STUDIES ON THE PHYSICO-CHEMICAL PARAMETERS OF THE WATER SAMPLES INFLUENCED BY TANNERY EFFLUENT DISCHARGE

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Abstract: The present study was aimed to see the influence of tannery effluent discharged in canal, river, well and bore waters collected from Vaniyambadi, Vellore district. For the present study water samples collected in the Girisamudram village of Vaniyambadi from untreated raw water (S1),tannery outlet discharge water (S2), canal water(S3), river water (S4), bore water (S5) and well water (S6) were analyzed for physico-chemical parameters such as turbidity, EC, TDS, PH, total alkalinity, total hardness, Ca, Mg, Fe, NH_3, NO_2, Cl, F, SO_4, and PO_4 and their results are depicted in table 1.The accepted limit mentioned in the text represents the standard for drinking water quality according to WHO(1984). The result showed that the content of EC, TDS, PH, total alkalinity, total hardness, calcium, magnesium, ammonia, chloride, fluoride and sulphate were found to be higher at manifold in the raw tannery water, outlet tannery treated water, canal carrying tannery effluent, river water mixing with tannery effluents. Despite the well and bore waters maintained the optimum condition of physico-chemical parameters, the content of EC, total hardness and sulphate are predominant in well water and bore water compared with portable purpose. It is concluded from this study that the increased level of physico chemical parameters present in the water samples may be due to the influence of tannery effluent discharge into the water. It is therefore suggested that industrial wastes should treated to the desired quality so as to render them in noxious or less harmful before their disposal into water bodies and that standard of effluent quality should be laid for abatement of pollution in the interest of public health and fisheries wealth.

Keywords: **Irrigation, Palar River, Physico-Chemical Parameters, Water Quality.**

Introduction: Many organisms made their habitat in lakes, rivers, ponds and the cells of terrestrial organisms are bathed in body fluids composed of largely of water. Water is one of the most abundant compounds found in nature, covering approximately three-fourths of the surface of the earth. The aquatic environment is a complex system that is influenced by many factors such as climate, weather patterns, landscape and geology. Most human activities and needs are closely related to water. Water is the soul of nature, its pollution will perish the world. The main pollutant that affects water bodies are identified as pesticides, heavy metals, industrial effluents, steel mills, oil refineries, chemical industries and sewage etc. More seriously, contaminated water destroys aquatic life and reduces its reproductive ability. In Vellore District places like Ranipet, Ambur, Vaniyambadi and Peranampet continue to maintain the dominant position in the tanning industry in Tamil Nadu (TN). The total number of tanneries in India has been estimated to be around 2500. There are so as many as 4,225 industrial units of significance in the country at present, and as per the new industrial policies of the Govt. of India and various State Government the number is likely to be double in 20-25 years.

In Tamil Nadu State, where 55% of India's tanning industry is located, over 35000 ha of land have become unfit for agriculture. Pollution from tannery effluents has rendered areas unsuitable for rice and sugarcane, declining by 40% and 80% respectively. Major tannery clusters in India are in Tamil Nadu, West Bengal, Uttarpradesh and Punjab. Nearly 90% of the tanning capacity is concentrated in these four states only. Within Tamil Nadu, tanneries are concentrated in Vellore, Trichy, Dindigul and Erode. Most of the Indian rivers and freshwater streams are seriously polluted by industrial waste of effluents. Effluents are waste products in a liquid form resulting from industrial processes and domestic activities. They are released by different industries such as fertilizer factories; oil refineries, pulp, paper, textile, sugar and steel mills, tanneries, distilleries, coal washeries, synthetic material plants for drugs, fibers, rubber, plastic etc.

Ghosh, et al. (1973) studied on survey and characterization of waste waters discharged from distillery, yeast, cotton textile, tannery, pulp and paper and rayon textile into the hooghlyestuary and reported that nearly 95 factories situated near hoogly estuary will adversely affects the physico-chemical parameters. Tamil Nadu Leather Corporation (1986) found out that the water quality in and around Vaniyambadi, Ambur, Ranipet and Dindigul are much polluted due to the discharge of leather tannery effluent in the river Palar. Thus, the agricultural lands, surface water resources and ground water sources were irreversibly damaged in places like Ranipet, Walajapet, Ambur and Vaniyambadi (Nandakumar and Backyavathy, 1986).

