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STATISTICAL APPROACH TOWARDS PHYSICO-CHEMICAL CHARACTERISTICS OF LAKE WATER: A REVIEW

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ABSTRACT:

Water is an essential natural resource for the existence of all living organisms and metabolic processes in the world. Lakes have always been of great importance to mankind being the valuable natural resources. From the ancient times they have always been supplier of water for domestic, industrial & irrigation purposes. A lake also plays an important role of catalyst in the development of any city but unfortunately, the popularity of lakes often leads to its deterioration. Due to increasing urbanization, industrialization & other developmental activities, the capacity & quality of lake water is getting deteriorated. Therefore, the present study has been undertaken to assess the quality of lake water &to study its possible Environmental impacts.Considering these factors and necessity this paper took the review of the existing literature of the modeling processes and to evaluate the lake water quality status.

KEYWORDS: Coefficient of Variation, Correlation Matrix, F-value, Mathematical modeling, Physico-chemical characteristics, P-value, Regression equation, Statistical approach, Water Quality Index.

INTRODUCTION:

Lakes are inland depressions comprising of standing enclosed water bodies which are being strongly influenced by the local climate. Lakes have always been of great importance to mankind being the valuable natural resources. Lakes are used by humans for many commercial purposes, including fishing, transportation, irrigation, industrial water supplies and receiving waters for waste water effluents. Aside from their importance for human use, lakes have intrinsic ecological and environmental values. They moderate the temperatures and affect the climate of surrounding land; they store water, thereby helping to regulate stream flow, recharge ground waters aquifers, and moderate droughts. They provide habitat to aquatic and semi aquatic animals and plants which in turn provide food for many terrestrial animals; and they add to the diversity of landscape.

In India, the lake systems are getting polluted day by day. As the water flows downstream, it picks up silt, minerals, and mineral salts from the soil. Many other pollutants enter lake water as it flows downstream, including animal waste, human sewage, agricultural runoff, urban runoff due to which unfortunately, most of the lakes are facing pollution problems. Hence, it is an upkeep interest to clean lake water.

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Therefore, we can freely access only the water in lakes. Of these, lakes are the best 'available fresh water source on the Earth's surface.' The Physico-chemical study could help in understanding the structure and function of particular water body in relation to its habitants. The proper balance of physical, chemical and biological properties of water in ponds, lakes and reservoirs is essential for limnological study.

LITERATURE REVIEW:

C. Barghigiani; et al.; (2001) has reported the results of a monitoring programme of six rivers (Serchio, Cecina, Cascina, Era, Elsa and Pavone) that drain north-west Tuscany (Italy). In this area, agricultural, industrial and urbanization pressures affect water quality, also in terms of suitability for the survival of aquatic organisms. The river waters were monitored for several physico-chemical parameters (temperature, DO, TSS, total ammonia, and nitrites, Cu, Cd, Cr, Ni and Pb) in order to assess the anthropogenic impact on the environmental conditions of these watercourses and their suitability for fish life.

S. K. Deshmukh; (2001) reported a study to assess the environmental facts of the existing waste

water treatment facility in Kolhapur and Ichalkaranji cities. Survey method was used for the generation of primary data. Stratified random sampling method was used to conduct the sample surveys in Kolhapur (E ward), villages downstream and the Ichalkaranji city. It was observed that the existing Sewage Treatment Plant adversely affected the water quality standards of Panchaganga River downstream, resulting in river pollution and substandard water supply to downstream cities and villages particularly Ichalkaranji. During the monitoring of the river Panchaganga, the B.O.D. levels were observed increased at Shirol and Ichalkaranji. It was due to mixing of untreated and partially treated domestic sewage into river from Kolhapur and Ichalkaranji cities. The water quality was also observed contaminated due to micro biological parameters.The study was used to carry out an investigation into alternative techno-feasible treatment.

A. B. Banakar, B. R. Kiran, E. T. Puttaiah;et.al.; (2005) carried out the research to analyze the hydrochemical parameters of water samples of Chandravalli pond near Chitradurga, Karnataka. The water samples where checked for parameters like pH, water temperature, electrical conductivity, turbidity etc & the results were tabulated month-wise. The results revealed that the water contained moderate content of all parameters except phosphates, nitrates & chlorides. Hence this pond is proved to be suitable for human consumption, as it is within permissible limits of drinking water as prescribed by ISI standards.

N. Ramamurthy, J. Subhashini and S. Raju; (2005) presented a study of the Vaniyambadi area, which has many tannery industries along the banks of Palar River, is a Major source of environmental pollution. Physico-chemical parameters, such as pH, Conductivity, carbonate, bicarbonate, chlorides, fluorides, calcium, magnesium, sodium, potassium, Sulphate, phenol, BOD and COD present in Palar River, Vaniyambadi area are determined and the intensity of pollution is assessed.

P. B. Lokhande, A. D. Gawas and H. A. Mujawar; (2005) presented a study focused on the determination of physico-chemical parameters, such as temperature, pH, turbidity, EC, hardness, chlorides, alkalinity, DO, BOD, COD, Sulphate and phosphate of water samples from different sampling points. In this investigation samples were collected from the Savitri River situated near Mahad city are of Konkan region. It was found that the water in all these places was not suitable for drinking purpose; however it may be used for domestic purpose.

