

# Physico – Chemical Evaluation Of Water Quality Parameters Of Khargharb River In Malga And Wist, Iran

Hassan Ali Mojallal<sup>1</sup> and Asha Iyengar.T<sup>2\*</sup>

**Abstract-** The water quality of Khargharb river flowing through Malga and Wist towns of Iran was assessed with respect to parameters such as temperature, pH, electrical conductivity, turbidity DO, COD, cations ( $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Na}^+$  and  $\text{K}^+$ ) anions ( $\text{Cl}^-$ ,  $\text{F}^-$ ,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$ ,  $\text{NO}_2^-$ ) and heavy metals (Cd, Cr, Cu, Fe & Zn). The study was conducted during a period of 12 months from October 2011 to September 2012. From the obtained data it is found that most of the parameters assessed were within the permissible limits of WHO standards. Correlation study was carried out on the monthly variations of the parameters.

**Index Terms-** Water quality, Khargharb river, Malga, Wist, Physico-chemical parameters.

## 1. INTRODUCTION

It is essential that water is clean and safe for consumption (drinking water) and utilization (domestic use) by human beings and other living systems. It is impossible for life forms to survive without water. Natural streams and rivers are a couple of water sources that fulfill the needs of humans. However, the quality of water flowing over various terrains through different environmental conditions tends to become heavily affected. Water becomes polluted due to the many different activities of mankind which include modern agricultural practices, advancing industrial technologies, sewage and industrial effluent disposal into water sources [1]. This paper deals with the water quality study with respect to the physico-chemical parameters and heavy metal concentrations in Khargharb river flowing through Malga and Wist of Iran, selecting one location for each place. The assessment of water quality is necessary from time to time to maintain safe standards and implement corrective measures if needed. Khargharb river is one of the sources of drinking water in Malga and Wist, Iran. Malga lies in the Prince of Esfahan, Iran with latitude  $33^{\circ}13'46''$  N and longitude  $50^{\circ}18'23''$  with a small population. Wist is also in Esfahan Province of Iran. Its latitude is  $33^{\circ}19'22''$  and  $50^{\circ}15'26''$  N longitude. Carpet making and honey production are some of the occupations of the people of these places.

## 2. MATERIALS AND METHODS

The water samples were collected monthly for a period of one year from October 2011 to September 2012. One sampling site was chosen for each place (Malga and Wist) along the flowing Khargharb river. The samples were collected during morning time in the first week of every month in clean plastic bottles and processed in duplicate. The different parameters were analysed according to the standard methods [1],[2]. The chemicals used were of analytical grade. The  $\text{P}^{\text{H}}$  of the samples were recorded with digital  $\text{P}^{\text{H}}$  meter after calibration with a standard buffer on the site itself. Turbidity was determined by nephelo turbidity meter while total alkalinity and total hardness were measured titrimetrically. For other parameters, appropriate titrimetric, gravimetric and spectrophotometric methods were employed. DO was determined using the Winkler's method [2] while COD was assessed using the open reflux potassium dichromate method [1].

## 3. RESULTS AND DISCUSSION

The results of the analysis of the monthly water samples of Malga for the various parameters are reported in Table 1 while that of Wist in Table 2. All water samples were found to be colorless. The various parameters studied have been grouped under four categories (a) physical parameters (temperature, electrical conductivity, turbidity and total dissolved salts), (b) non-specific chemical parameters (total hardness, alkalinity, DO and COD), (c) specific chemical parameters - (i) cations ( $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ) and (ii) anions ( $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$ ,  $\text{NO}_3^-$ ,  $\text{NO}_2^-$ ) and (d) heavy metals (Cd, Cu, Cr, Fe, Zn). Also, the parameters have been compared with respect to three seasons of winter, summer and rainy, taking the average values in each season (Table 3).

### 3.1 Physical Parameters

The average temperature of the river water was found to be  $6.8^{\circ}\text{C}$  over the 12 month period at Wist with the summer season recoding a high of  $35.2^{\circ}\text{C}$  in August 2012 while at Malga, the annual average temperature was  $26.2^{\circ}\text{C}$  with the highest temperature being  $30.8^{\circ}\text{C}$  in the summer season.

