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Investigation of Aquatic condition of *Chandola lake*, Ahmedabad, India

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ABSTRACT

Current inspection deals with Geographical fluctuation of aquatic condition of *Chandola lake* against hexadic depots. The results showed that the concentration of parameters vibrated according to moment and area. Hexagonal depots were substantially concerted within diploid preeminent category by cluster investigation. Ternary prominent plight are culpable for deviation of aquatic condition in *Chandola lake*. Aquatic condition in *Chandola lake* is invegiled by periodic deviations and releases from fleck origin of deterioration. Revamp geographical approach of inspection is mandatory to caparison maximum vulgarized space in encompassing space of *Chandala lake*.

Keyword: Geographical fluctuation, *Chandola lake*, Aquatic condition, Water pollution.

INTRODUCTION

Ahmedabad is the largest city of Gujarat. Now a days it is one of the commercial city in Gujrat. The River Sabarmati has prorated the city into bipartite section particularly eastward and westward Ahmedabad.

Due to industries and population the development of the city has changed. Mismanagement and unawareness of people the aquatic environment has disturbed. For this reason aquatic ecosystem is also effected.

This Lake is one of the bulkiest lakes of the city. It is located near Dani Limda road, Ahmadabad city. It is in circular form. It is spreader over 6, 18,100 m^2. 22059'03.33" N is its actual latitude and 72035'24.19" E is its actual longitude. Water from this lake is used for cultivation and industrial purposes. Kharikat canal is used for outfitting water of *Chandola lake*. From the encompassing rookery range the contaminated water also mixed up with lake water. The wastage water sweeping actinic was discharged by the washer man, cramped proportion commercial enterprises also discharges their ravage undeviatingly towards the lake[1,2].

Now days, for investigating geographical fluctuations of more than one variable, correlation matrix, cluster and principle component analysis are universally activated. Cluster analysis is applied to develop geographical illustration procedure by shrinking the count of specimen locations[7,8,9]. Very important method for calculating the eigen values of the attributes by which one can understand regarding the aquatic condition of lake is Principal Component Analysis (PCA)[14].

Methodology

Location of sample

Chandola lake is one of the bulkiest lakes of the city. It is located near Dani Limda road, Ahmadabad city. It is in circular form. It is spreader over 6, 18, 100 m^2. 22059'03.33" N is its actual latitude and 72035'24.19" E is its actual longitude. Water from this lake is used for cultivation and industrial purposes. Kharikat canal is used for outfitting water of *Chandola lake*.

Sample collection

Water samples are collected in the morning from the six locations of the lake in closed bottle to prevent fortuitous abridgement in specimen using suitable approach[5,6]. The physico-chemical parameters of the specimen is properly studied.

Investigation of Samples

The parameters were examined for different attributes such as Electric Conductivity(CEC), Turbidity(CTB), Total Dissolved solids(CTDS), potential of Hydrogen(CPH), Total Alkalinity(CTA), Total Hardness(CTH), Dissolved Oxygen(CDO), Calcium(CCa), Magnesium(CMg), Biochemical Oxygen Demand(CBOD), Chloride(CCl), Sodium(CNa), Nitrate(CN) and Phosphate(CP) as per standard method(APHA, 1998[7,8]. The experimental of values of the parameters of water quality characterization are shown in Table 1. The eigenvalues of the parameters of the Chandola lakes are graphically presented in Fig. 1, Fig. 2 represents denodram and Fig. 3 represents component plot.

Agglomerate Analysis

For calculating similarity or dissimilarity of data by dividing it into cluster Agglomerate analysis is applied. Euclidean distances and Ward's method is useful for this.[15]

Principle Component Analysis

PCA is used to recognize the co relationship among water attributes, with minimum effort[6]. It is used to minimize the original attributes by involving latent factors[15,16]. Before PCA, Kaiser-Meyer-Olkin (KMO) statistics and the Bartlett's test is used for analyzing the data. The limits of KMO value will be more than 0.5, and the limits of Bartlett's test will be always less than 0.05[15,16,17].

Interrelationship model

To determine the attachment between the attributes interrelationship model is act as the best tool. Using this one can conclude regarding data sets. The attributes may be in strong positive or negative relationship which is easily determined by using correlation matrix.

Analyzing the results

Brief of attributes of Water

The dissimilarity of numerous attributes of Chandola Lake water are recorded in Table 1.

Electric Conductivity (CEC): Range of Conductivity is from 3.19 mhos/cm to 4.25 mhos/cm. This is due high level of contaminated water[5,6].

Turbidity (CTB): The turbidity limit is between 19.23 NTU to 25.34 NTU. In general turbidity is due to dangling lifeless materials.

Total dissolved solids (CTDS): Its range is between 834 ppm to 1012. Fluctuations of dissolved solids are catastrophic for aquatic live. 400 ppm is suitable for the aquatic live.

pH (CPH): pH has a imperative aspect for water born species. 8.14 to 9.24 of pH range is observed (Table 1). It is very important for cultivation of fish. It determines the purity of lake water.