Bichi and Anyata (1999) reported that the Kano river basin of Kano is subjected to pollution caused by the

industrial discharges. Three major rivers in the basin are being used extensively for water supply, irrigation and fishing, the quality of the water was found to be unsuitable for these purposes, since it contains high content of COD, total solids, ammonia nitrogen.Tyagi (2000)reported that the concentration of some physico-chemical parameters like color, hardness, COD, BOD, chloride, fluoride, calcium, nitrate, phenols, cyanide and heavy metals like aluminum, arsenic, cadmium, copper, iron, manganese, nickel, lead, zinc in the industrial areas were much higher than the permissible limit of WHO (1993) drinking water standard.

Amathussalam and Gnanaganesan (2004) studied on physico chemical and bacteriological analyses of tannery effluent polluted ground water in Tiruchirappalli and found out that the ground water appears to be of poor quality and not suitable for drinking purpose. Gunwa, et al. (2006) studied on analysis of tannery effluents from the Challawa industrial estate in Kano, Nigeria and reported that the concentration of some physicochemical parameters like conductivity, alkalinity, chloride, sulphide, chemical COD and BOD of the Challawa river water diluted by the effluents of the discharge of tanneries were much higher than the permissible limits of Federal Ministry of Environment.

Patil shilapa, et al. (2011) studied on physico-chemical parameters and biological characteristics of lakes from Shivaji university campus Kolhapur Maharashtra reported that all the parameters were within the permissible limits except BOD, COD phosphate. The results indicated that the Rajaram Lake was more contaminated than remaining two lakes of Shivaji university campus, due to varies anthropogenic activity. Raullah, M., et al (2012) studied on physico-chemical analysis of Triveni lake water of Amravati district and reported that there was significant seasonal variation on some physico-chemical parameters and most of the parameters were in normal range and indicated better quality of lake water. It has been found that the water is best for drinking purpose in winter and summer seasons. Prasad, et al. (2014) studied on physico-chemical parameters to assess the water quality in obulvaripalli mandal of YSR (kadapa) and reported that ground water in the study area is not suitable for drinking purposes, and the TDS, EC, TH and fluoride concentrations were exceeding the permissible limits for human consumption, as per the standards of WHO.

Qureshimatva umerfaruq (2015) observed from physico-chemical parameters of water in Bibi Lake of Ahmedabad and revealed the high level of turbidity, total dissolved solids, PH, hardness, alkalinity and phosphate in the water content. The accumulation of these pollutants poses a dangerous threat to both aquatic and human lives. Smita anear and meena dongare (2016) observed through their study on determination of water quality index of some lakes around olhpur city Maharashtra that the water quality of shiroli and vadange is very poor for human consumption, whereas water quality of attigre and Pethvadagaon Lake is good for human use.

Figure 2. Map showing sampling stations in Girisamudram Area of Vaniyambadi, Tamil Nadu, India.

Materials and methods:

Study Area and Sampling Stations: The sampling area of Girisamudram is located nearer to the leather industrial area of Vaniyambadi in Vellore district. Vaniyambadi Town is located along National Highway No.46, Chennai to Bangalore road and 67 kms southwest of Vellore city. Vaniyambadi is situated between 78 – 35 and 78 – 38 North latitude and 12 – 42 East longitude. The town has an average elevation of 351.31 meters above M.S.L. It has covers an extent of 954.2031 Hectares out of this 446.457 Hectares are in Urban use and 507.7461 Hectares are in Non-Urban use consisting of agriculture wet, dry lands and Palar river. 46.39% of total areas are under urban use and 53.21% to total area are under non-urban use. Dry land for future urban use is 182.0087 Hectares or 19.07% to total area. All land under water bodies are occupied by river, Coconut Thoppu and other agricultural activities are grown in wet land. Extent of the town is 9.52Sq.Km. The town is located at 351.21 Meters from sea level. The total human population of the area is 195,061.