Table-1 Monthly variation of parameters in Malga

	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	av	SD
Temp.	24.2	24	23.2	22.8	22.5	25.6	26.6	25.8	29.6	29.1	30.2	30.8	26.2	3.03
E.Cond.	798	964	835	892	523	473	543	310	655	692	685	800	680.83	191.15
Turb.	10	12	14	10.7	9.97	11.34	10.6	8.8	5.9	4.8	5.89	8.2	9.35	2.75
pH	7.4	6.2	6.8	6.8	6.3	8.1	8.2	6	5.9	6.2	7.4	7.9	6.93	0.84
TDS	452	554	710	654	710	584	644	688	548	606	570	599	609.92	75.99
TH	213	118	132	136	240	201	193	176	168	153	195	218	178.58	38.04
Alk	11.2	11.7	6.8	7.59	7.57	7.6	6.68	5.81	7.35	5.66	6.46	6.39	7.57	1.93
COD	0.34	0.14	0.13	0.62	0.91	1.32	3.7	2.1	3.2	0	0.4	0.45	1.11	1.24
DO	7.2	5.2	5.4	4.8	6.7	4.8	4.5	5.2	5.1	1.9	1.6	1.9	4.53	1.82
Chloride	40.6	32.9	25.2	29.7	26	18.7	15.6	11.7	11.6	24	11.8	46.8	24.55	11.53
Nitrate	5.3	2.56	2.39	1.94	2.61	1.26	1.34	1.27	0.54	0.65	0.39	2.38	1.89	1.34
Fluoride	0.64	0.73	0.59	0.42	0.77	0.87	0.46	0.93	0.68	0.87	0.98	0.76	0.73	0.17
Nitrite	3.2	2.79	3.1	1.4	0.95	0.45	0.48	0.24	0.15	0.3	0.43	1.9	1.28	1.17
Sulphate	1.7	0.76	0.1	0.62	0.78	1.4	2.53	1.87	1.3	1.78	1.45	3.7	1.49	0.95
Phosphate	0.14	0.19	0.21	0.15	0.18	0.14	0	0.4	0.22	0.04	0.07	0.09	0.15	0.10
Calcium	0.12	0.1	0.14	0.02	0.06	0.055	0.039	0.08	0.035	0.088	0.028	0.02	0.07	0.040
Magnesium	7.5	13.5	4.6	5.3	10.6	12.3	11.4	7.9	5.6	6.35	6	7.2	8.18	2.99
Sodium	49.3	37.2	57.5	42.8	39.4	43.6	27.4	30.5	37.2	40.7	38.9	45.1	40.8	7.97
Potassium	22.7	34.4	19.6	24.7	18.6	12.68	13.5	16.56	16.8	19.32	18.15	17.47	19.54	5.76
Cadmium	0	0.07	0	0	0	0.09	0	0.05	0	0	0.13	0	0.028	0.04
Chromium	0.092	0.04	0.02	0.06	0.06	0.01	0	0	0	0	0.07	0	0.029	0.03
Copper	0	0.016	0	0	0.012	0	0.08	0.021	0	0.024	0	0	0.012	0.02
Iron	0.57	0.61	0	0	0.64	0	0.51	0	0	0	0.7	0	0.25	0.31
Zinc	0.91	0	0.8	0	0	0.65	0	0.62	0	0.51	0	0.6	0.34	0.36