Total Alkalinity (CTA): Total alkalinity range of Chandola Lake is 198 ppm to 229 ppm. For aquatic live it must be more than 20 ppm.

Total Hardness (CTH Total hardness range is 324.56 ppm to 368.52 ppm which is good for aquatic life.

Dissolved Oxygen (CDO): Range of dissolved oxygen is 2.16 ppm to 4.56 ppm. It is less than 5 ppm. So it is not good for aquatic life.

Calcium(CCa): Calcium is very useful for plastron development, building of bone[41]. Its range in Chandola lake is 72.54 ppm to 104.56 ppm.

Magnesium(CMg): Magnesium effects the aquatic life . Its range in Chandola lake is 24.56 ppm to 36.20 ppm. Sometime it is associated to calcium and help the aquatic life.

Biochemical Oxygen Demand(CBOD): It is very useful for aquatic life. It is essential for organic matter. The CBOD value is between 1.16 ppm to 2.12 ppm.

Chloride(CCl): Its range in *Chandola lake* is 108.43 ppm to 117.45. Due to anatomical desolation of mammalian the consolidation of Chloride is high.

Sodium(CNa): It is a instinctive ingredient of mineral deposit water, but congregation of it is elevated by deterioration origin. Its range in *Chandola lake* ranges is 54.7 ppm to 69.8 ppm. The inclusion of contaminated aqua sweeping soapsuds are main cause of increasing sodium level in aqua.

Nitrate(CN): Release of excrement and wastage of factory materials are main cause of increased Nitrates into fresh water. Nitrate range of *Chandola lake* is between 7.8 ppm to 0.29 ppm to 11.8 ppm.

Phosphate(CP): Range of Phosphate in *Chandola lake* is between 1.14 ppm to 2,.15 ppm. This is due to the surrounding area which discharges the contaminated water in lake water.

Statistical Analysis

The monitoring station of *Chandola lake* is classified into two clusters. Dissimilarity of water quality between the clusters which is shown in Fig. 2. The Fig. 1 shows the scree plot of eigen values which is made my principle component analysis. Components are shown in Fig. 3 and its Eigenvalues are represented in Table 4 and after rotion in Table 5. It shows that the significant difference happened between the parameters. According to percentage they are different. Table 2 represents the correlation coefficient of the parameters which shows the relationship between the parameters.

Table 1: Water Quality of Chandola Lake (Experimental)

Name of Station	CEC (mhos/cm)	CTB (NTU)	CTDS (ppm)	CPH	CTA (ppm)	CTH (ppm)	CDO (ppm)	CCa (ppm)	CMg (ppm)	CBOD (ppm)	CCl (ppm)	CNa (ppm)	CN (ppm)	CP (ppm)
CL1	3.36	25.34	834	8.85	202	324.56	2.16	72.54	24.56	1.16	116.45	54.7	8.6	1.14
CL2	3.50	19.45	1012	9.24	229	368.52	3.23	89.67	29.34	1.98	109.45	65.4	7.8	1.78
CL3	3.19	23.36	956	8.14	212	343.14	4.56	100.45	34.76	2.12	117.45	69.8	11.8	1.56
CL4	4.23	21.50	987	9.18	224	329.53	2.87	104.56	30.76	2.05	108.43	57.8	9.6	2.15
CL5	3.27	19.23	825	8.76	198	360.56	3.65	98.43	36.20	1.45	112.3	56.4	10.5	1.89
CL6	4.25	20.34	998	8.43	209	358.65	3.22	83.65	25.89	1.67	117.54	65.4	8.5	2.02