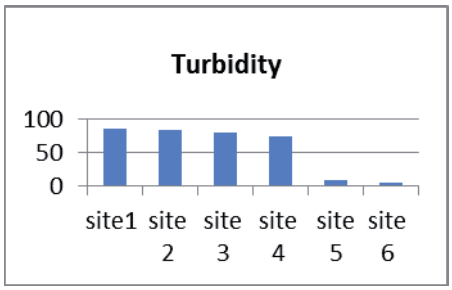
Sample Collection, Storage and Analysis: The water sample were collected from sampling stations of Girisamudram area of Vaniyambadi, Vellore district, Tamil Nadu namely, 1. Untreated tannery water (S1), treated tannery outlet water (S2), canal water (S3), river water (S4), bore water (S5) and well water (S7). During the water sampling, the pH of the water was ranged between 7.0 and 7.9 and temperature was ranged between 370C and 390C. The water sample collected using 1 liter of polythene container and 2kg of polythene bag with various numbers respectively were brought to the laboratory condition and refrigerated until the analysis of the physico-chemical parameters of the water samples. The methods followed for all the physico-chemical parameters were done according to the procedures given in APHA (2000).

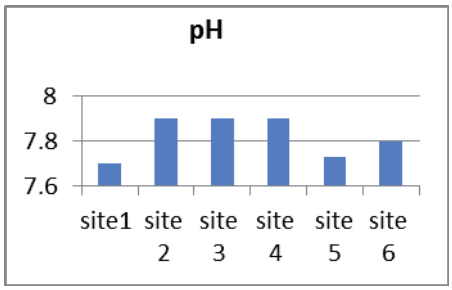
Result and discussion: For the present study water samples collected in the Girisamudram area of Vaniyambadi from untreated water (S1), outlet water (S2), canal water(S3), river water (S4), bore water (S5)and well water (S6) were analyzed for physico-chemical parameters such as turbidity, EC, TDS, PH, total alkalinity, total hardness, Ca, Mg, Fe, NH_3, NO_2, Cl, F, SO_4, and PO_4 and their results are depicted in table 1.The accepted limit mentioned in the text represents the standard for drinking water quality according to WHO(1984). The present study is aimed to see the influence of tannery effluent discharge in canal water, river water, and well water and bore water at Girisamudram area of Vaniyambadi Vellore district.Turbidity content of the untreated tannery water (S1),outlet treated tannery water (S2), canal water (S3), river water (S4), well water (S5) and bore water (S6) was recorded to be 85, 84, 80,75,9 and 4 and the color was reddish, pale yellow, blackish, blackish, turbidity and colorless respectively. Color and appearance may result from the presence of natural metallic ions like iron and manganese, human and peat material, plankton, weeds and industrial wastes. The result showed that the values of turbidity were higher in the all samples than the permissible limit of 10 except well and bore waters. Thus, it is predicted that the content of turbidity is likely to be decreased or increased according to the dilution level of tannery effluent into the mouth and middle of the canal water.

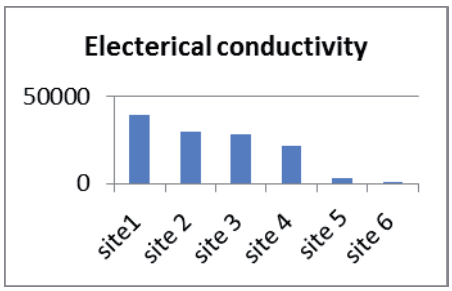
Table 1. Physico-chemical parameters of the water collected from Girisamudram Village of Vaniyambadi, Tamil Nadu, India.