Table-2 Monthly variation of parameters in Wist

	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	av	SD
Temp.	31.3	21.6	20.4	19.5	21.3	27.4	25.5	27.3	31.1	32.5	35.2	29.4	26.88	5.24
E.Cond.	643	715	801	530	549	428	296	306	300	419	586	639	517.67	169.10
Turb.	10	1.8	1.5	7.4	9.2	11	6.1	5.6	6	4.3	8.3	8.5	6.64	3.026
pH	7.8	8.9	8	9.5	8.8	8.3	5.8	5.9	6	6.4	6.2	7	7.38	1.33
TDS	444	513	722	648	712	578	644	692	531	573	600	607	605.33	84.06
TH	169	238	121	129	139	193	201	171	175	154	177	195	171.83	33.13
Alk	8.3	7.5	3.4	6.3	4.1	4.2	6.9	7.1	6.8	9.2	10.3	8	6.84	2.09
COD	0	0.04	0.062	0.31	0	0.18	0	0.11	0.23	0.17	0.18	0.5	0.15	0.15
DO	1.7	1.74	0.39	1.53	2.47	5.6	6	4.22	2.29	4.2	6.4	6.5	3.59	2.16
Chloride	38.5	35.7	25.3	59.5	11.6	12.3	15.7	10.2	18.1	22	29.6	15.89	24.53	14.43
Nitrate	1.5	1.3	3.7	1.1	0.3	1.5	1.6	1.24	1.4	0.72	1.8	2.67	1.57	0.88
Fluoride	1.1	0.5	0.82	0.65	0.79	0.23	0.35	0.32	0.92	0.91	0.83	0.85	0.69	0.28
Nitrite	4.62	3.41	1.48	1.34	0.63	0.45	0.01	0.4	0.22	0.18	0.01	0.093	1.075	1.48
Sulphate	1.1	0.81	1.77	0.27	3.6	1.3	5.86	3.11	2.73	2.01	2.23	3.96	2.40	1.57
Phosphate	0	0	0.13	0.065	0	0.14	0	0	0.094	0	0	0.053	0.04	0.05
Calcium	1.1	0.062	0.07	0.05	0.07	0.12	0.1	0.15	0.1	0.13	0.074	0.085	0.18	0.29
Magnesium	8.8	11.7	3.56	7.51	1.8	5.6	12.3	13.2	6.45	9.44	1.31	11.1	7.73	4.07
Sodium	40.6	51.5	60.5	53.7	14.79	20.4	11.84	43	38.57	25.75	38.6	53.21	37.70	16.18
Potassium	20.32	22.1	24.6	24.22	7.7	12.5	7.04	13.2	16.64	11.34	17.3	21	14.15	6.12
Cadmium	0	0	0	0	0	0.094	0	0	0	0.042	0	0	0.01	0.03
Chromium	0	0.03	0	9	0	0	0.1	0	0	0	0	0	0.76	2.59
Copper	0	0	0	0.09	0	0	0	0	0.15	0.13	0	0	0.03	0.06
Iron	0.032	0	0	0	0.064	0	0	0	0	0	0	0.026	0.01	0.02
Zinc	0	0	0.04	0	0	0.095	0	0.1	0	0	0	0	0.02	0.04

All parameters are expressed in mg/l except temperature( $^{\circ}$ C),pH,electrical conductivity( $\mu$ Scm $^2$ mol $^{-1}$ )

Table-3 Seasonal variation of parameters in Malga and Wist

	Malga						Wist					
	winter		rainy		summer		winter		rainy		summer	
	av	sd	av	sd	av	sd	av	sd	av	sd	av	sd
Temp.	22.83	0.351	26	0.52	29.63	0.55	20.4	0.9	26.73	1.07	32.93	2.08
E.Cond	750	198.64	442	119.55	677.33	19.65	626.67	151.28	343.33	73.49	435	143.67
Turb.	11.55	2.147	10.24	1.30	5.53	0.63	6.03	4.03	7.57	2.98	6.2	1.64
pH	6.63	0.28	7.43	1.24	6.5	0.79	8.77	0.75	6.67	1.42	6.2	0.2
TDS	691.33	32.33	638.66	52.20	574.66	29.28	694	40.15	638	57.24	568	34.78
TH	169.33	61.23	190	12.76	172	21.28	129.67	9.02	188.33	15.53	168.67	12.74
Alk	7.32	0.45	6.69	0.89	6.49	0.84	4.6	1.51	6.07	1.62	8.77	1.79
COD	0.55	0.39	2.37	1.21	1.2	1.74	0.12	0.16	0.1	0.0	0.19	0.03
DO	5.63	0.97	4.83	0.35	2.86	1.93	1.46	1.04	5.273	0.93	4.30	2.06
Cl <sup>-</sup>	26.96	2.40	15.33	3.50	15.8	7.10	35.55	24.67	2.73	2.78	23.23	5.85
NO <sub>3</sub> <sup>-</sup>	2.31	0.34	1.29	0.04	0.52	0.13	1.7	1.78	1.45	0.19	1.31	0.55
F <sup>-</sup>	0.59	0.17	0.75	0.25	0.84	0.15	0.75	0.09	0.3	0.06	0.89	0.05
NO <sub>2</sub> <sup>-</sup>	1.81	1.13	0.39	0.13	0.29	0.14	1.15	0.46	0.29	0.24	0.14	0.11
SO <sub>4</sub> <sup>2-</sup>	0.5	0.35	1.93	0.56	1.51	0.25	1.88	1.67	3.42	2.3	2.32	0.37
PO <sub>4</sub> <sup>3-</sup>	0.18	0.03	0.18	0.20	0.11	0.09	0.07	0.07	0.05	0.08	0.03	0.05
Ca <sup>2+</sup>	0.07	0.06	0.05	0.02	0.05	0.03	0.06	0.01	0.12	0.03	0.10	0.03
Mg <sup>2+</sup>	6.83	3.28	10.53	2.32	5.98	0.37	4.29	2.92	10.37	4.15	5.73	4.11
Na <sup>+</sup>	46.56	9.61	33.83	8.59	38.93	1.75	42.99	24.67	25.08	16.10	34.31	7.41
K <sup>+</sup>	20.96	3.27	14.24	2.04	18.09	1.26	18.84	9.65	10.91	3.37	15.09	3.27
Cd	0	0	0.04	0.04	0.04	0.07	0	0	0.03	0.05	0.01	0.02
Cr	0.04	0.02	0.003	0.005	0.02	0.04	3	5.2	0.03	0.06	0	0
Cu	0.004	0.008	0.03	0.04	0.008	0.01	0.03	0.05	0	0	0.09	0.08
Fe	0.21	0.36	0.17	0.29	0.23	0.40	0.02	0.04	0	0	0	0
Zn	0.26	0.46	0.42	0.36	0.17	0.29	0.01	0.02	0.07	0.06	0	0

