Study of some Physico-Chemical Parameters of Pond and River water with reference to Correlation Study

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Abstract : Surface water samples were taken and collected from pond and river samples in and around of Lumding Town of Assam and analysed for temperature, pH, conductance, TS, TDS, TSS, turbidity, hardness, total alkalinity, D.O., C.O.D., F^-, NO_3^-, HCO_3^-, Cl^-, SO_4^{-2}, Na^+, K^+, Ca^{+2}, Mg^{+2}, Fe. The results were considered for correlation analysis and it was observed that many of the parameters bear a good positive correlation and some bears a negative correlation.

Keywords: Surface (Lentic & Lotic) water, correlation study, physico-chemical parameters.

INTRODUCTION

Water the life's matter and matrix and without it life cannot exist. The presence of safe and reliable drinking water is an essential prerequisite for a stable community. So quality of water is to be determined for a locality of various purposes. As water balances human life system in a positive way, its negative effect is attributed by consequence of various parameters beyond the permissible limits. Many studies have carried out on the quality of water (Lentic & Lotic) in various   parts   of   the   country including Assam, but no such attempt was taken for Lumding Town, Nagaon District of Assam. Many of the Indian rivers, which are, used as drinking water contaminated by various sources [1,2,3,4,5,6,7]. The objectives of this study have been considered to investigate few water sources in Lumding Town, which are used for drinking purposes.

To determine the quality of water sources with respect to physico–chemical parameters and to study the statistical correlations among various parameters with significant values.

MATERIALS AND METHODS

Lumding is a railway divisional town which lies between $25\ ^0 45$ to $26\ ^0 45$ in North Latitudes & $91\ ^0 50$ to $93\ ^0 20$ in East Latitudes. The area is highly dry and so water scarcity is a common phenomenon of the locality. Their own supply water covers some of the railway area. So the local people adjoining the local town use pond and river water for their domestic purposes. Again this freshwater is contaminated by sewage or sewerage, run off materials, industrial waste, biological contamination, toxic metal ions, biodegradable, non- biodegradable pollutants. The shortage of pure domestic water, care should be taken throughout the world so people can take it in pure form to avoid unsafe consequences. Metals also settle in the bed sediments in the ponds and rivers and transported to the human food chain by other animals [8,9].

Water samples were collected randomly from six ponds (PI to P6) and four rivers (RI to R4) surrounding the Lumding Town and its adjoining areas. They were collected in pre- cleaned 2500 ml plastic containers. The samples were analysed in four seasons from May, 2001 to April, 2004.

Temperature is determined by mercury thermometer, pH is determined by digital pH meter, TDS, TSS, TS values were estimated by evoporation method, turbidity by Nephelometer, and conductivity by Conductivitymeter. Hardness, total alkalinity, bicarbonate, Ca^{+2}, Mg^{+2}, chloride, D.O. and C.O.D. were estimated by volumetric method. Sodium and potassium were analysed by digital flame photometer. Nitrate and fluoride by UV spectrophotometer and finally iron by Atomic Absorption Spectrophotometer. The methods applied as per APHA[10].

RESULTS AND DISCUSSION

Twenty-one parameters are analysed for water samples from ten (10) sampling stations, as per Table 1.
The results of the analysis were summarised in the Table 2 and compared with WHO levels.
The correlation coefficients (r) between various pairs of the physico- chemical parameters of surface water samples from ponds and rivers were furnished in the Table 3. For the determination of r values among different physico- chemical parameters a ready made Computer Programming is used, taking into account the all season mean of the experimental values of the parameters. The interferences drawn by observing the correlation coefficients of various pairs of parameters have been outlined below.

The excellent correlations of temperature with pH (0.442), TDS (0.756), TS (0.863) which satisfies the experimental result of these sources of water of the locality. There is a positive correlation of TDS with sodium (0.411) and potassium (0.303) that the alkali metals soluble precipitate of the pond and river water sources of Lumding. TDS is also strongly correlated to anions – F^- (0.208), HCO_3^- (0.706), Cl^- (0.145) as observed by Garg[11]. Again pH is positively correlated with conductance (0.170) and strongly correlated with TDS (0.731) and TS (0.583). Similar type of positive correlation of pH with conductance, TSS and TS in drinking water around a mine in Keonjhar district, Orissa were obserbed[12].
The pH values of surface water samples were significantly correlated with major cations (Na$^+$, K$^+$, Ca^{+2}, Mg^{+2}) and anions (F$^-$, HCO$_3^-$, Cl$^-$). Therefore, pH of surface water depend on hydrolysis of ions. Temperature is also positively correlated with D.O. (0.669) and C.O.D. (0.166) and increase of temperature dissolves more iron in water, which is

positively correlated (0.172) with temperature. The Pearson's correlation matrix and cluster analysis is an important tool to determine the pollution levels of waters[13].