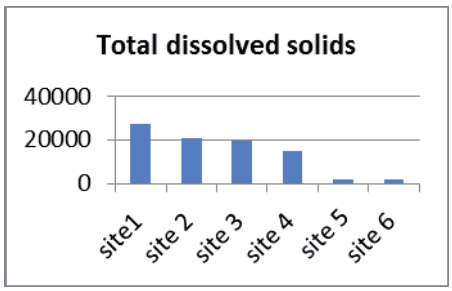
Parameters	Acceptable Limit WHO (1984)		Site-1 Untreated tannery raw water(S1) (mg/l)	Site-2 Outlet treated tannery water (S2) (mg/l)	Site-3 Canal water (S3) (mg/l)	Site-4 Palar water (S4) (mg/l)	Site-5 Well water (S5) (mg/l)	Site-6 Bore water (S6) (mg/l)
	Desirable	Permissible						
Appearance	-	-	reddish	Pale yellow	Blackish	Blackish	turbid	Colorless
Turbidity NTU	1	10	85	84	80	75	9	4
Electrical conductivity (Mic mho/cm)	-	600	39500	29800	28400	21400	2880	325
Total dissolved solids mg/l	500	2000	27650	20860	19880	14980	1900	1880
pH	7.0	8.5	7.70	7.90	7.90	7.90	7.73	7.80
Alkalinity total as CaCo3 mg/l	150	600	3200	8400	7800	6800	388	540

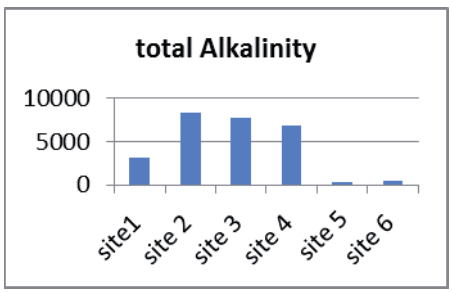
Total Hardness as CaCo3 mg/l	200	600	11060	8344	7952	5992	840	1020
Calcium as Ca mg/l	75	200	2654	2003	1908	1438	156	128
Magnesium as Mg mg/l	30	150	1062	801	763	575	58	59
Iron Total as Fe mg/l	0.1	1.0	0.932	0.932	1.034	0.932	0.35	0.28
Free ammonia as NH3 mg/l	0.1	-	10.20	24.00	24.00	12.00	0.125	0.125
Nitrite as NO2 mg/l	-	-	0.025	0.025	0.025	0.025	0.09	0.04
Nitrate as NO3 mg/l	45	100	4	5	5	5	3	3
Chloride as CL mg/l	200	1000	3480	2740	2590	1720	395	625
Fluoride as F mg/l	1.0	1.5	11.35	8.65	7.65	6.20	0.8	0.8
Sulphate as SO4 mg/l	200	400	1375	1875	1625	1800	734	182
Phosphate as PO4 mg/l	-	-	4.00	4.00	4.00	0.08	0.05	0.04