The electrical conductivity in  $\mu\text{S}/\text{cm}$  which indicates the presence of ions ranged from 473 to 964 units in Malga (av – 680.83 units) and from 296 to 801 units in Wist. Seasonally, it was found that the electrical conductivity was highest in the winter season at both places (626 units in Wist and 750 units in Malga). The relationship between dissolved salts and conductivity is a function of type and nature of the dissolved ions in water [3]. The high range of conductivity indicates the presence of a higher concentration of dissolved ions of inorganic acids, bases and salts. However, they are within the permissible limits of 750-2000  $\mu\text{S cm}^{-1}$ [4]. The  $\text{p}^{\text{H}}$  observed was in the range of 5.9 to 8.2 in Malga and from 5.8 to 9.2 in Wist indicating the slight acidic to alkaline range in both the places. The recommended pH range is 6 to 9.5. Seasonally, highest pH of 8.77 was recorded in the winter season at Wist and 7.43 in the rainy season of Malga. The total dissolved solids varied between 444 mg/L to 722 mg/L with the highest content being in winter season of both places (691.33 mg/L in Malga and 694 mg/L in Wist). This seems to be more than the extendable limits of 500mg/L [5] which might act as a gastro intestinal irritants.

### 3.2 Non-Specific Chemical Parameters

On the basis of hardness, water is classified as hard water and soft water. The total hardness varied seasonally from 190 mg/L in rainy season to 169 mg/L in winter season at Malga and between 129.67 mg/L in winter to 188.33 mg/L in rainy season at Wist, indicating that water was neither hard nor soft. The COD value was observed

in the range 0 - 3.7 mg/L in Malga and from 0.04 mg/L to 0.31 mg/L in Wist over the 12 month period. A few months recorded absence COD in both places.. The dissolved oxygen (DO) concentration indicates the pollution load [6],[7] in water. In the present study, the DO content varied from 0.39 mg/L to 4.22 mg/L at Wist and 1.9 mg/L to 7.2mg/L at Malga. The highest DO concentration was recorded in the winter season at Malga (5.63 mg/L) and in rainy season (5.27 mg/L) at Wist. The higher values of DO concentration indicates a fairly less polluted water.

### 3.3 Specific Chemical Parameters

**3.3.1 Anions** - The results obtained showed that chloride content ranged from 4.68 mg/L to 11.6 mg/L while recording the highest concentration of 26.96 mg/L in the winter season at Malga. Wist showed chloride concentrations of 10.2 mg/L to 59.5 mg/L over the 12 month period with the winter season recording the highest average of 35.55 mg/L. The chloride content was found to be within permissible limits [8]. Fluoride content was observed to be well within permissible limits (1.2 mg/L) showing a maximum of 0.89 mg/L at Wist and 0.84 mg/L at Malga in the summer season. Fluoride in excess causes dental fluorosis, skeletal fluorosis and crippling fluorosis [9].