The major inorganic ions dissolve in surface water of the experimental regions were fluorides, nitrates, chlorides, bicarbonates, sulphates of sodium, potassium, calcium and magnesium. It was observed significantly that the correlation of the pairs of sodium – potassium (0.782), sodium – calcium (0.331), potassium – calcium (0.760), potassium – iron (0.759), calcium – magnesium (0.594), calcium – iron (0.587), magnesium – iron (0.558). These types of positive correlation between the metal ions indicate that the metal ions are from the same source. Rajmohan et al (2003) showed similar type of positive correlation among the major cations in ground water of Kancheepuram Region, South India. In the same way the pairs of anions are positively correlated as: - fluoride – nitrate (0.254), fluoride – chloride (0.472), nitrate – chloride (0.161), nitrate – sulphate (0.192), bicarbonate – chloride (0.263), bicarbonate – sulphate (0.013). The excellent correlations between the anions were observed by researchers[13,14]. Karthikeyan[15] applied the linear and multiple regression equations on the influence of hardness, alkalinity, total dissolved solids and pH on fluoride in the drinking water of Veppanapalli block Dharmapuri District in Tamilnadu.

The hardness of surface water is positively correlated with major anions namely nitrate, bicarbonate, chloride, sulphate and cations – sodium, calcium, magnesium and iron. Hence from the correlation analysis it signifies that the surface water (pond and river water) of the study samples are hard water are of both type – temporary and permanent. A strong positive correlation of hardness with major cations and anions in the water quality of Western Yamuna, Delhi was also observed[16]. Total solids (TS) is strongly correlated with turbidity ($\approx$ 1) indicates that in the surface water total solids appear as turbidity. Temperature is also positively correlated with D.O. (r = 0.669) and C.O.D. (r = 0.166) signifies increase in temperature increases D.O. and C.O.D. Total dissolved solids (TDS) is strongly and positively correlated with TS (0.890) which indicates TDS was main contributory source of TS. Total suspended solids (TSS) is positively correlated with fluoride (0.053), nitrate (0.736), chloride (0.323), sulphate (0.430), calcium (0.603), magnesium (0.607), iron (0.203). So, it is significantly concluded these anions – cations combine and precipitate as total suspended solids (TDS).The analysis[17] of the sub-surface water quality of different sampling stations at Machlipatnam Town and found that the highest positive correlation (r=1.0) between specific conductivity and TDS and other parameters bear strong positive correlation.

Turbidity is positively correlated with alkalinity (0.381), but alkalinity is negatively correlated with the major anions and cations. Hardness is negatively correlated with total alkalinity (-0.414). Similar type of negative correlation was observed between hardness and total alkalinity (-0.450) in the Coastal Aquatic Systems around the Industrial Zone of Tuticorin, Tamilnadu[18].

Therefore, the determination of correlation coefficient analysis can be used as an important method for the interpretation among the physico – chemical parameters and pollution levels of the various surface waters of the locality.

Table 1. List of the Sampling Stations and Nature of Sources

Serial No.	Sampling stations	Nature of source
1.	Nadirpar	DW
2.	Halflong Road	DW
3.	Subash Palley	DW
4.	Patupather	DW
5.	Khanger basti	DW
6.	Santipara	RW
7.	Subash Palley	RW
8.	Ananda Palley	RW
9.	Lanka Road	RW
10.	Upper Babupatty	RW
11.	Nadirpar (East Lumding)	RW
12.	Bazar Area (Main Bazar)	RW
13.	Jarangdisha	RW
14.	New Coloney	RW
15.	Samajbari Area	RW
16.	Buddhamandir	RW
17.	Murabasti	RW
18.	Kamakhya Coloney	RW
19.	Loco Coloney	P
20.	Nadirpar (Sitlabari Area)	P
21.	Ananda Palley	P
22.	Halflong Road	P
23.	Santipara	P
24.	Jarangdisha	P
25.	Jhulanpool	R
26.	Lanka Road	R
27.	Near DRM Office	R
28	Balunala	R
29.	Railway Coloney	RSW
30.	ASEB Area	PHE

Abb: DW – Dug well, P = Pond, RSW – Railway supply water, RW – Ring Well, R – River, PHE – Public Health Engineering supply water.

Table 2: Summary Analysed Parameters and WHO Guideline Levels.