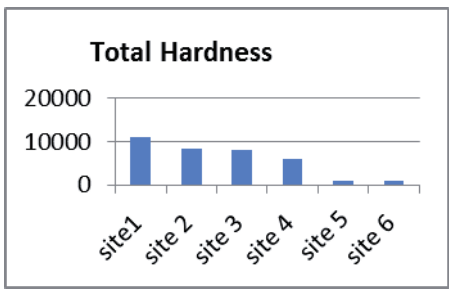












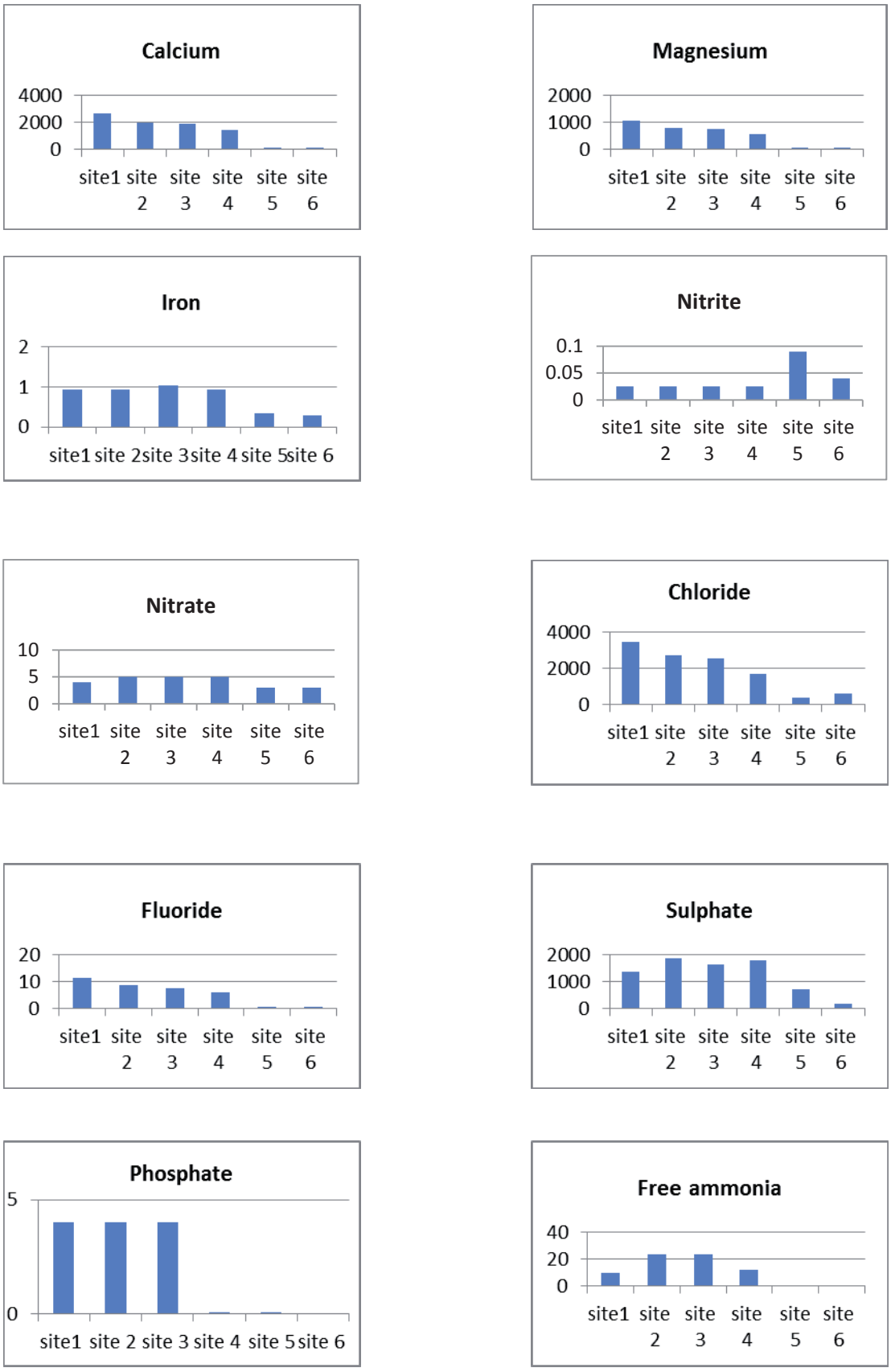


Figure 3. Variations of physico-chemical parameters in different sites of water samples collected from Girisamudram Village of Vaniyambadi (TN)

Electrical conductivity is a useful tool to evaluate the purity of water. The acceptable limit of EC is 600(WHO, 1984). The level of EC were seemed to be higher in all the water samples except bore water than the desirable limit of 600 for drinking purpose and this may be due to, the accumulation of total dissolved solids and ionic constituents. The high content of TDS was recorded in the sample as 27650 in (S1), 20860 in (S2), 19880 in (S3) and 14980 in (S4). In well water and bore water the TDS contents were found within the limit (1960 and 1880). It is predicted that the high level of TDS ranged between 14980 and 27650 from S4-S1 it renders for unsuitable for drinking and agriculture purpose.

