l, minimum value is 0.59 mg/l, and maximum value is 1.34 mg/l. The PCRWR (2004) reported 3.43 mg/l of iron in raw water, which is very high, while Kandhar (1998) reported 0.23 mg/l for raw water. The values of this parameter on Location 2 show the mean value of 1.237 mg/l, minimum value is 0.92 mg/l, and maximum value is 1.65 mg/l. Comparing both values of location1 and Location 2, it is evident that the mean content of iron at 30.47 % in raw water is increased in lagoon. The same trend of increase of iron content in lagoon is confirmed by Kandhar (1998) reporting 0.34 mg/l compared to 0.23 mg/l of raw water. No significant change is found within the quality of raw water and the inlet of the treatment plant. The comparative statistical values of Iron are shown in Table 5.

Table 5. Comparative values of Iron (Fe) mg/l

S.No.	Author		Kandhar		PCRWR	
	Min	Max	Min	Max	Min	Max
L1	0.59	1.34	-	0.23	--	--
L2	0.92	1.65	-	0.34	---	--

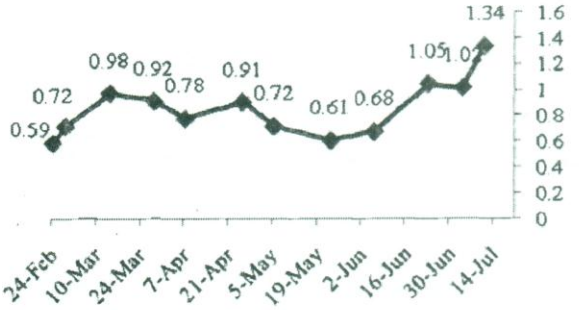

Figure 8: Iron (mg/l) values at Location 1

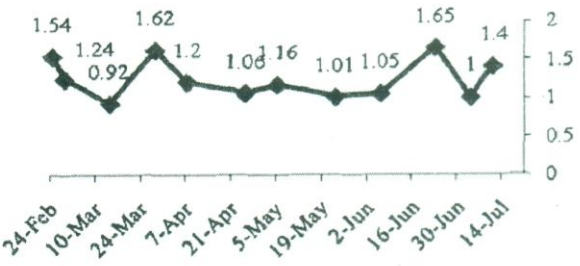

Figure 9: Iron (mg/l) values at Location 2

4. CONCLUSIONS

From the present study, summarizing the results it is concluded that during period of six months from February to July, 2012, the pH of water remains within the WHO drinking water guidelines value (6.5-8.5). Its Turbidity was found very high ranging from 60-125 NTU. (The PCRWR study is in agreement. From mean value it is

clear that that there is drop in Turbidity due to settling of river water.

The TDS value has increased (487 mg/l) in comparison to previous study-188 mg/l (Kandhar) and152 mg/l, (PCRWR, 2004) showing that there is influent of saline water in the river system from different sources, especially from Manchar lake. There is a precaution note as this value is reaching the WHO guideline value 500 mg/l. This trend must be checked and alternate measures be taken to control the TDS & other health related parameters. The raw water DO has not been determined frequently by researchers. The Iron content in raw water at the intake from river was higher (0.59-1.34 mg/l) than (0.23 mg/l). It was also noticed that the Fe content increased in lagoon water (0.92-1.65 mg/l). This increase was also reported by Kandhar (1998) who additionally witnessed the high rise of Manganese in lagoon waters. This suggests that iron and manganese dissolved solids are possibly coming from the rocky structure of lagoons, the total hardness of river water was found as 300-395 mg/l. Hardness and TDS of Raw water are found increasing continuously from 1998 to present study. The source of increase in iron also must be taken into consideration for further study of the raw water.

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