The permissible limit of nitrates in drinking water being 10mg/L to 45mg/L, water samples at Wist and Malga of the Khargharb river showed negligible content of  $\text{NO}_3^-$  ions. Similarly, nitrite

concentration was within the levels permitted [4] in both places. It also indicates presence of biological contamination to an harmless extent.

The sulphate content ranged from 0.27 mg/L to 58.6 mg/L in Wist averaging the highest concentration of 3.42 mg/L in the rainy season. Malga exhibited an average concentration of 1.93 mg/L in the rainy season, which is the highest again. The phosphate concentration ranged from zero to 0.2 mg/L with the highest concentration of 0.18 mg/L both in winter and rainy seasons at Malga whereas the phosphate content at Wist was low ranging between 0.053 to 0.14 mg/L. The month of April 2012 in Malga and many months in Wist showed zero presence of phosphate, indicating not much pollution load and lack of sewage, agricultural and industrial disposal at the locations of study (Tables 1, 2, 3).

**3.3.2 Cations** - The calcium content was found to be in the range of 0.02 mg/L to 0.12 mg/L at Malga and between 0.05 mg/L and 1.1 mg/L at Wist (permissible limit 75 mg/L). The magnesium concentration was also found to be well within the standards of 30 mg/L in both places. Sodium and potassium were found to be in higher ranges. Sodium was in the range of 27.4 mg/L to 57.5 mg/L in the 12 month period studied with the winter season exhibiting the highest concentration at 46.50 mg/L in Malga. The wist town also showed a high sodium content of 42.99 mg/L in winter season

**3.4 Heavy Metals**

The water samples at both places were analyzed for a few heavy metals like cadmium, chromium, copper, iron and zinc. It was found that the heavy metals were below the detectable range in most months at both the places. And, if present were well within the permissible limits for most ions. However, Cd and Cr have been found to be in excess of the permissible limits in a couple of months indicating discharge of chemicals containing these elements.

The seasonal variations of the heavy metals is represented in Figs 1,2,3,4 and 5 which clearly indicate the negligible presence of the heavy metals. The heavy metals find their way into water bodies due to effluent discharge from industries and geo-chemical sources. The negligible presence of heavy metals in the present study indicates absence of heavy industrial activity near these locations.