Sl. No.	Parameters	Minimum	Maximum	WHO level
1.	Temperature	15.9 ^{0}C	35.1^{0}C	
2.	pH	6.8	9.0	6.5 – 9.2
3.	Conductance	89	1410	
4.	Turbidity	1.2	16.4	5 - 25
5.	Hardness	28	200	200 - 600
6.	Total Alkalinity	23	800	
7.	TS	87.4	450.2	500 - 1500
8.	TDS	5.8	350	500 - 1000
9.	TSS	30.0	142.5	
10.	D.O.	1.9	8.8	4.0
11.	C.O.D.	7.8	125.0	10.0
12.	Cl^-	2.1	63.0	250 - 600
13.	HCO_3^-	20.0	145.0	
14.	NO_3^- - N	0.06	12.2	10 - 45
15.	F^-	0.1	1.2	1.0 – 1.5
16.	SO_4^{-2}	20.0	260.5	200 - 400
17.	Na^+	4.00	45.0	200
18.	K^+	1.2	29.0	
19.	Ca^{+2}	8.2	143.0	100
20.	Mg^{+2}	2.1	100.5	30 - 150
21.	Fe	0.4	5.4	0.3 – 1.0

Note: Temperature in ^{0}C, Conductance in μ mho cm^{-1}, Turbidity in N. T. U. and other parameters are in mg/l.

Table 3. Correlation coefficients (r) of some physico-chemical parameters of surface water (pond and river water) samples in and around Lumding Town of Nagaon District, Assam,India.

	Temp.	pH	Cond	TDS	TSS	TS	Turbidity	Hardness	Total alkalinity	D.O.	C.O.D	F -	NO$_3$-N	HCO$_3^-$	Cl$^-$	SO$_4^{-2}$	Na$^+$	K$^+$	Ca^{+2}	Mg^{+2}	Fe
Temp.	1.000	.345913	0.44179	0.75613	-.40367	.86254	-.19548	-.10079	-.37009	.668506	.165801	.032078	-.8071	.893147	.284714	-0.1093	.656206	.53151	-.04364	-.63287	.172206
pH		1.000	.169785	.730889	-.70386	.582562	-.13085	-.43085	.097468	.466658	-.16279	.08149	-.47441	.33235	.055391	-.35339	.220998	.19355	-.3178	-.53334	-.18062
Cond			1.000	.257375	-.01698	.460005	-.31466	-.09962	-.3512	.347295	.278742	-.33643	-.4257	.259091	.405627	.278464	.639402	.700813	.11651	.11116	.641525
TDS				1.000	-.73757	.890384	.180004	-.56663	.060587	.782574	.198045	.207766	-.72267	.706306	.145136	-.42444	.411228	.302542	-.46094	-.85409	-.28548
TSS					1.000	-.43694	.004571	.407134	-.16379	-.77183	.191927	0.053097	.736144	-.40145	.322508	.429814	-.31219	-.40478	.6032	.607139	.202887
TS						1.000	.095885	-.31499	-.19552	.716818	.366465	.197764	-.61789	.80335	.496953	-.21397	.554016	.303652	-.14173	-.71334	-.09657
Turbidity							1.000	-.53528	.381122	.163953	.578923	.512081	.327376	-.19779	.09156	-.33139	-.34285	-.58509	-.47652	-.34865	-.79395
Hardness								1.000	-.41437	-.32114	-.16189	-.15948	.265375	.077002	.251868	.37605	.016802	-.02373	.643368	.533881	.42439
Total alkalinity									1.000	-.23318	.146408	.30825	.148004	-.32404	-.13911	-.67418	-.60045	-.26709	-.52983	-.31072	-.49676
D.O.										1.000	.160456	-.09157	-.74623	.617164	.031116	-.12959	.667716	.48457	-.37875	-.5574	-.0625
C.O.D.											1.000	.666137	.145481	.035025	.736562	-.40296	-.20046	-.2779	-.36559	-.28333	-.371
F$^-$												1.000	.253817	-.04513	.471924	-.73477	-.65012	-.68377	-.51261	-.50433	-.76855
NO$_3$-N													1.000	-.65956	.161131	.192033	-.66919	-.79597	.297275	.56591	-.28384
HCO$_3^-$														1.000	.262901	.012558	.622668	.42174	.139395	-.53742	.114205
Cl$^-$															1.000	-.13404	.016504	-.18009	.165724	-.11582	-.0437
SO$_4^{-2}$																1.000	.512555	.259592	.808028	.722481	.64998
Na$^+$																	1.000	.787287	.330706	-.05379	.604054
K$^+$																		1.000	.076049	.000729	.759166
Ca^{+2}																			1.000	.594128	.586557
Mg^{+2}																				1.000	.558014
Fe																					1.000

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