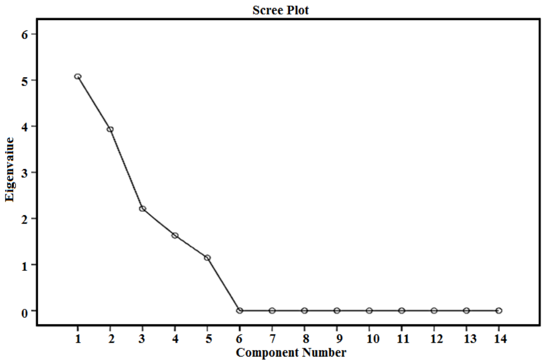

Fig. 1. Scree plot

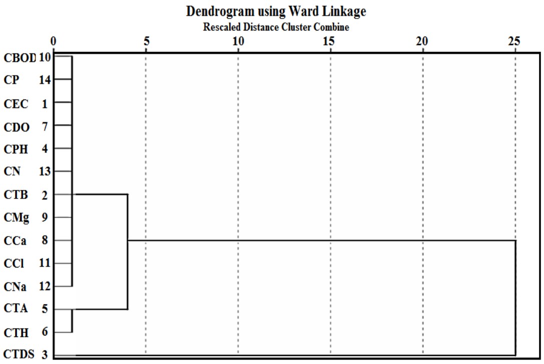

Fig. 2. Dendogram using Hierarchical cluster analysis

Table 2: Correlation matrix

Correlation Matrix	CEC	CTB	CTDS	CPH	CTA	CTH	CDO	CCA	CMG	CBOD	CCL	CNA	CN	CP
CEC	1.000													
CTB	-0.258	1.000												
CTDS	0.583	-0.327	1.000											
CPH	0.228	-0.275	0.089	1.000										
CTA	0.372	-0.261	0.841	0.513	1.000									
CTH	-0.074	-0.844	0.289	-0.013	0.142	1.000								
CDO	-0.348	-0.269	0.209	-0.628	0.009	0.427	1.000							
CCA	0.065	-0.408	0.274	-0.002	0.331	0.117	0.633	1.000						
CMG	-0.435	-0.358	-0.155	-0.211	-0.080	0.268	0.776	0.829	1.000					
CBOD	0.224	-0.278	0.805	-0.024	0.774	0.192	0.587	0.723	0.399	1.000				
CCL	-0.214	0.507	-0.234	-0.869	-0.621	-0.135	0.204	-0.484	-0.237	-0.345	1.000			
CNA	-0.020	-0.159	0.694	-0.519	0.404	0.450	0.716	0.223	0.165	0.699	0.301	1.000		
CN	-0.411	0.180	-0.256	-0.617	-0.329	-0.188	0.746	0.638	0.794	0.283	0.250	0.204	1.000	
CP	0.687	-0.775	0.538	0.201	0.391	0.402	0.213	0.635	0.289	0.511	-0.507	0.139	-0.010	1.000

Table 3: Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	10	14	.340	0	0	4
2	1	7	3.562	0	0	4
3	4	13	12.933	0	0	6
4	1	10	30.750	2	1	6
5	2	9	347.206	0	0	8
6	1	4	689.099	4	3	8
7	8	11	2671.210	0	0	9
8	1	2	6714.677	6	5	11
9	8	12	13575.165	7	0	11
10	5	6	69396.135	0	0	12
11	1	8	150990.404	8	9	12
12	1	5	778344.933	11	10	13
13	1	3	4984054.585	12	0	0

Table 4: Component Matrix

	Component				
	1	2	3	4	5
CEC	.285	-.632	.259	.096	.666
CTB	-.679	.232	.297	.625	-.082
CTDS	.726	-.351	.579	.120	-.011
CPH	.066	-.824	-.459	.115	-.306
CTA	.659	-.522	.235	.333	-.358
CTH	.521	.011	.019	-.827	-.212
CDO	.613	.776	.082	-.101	-.067
CCa	.793	.286	-.411	.316	.143
CMg	.532	.636	-.555	.023	-.066
CBOD	.889	.066	.237	.366	-.127
CCl	-.482	.577	.592	-.179	.229
CNa	.589	.353	.691	-.101	-.201
CN	.208	.877	-.234	.321	.170
CP	.775	-.292	-.180	-.138	.513

Eradication Method: Principal Component Analysis.
a. 5 components extracted.

Table 5: Rotated Component Matrix

	Component				
	1	2	3	4	5
CEC	-.293	.226	-.092	-.049	.923
CTB	-.183	-.076	.275	-.878	-.338
CTDS	-.103	.903	-.025	.160	.383
CPH	-.277	.005	-.958	.046	.064
CTA	-.060	.852	-.504	.029	.127
CTH	.022	.175	.052	.981	-.059
CDO	.743	.340	.447	.324	-.163
CCa	.891	.271	-.232	.079	.269
CMg	.953	-.046	-.053	.254	-.149
CBOD	.470	.859	-.093	.048	.175
CCl	-.186	-.155	.941	-.165	-.168
CNa	.149	.793	.510	.281	-.102
CN	.891	-.081	.367	-.224	-.118
CP	.312	.215	-.226	.424	.791

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.a
a. Rotation converged in 5 iterations.

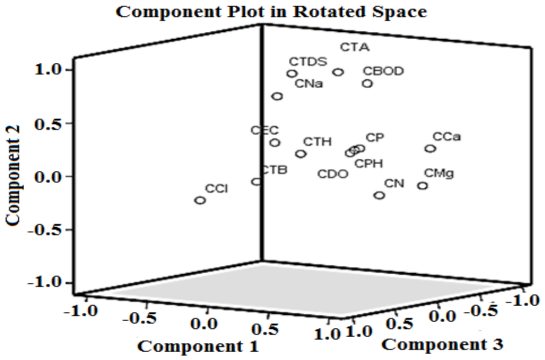

Fig. 3. Component plot

CONCLUSION

From experiment data, it is shown that maximum attributes are beyond the standard limits which conclude that the lake water is polluted. Principle component analysis also proves this that it is unhygienic for consuming purposes. This is due to human activities because they discharge the unwanted things in lake water which polluted the lake water. So monitoring system needed for this and investigate properly.

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Conflict of interest

The author declare that we have no conflict of interest.

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