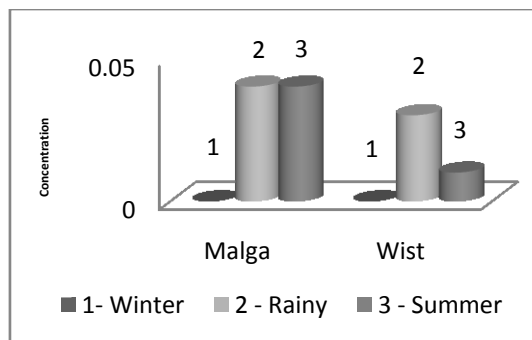


Fig 1. Average Seasonal Variation of Cadmium Ions

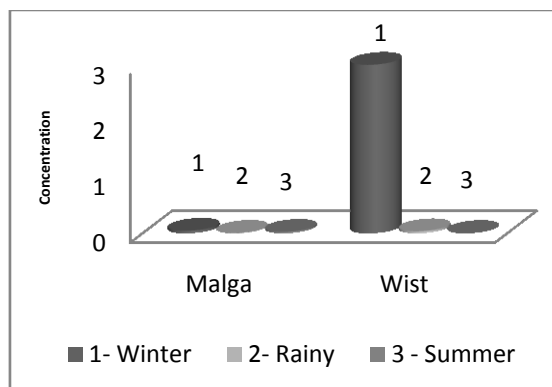


Fig 2. Average Seasonal Variation of Chromium Ions

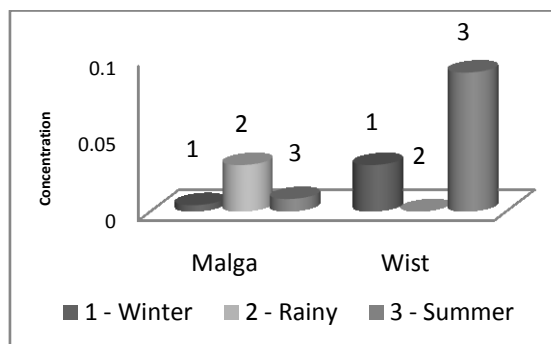


Fig 3. Average Seasonal Variation of Copper Ions

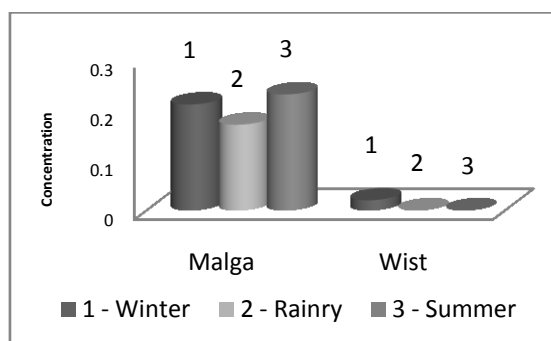


Fig 4. Average Seasonal Variation of Iron Ions

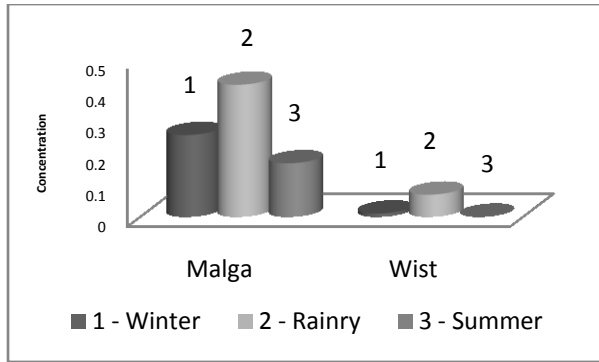


Fig 5. Average Seasonal Variation of Zinc Ions

4.0 STATISTICAL ANALYSIS

The Pearson correlation co-efficient analysis was done for the monthly parameters studied to estimate the degree of association amongst the various variables. Correlation co-efficients range between - 1.00 to 71.00 showing negative and positive association between parameters. The Pearson correlation tables for Malga and Wist of the all parameters are given in Tables 4 and 5.

The correlation co-efficient was found to be significantly negative between most parameters.

Table – 4 : Correlation table for monthly variation in Malga

	temp	cond	turb	pH	TDS	TH	Alk	COD	DO	ChloriNO3-	FluoriNO2-	Sulph	Phosp	Calcium	Mg	Sodi	pot	cadm	chrom	copper	iron	zinc		
temp	1.00																							
cond	-0.11	1.00																						
turb	-0.79	0.21	1.00																					
pH	0.17	-0.02	0.23	1.00																				
TDS	0.20	-0.34	0.29	-0.20	1.00																			
TH	-0.32	-0.50	-0.23	0.44	-0.10	1.00																		
Alk	-0.47	0.51	0.42	-0.04	-0.60	-0.14	1.00																	
COD	0.18	-0.57	-0.11	0.08	0.10	0.18	-0.26	1.00																
DO	-0.80	-0.08	0.59	-0.22	0.01	0.06	0.57	0.18	1.00															
Chloride	-0.17	0.63	0.27	0.21	-0.28	0.10	0.47	-0.59	0.07	1.00														
NO3-	-0.54	0.38	0.50	0.14	-0.32	0.21	0.70	-0.37	0.62	0.75	1.00													
Fluoride	-0.32	-0.44	-0.49	-0.17	-0.10	0.27	-0.24	-0.24	-0.39	-0.27	-0.34	1.00												
NO2-	-0.47	0.72	0.63	0.08	-0.22	-0.24	0.67	-0.56	0.38	0.74	0.82	-0.38	1.00											
Sulphate	0.68	-0.23	-0.42	0.49	-0.23	0.51	-0.29	0.26	-0.49	0.24	-0.05	0.17	-0.24	1.00										
Phosphate	-0.34	-0.30	0.21	-0.61	0.26	-0.19	0.06	0.09	0.49	-0.21	0.07	0.21	0.05	-0.34	1.00									
Calcium	-0.48	0.18	0.44	-0.29	-0.04	-0.32	0.40	-0.39	0.46	0.18	0.51	0.01	0.62	-0.43	0.30	1.00								
Mg	-0.27	-0.22	0.36	0.23	-0.07	0.18	0.43	0.18	0.27	0.03	0.12	0.09	-0.02	0.08	-0.08	0.02	1.00							
Sodium	-0.24	0.53	0.35	0.11	-0.09	-0.11	0.18	-0.67	0.12	0.52	0.48	-0.13	0.68	-0.33	-0.02	0.47	-0.43	1.00						
pot	-0.39	0.74	0.27	-0.41	-0.25	-0.57	0.72	-0.54	0.20	0.47	0.41	-0.19	0.62	-0.41	0.13	0.34	0.13	0.16	1.00					
cadmium	0.19	-0.18	-0.08	-0.20	-0.20	-0.01	0.06	-0.15	-0.30	-0.39	-0.35	0.64	-0.23	-0.10	0.06	-0.13	0.30	-0.19	0.03	1.00				
chromium	-0.43	0.38	0.15	0.03	-0.33	0.17	0.57	-0.48	0.35	0.30	0.58	-0.10	0.44	-0.40	-0.08	0.14	-0.06	0.31	0.46	0.17	1.00			
copper	0.02	-0.33	0.04	0.21	0.24	0.03	-0.18	0.58	-0.03	-0.29	-0.20	-0.29	-0.30	0.32	-0.33	-0.08	0.42	-0.67	-0.22	-0.19	-0.37	1.00		
iron	-0.18	0.11	0.06	0.13	-0.27	0.31	0.50	-0.08	0.20	0.04	0.32	0.04	0.20	-0.09	-0.28	0.07	0.43	-0.23	0.31	0.30	0.65	0.25	1.00	
zinc	-0.05	-0.07	0.20	0.21	-0.13	0.11	-0.01	-0.33	0.11	0.35	0.44	0.18	0.39	0.18	0.20	0.59	-0.21	0.59	-0.20	-0.14	-0.10	-0.29	-0.40	1.00