The pH of the present study was fluctuated from 7.70 to 7.90 in all water samples from S1-S6. Result of the pH in the samples showed that there is no harmful effect due its presence varied between 7.70-7.90.Alkalinity is a total measure of the substances in water that have acid neutralizing ability. Alkalinity is not a pollutant. Total alkalinity of the water sample was likely to be increased in the outlet treated tannery water at S2 and these content were likely to be decreased according to the dilution level tannery water mixing at canal water S3and river water S4. The alkalinity of well and bore water was found to be with in the limit (388 and 540). Ions especially calcium, sulphate, magnesium and sodium impart hardness to water. The value of the total hardness in untreated tannery water (S1), outlet treated tannery water (S2), canal water(S3), river water (S4), well water (S5) and bore water (S6) was reported 11060, 8344, 7952, 5992, 840 and 1020 respectively. The highest value was found in untreated tannery water (S1) followed by other water samples (S2-S6). It is known that the value of well water and bore waters comparatively lower compared to manifold increase of total hardness in other water samples from S1- S4 and these values were higher than the permissible limit. However, hike of values at manifold renter the water unfit in many aspects. Higher content of Ca was always noticed from the station S1-S4 where the instruction of tannery effluent is suspected to be more. The acceptable limit of magnesium is 30-150. The content of Mg in S1 to S4 was recorded to be 1062, 801, 763 and 575 respectively and their values are higher than the acceptable at manifold.

Fe in all six stations from S1-S6 was found to be within the acceptable limit except the canal water (S3). The iron content for the present study was high only in the canal water at S3 and its fluctuation may be due to the presence of organic load in the water at various levels. In the present study, high content of Fe was detected only in the canal water at S3 and it was not detected in other samples and thereby it showed its harmless effect to the aquatic organisms. Ammonia content was high at manifold in raw tannery waters followed by outlet, canal and river waters. The content of (NO_3) in all water sample (S1-S6) was lower than the desirable limit of 45 as their values ranged between 3 and 5. As far as this study is concerned, the NO_3 level was poor and it may render the water unfit for agriculture purpose.

In the present study high content of Cl present in raw water, outlet water, canal water and river water showed its harmful effect for drinking purpose. In well and bore water this content was found within the acceptable limit. Content of F in S1to S6 was found to be 11.35, 8.65, 7.65, 6.20, 0.8 and 0.8 respectively and these values for from S1 to S4 were above the acceptable limit. It is predicted that the hike of this species at manifold may cause the water unfit for drinking and other purpose. Acceptable limit of SO_4 is 200-400. SO_4 content of untreated tannery water (S1), outlet treated tannery water (S2), canal water (S3), river water (S4), well water (S5) and bore water (S6) was recorded to be 1375, 1875, 1625, 1800, 734 and 182 respectively. It is predicted that the hike of this species at manifold may cause the water unfit for drinking and other purpose.

The excessive phosphate concentrations evoke an algal bloom in the water. Since nitrate, nitrite and phosphate are nutrients for plankton growth, the water is rich in algal contents. In the same way for the present study, high level was attributed may due to discharge of tannery effluents. Their result indicated that the drinking water was found to be highly contaminated with reference to most of the parameters. Their study suggested that people on this water are prone to health hazards of contaminated drinking water and some effective measures are urgently needed for water quality management.

Conclusion: The result of the present study showed that the content of EC, TDS, PH, total alkalinity, total hardness, calcium, magnesium, ammonia, chloride, fluoride and sulphate were found to be higher at manifold in the raw tannery water, outlet tannery treated water, canal carrying tannery effluent, river water mixing with tannery effluents. Despite the well and bore waters maintained the optimum condition of physico-chemical parameters, the content of EC, total hardness and sulphate are predominant in well water and bore water is comparatively for drinking purpose. It is concluded from this study that the increased level of physico chemical parameters present in the water samples may be due to the influence of tannery effluent discharge into the water. It may also lead to unsuitable condition for drinking purpose and survival of aquatic organisms. It is therefore suggested that industrial wastes should treated to the desired quality so as to render them in noxious or less

harmful before their disposal into water bodies and that standard of effluent quality should be laid for abatement of pollution in the interest of public health and fisheries wealth.

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