Table – 5 : Correlation table for monthly variation in Wist

	temp	cond	turb	pH	TDS	TH	Alk	COD	DO	ChloriNO3-	FluoriNO2-	Sulph	Phosp	Calcium	Mg	Sodi	pot	cadm	chrom	copper	iron	zinc		
temp	1.00																							
cond	-0.31	1.00																						
turb	0.34	-0.22	1.00																					
pH	-0.70	0.59	0.07	1.00																				
TDS	0.24	-0.04	-0.18	0.03	1.00																			
TH	-0.51	-0.12	-0.01	-0.20	-0.53	1.00																		
Alk	0.73	-0.11	0.04	-0.50	-0.52	0.36	1.00																	
COD	0.22	-0.01	0.22	-0.06	-0.01	0.00	0.23	1.00																
DO	0.56	-0.41	0.43	-0.56	0.03	0.44	0.42	0.36	1.00															
Chloride	-0.25	0.42	-0.10	0.53	-0.29	-0.20	0.22	0.09	-0.48	1.00														
NO3-	-0.06	0.51	-0.30	-0.09	0.18	-0.07	-0.18	0.23	-0.02	-0.02	1.00													
Fluoride	-0.51	0.40	0.03	-0.02	-0.32	-0.40	0.32	0.14	-0.33	0.28	0.12	1.00												
NO2-	-0.21	0.55	-0.10	0.51	-0.56	0.13	0.03	-0.42	-0.62	0.55	0.02	0.27	1.00											
Sulphate	0.14	-0.45	0.08	-0.62	0.37	0.18	0.02	-0.05	0.55	-0.68	0.04	-0.17	-0.57	1.00										
Phosphate	-0.23	0.11	0.02	0.25	0.14	-0.25	-0.63	0.33	-0.18	-0.05	0.52	-0.12	-0.17	-0.27	1.00									
Calcium	0.31	0.16	0.36	0.03	-0.61	-0.01	0.23	-0.32	-0.23	0.24	-0.04	0.43	0.72	-0.23	-0.24	1.00								
Mg	0.00	-0.31	-0.26	-0.27	-0.23	0.52	0.30	0.09	0.16	-0.04	-0.07	-0.35	0.15	0.22	-0.33	0.12	1.00							
Sodium	-0.20	0.60	-0.43	0.25	-0.04	-0.12	0.07	0.39	-0.43	0.52	0.59	0.28	0.36	-0.50	0.25	0.02	0.09	1.00						
pot	-0.21	0.70	-0.29	0.42	-0.21	-0.11	0.04	0.36	-0.48	0.68	0.56	0.34	0.50	-0.64	0.34	0.14	-0.03	0.94	1.00					
cadmium	0.17	-0.24	0.33	-0.42	-0.15	0.12	-0.23	0.08	0.32	-0.28	-0.15	-0.39	-0.20	-0.24	0.45	-0.08	-0.10	-0.42	-0.31	1.00				
chromium	-0.45	0.02	0.08	0.50	0.16	-0.40	-0.08	0.34	-0.30	0.76	-0.17	-0.05	0.06	-0.42	0.14	-0.14	-0.01	0.31	0.39	-0.13	1.00			
copper	0.23	-0.42	-0.18	-0.19	-0.22	-0.26	0.19	0.31	-0.21	0.19	-0.32	0.35	-0.24	-0.18	0.14	-0.15	0.00	-0.01	0.00	0.07	0.30	1.00		
iron	-0.13	0.24	0.47	0.32	0.09	-0.21	-0.21	-0.15	-0.12	-0.19	-0.28	0.38	0.18	0.22	-0.29	0.31	-0.28	-0.27	-0.24	-0.22	-0.16	-0.29	1.00	
zinc	-0.08	-0.25	0.07	-0.06	0.31	-0.02	-0.42	-0.07	0.13	-0.42	0.14	-0.64	-0.17	-0.09	0.40	-0.10	0.10	-0.02	-0.14	0.52	-0.17	-0.30	-0.28	1.00

## 5.0 CONCLUSION

The results obtained from the analysis of various physio-chemical characteristics of the river water at these two places at the sites chosen indicated that there was no harmful contamination in it. The absence of heavy metals also suggested that there is no toxicity in the water. Almost all the parameters studied were within the permissible limit for drinking water quality [4].

## 6.0 REFERENCES

1. R.K Trivedy, and P.K Goel., "Chemical and Biological Methods for Water Pollution Studies", Environmental Publications, Karad, India, 1986.
2. APHA Standard Methods for the Examinations of Water and Waste Water, 19<sup>th</sup> edition. American Public Health Association, Washington D.C, 1995, 2004.
3. C.N Sawyer, P.L McCarty, and F.Gene Parkin, Chemistry for Environmental Engineering, 4<sup>th</sup> Ed., McGraw-Hill, London, 1994.
4. World Health Organization, Guidelines for Drinking Water, Vol.2 Recommendations, World Health Organization, Geneva, 2004.
5. C.K.Jain, C. P Kumar, and M.K.Sharma, "Ground Water qualities of Ghataprabha Command Area, Karnataka, India", *J. Environ and Ecoplan*, 7(2), pp.251-262, 2003.
6. S.P Hosmani, and B.B Mallesh., "Observation on Pond Life with Special Reference to Algal Species Diversity Indicating Water Pollution", *Plant and Nature*, 3(1), pp.41-44, 1985.
7. C.K.Jain, Praveen Khatwari and S.A Geeta Pillai., "Water Quality of Hathai Khada Dam". *Irrigation Orient. J.Chem.* 12(2) pp.213-214, 1996.
8. R.Shiva Kumar. R.Mohan Raja. and P.A.Azeez, "Physico-Chemical Analysis of Water Source of Ooty, South India". *Poll Res.*, 19(1), pp.143-146, 2000.
9. S.Srikantswamy, Shakunthala Bai, Siamak Gholami and J.Mahadev, "Assessment of Seasonal Variation of Drinking Water Quality in Mysore, India". *Asian J. Environmental Science*. Vol 3(2) pp.104-110, 2008-2009.

**First Author** : Mr Hassan Ali Mojallal, He has done MSc, General Chemistry, from Teheran University, Iran in 1974. He has been teaching since 33years in Department of Chemistry, Teheran Imam Ali University and Teheran branch of Islamic Azad University, Iran, handling classes for both Bachelors and Master degrees in General Chemistry, Explosive Materials Chemistry and Sources of Energy. He has also written a book about explosive material chemistry and sources of energy which is published. At present he is working for his PhD degree at Yuvaraja's College Mysuru, India. He has published three papers on the research topic.

**Second Author: (Corresponding author)**, Dr Asha Iyengar T MSc Chemistry, 1981, from Department of Chemistry, Karnatak University, Dharwad, Karnataka, India. She has done her PhD in Physical Chemistry in the subject of Chemical Kinetics from DOS in Chemistry, Manasagangothri, University of Mysuru, Mysuru, India. At present she is working as Associate Professor in Department of Chemistry (UG and PG), Yuvaraja's College Mysuru. Currently she is guiding PhD students working on subjects- environmental chemistry, chemical kinetics and metal-organic ligand complexes.