R. K. Tiwary and Abhishek; (2005) carried out a study to assess the role of coal washeries in polluting the Damodar River. People living in the basin are slowly being poisoned because polluted and its tributaries are being used for drinking and other domestic purposes by the huge population of this area. The study revealed that coal fines in the form of suspended solids are the major pollutants and to reduce the level of pollution of the river, top priority should be given to proper management and disposal of coal fines.

Prakash Chandra Mishra;(2005) carried out a study to assess the water quality in Rourkela region of Orissa state; since Rourkela is the most important industrial centre in the mineral rich state of Orissa in eastern part of India. Various toxic gases, particulate matter and liquid effluents daily enter to the biosphere. Thus it is important to estimate the extent to which the water consumed by the residents of Rourkela city and the periphery areas has been polluted. For water analysis and assessment regarding the suitability of water for human consumption and other domestic purposes, specialized sampling and sample handling procedures are required. The samples were analyzed for various parameters like Temperature, pH, Turbidity, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Hardness, Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), Electrical Conductivity (EC), Residual Chlorine, Chloride, Sulphate, Total Alkalinity, Chemical Oxygen Demand (COD), Fluoride, Iron; etc. The results show that the water in the study region is having presence of more than 200 chemical constituents. Thus the treatment of the surface water in this region is to be done.

S.V. Mahajan, Savita Khare, V. S. Shrinivasa (2005) carried out a research for assessment of hydro chemical characteristics of groundwater samples from the bore wells of different locations of the nearby G.I.D.C.Vapi(Gujarat) were collected before & after rainy seasons. Total 19 parameters are within the permissible limit & some are beyond the permissible limits of drinking water standards. The correlation & regression calculated coefficients for water quality. In this study the results show that all the parameters are more or less, correlated with one another. Thus the linear correlation is very useful to get fairly accurate idea of the quality of the ground water experimentally.

Ammar. Tairi , Abderrahamne Boudoukha (2007) made a research on assessment of water quality of KoudiatMedouar dam from the country Algeria with the help of principle component analysis. The water was assessed to check whether it was safe for drinking or not. Water samples were checked for the parameters like pH, TDS, EC etc. Due to tremendous increase in the population and industrialization, water demands are getting high day by day. The water bodies in this area are

highly influenced by the geology. So, main aim of the study was to assess the quality of water in this area.

M. M. Khan, M. Admassu and H. R. Sharma; (2009) presented study of the water quality of river Shinta which was assessed near Azuzu area of Ethiopia with the view of determining the effects of urban activities, human settlement and industrial effluent discharge on its water quality. There were distinct variations observed in some water quality parameters. The survey results showed that about 25 % of the respondent's children face health problems and about 18.75 % of the respondent's complaints about irritation after taking bath from the river water. About 25 % of respondents reported illness of their domestic animals as they believed it may be due to consumption of polluted river water whereas, 59 % who are using river water for irrigation purposes complained of wilting of seasonal crops and decrease in crop yields.

S. Harinath; (2009) presented study which aims at assessment of water quality of Bommanahalli Lake. Data were collected for four sample stations to assess the quality of water from the lake for human consumption and irrigation. The physico-chemical parameters of experimental water samples were collected and analyzed as per standard methods; also obtained values were compared with standard values, which are recommended by Bureau of Indian Standards (BIS). This study showed that the water is unsafe for human consumption.

Akshay R. Thorvat, N. P. Sonaje & M. M. Mujumdar; (2011) presented the study in which river water samples were collected from four different stations of Panchaganga river in Kolhapur city and water quality assessment was carried out from october 2009 to March 2010 on weekly basis. Then correlation-regression study was carried out and correlation coefficients (R) were determined using correlation matrix to identify the highly correlated and interrelated water quality parameters. The correlations among water quality parameters for each station were determined. Pairs of parameters were selected having significant R and regression models were developed for the four different stations. To test the significance of the pair of parameters P-value test was carried out and in order to test the joint effects of several independent variables, without necessarily taking the separate effects of each variable into account, F-test was also used. The comparison of the observed and predicted values of the different parameters using regression equations revealed that the regression model can be used to provide a mean for easier and faster monitoring of water quality in a location. The correlation study and correlation coefficient values can help in selecting the treatments to minimize contaminants in river water.

P. Satheeshkumar et al (2011) in their research different multivariate statistical analysis such as, cluster analysis, principal component analysis, and multidimensional scale plot were employed to evaluate the tropic status of water quality for four monitoring stations. They carried study out to determine the physicochemical parameters of water and sediment characteristics of Pondicherry mangroves— southeast coast of India, during September 2008– December 2010. Seasonal variations of different parameters investigated were as follows: salinity (10.26–35.20 psu), dissolved oxygen (3.71–5.33 mg/L), pH (7.05– 8.36), electrical conductivity (26.41–41.33 ms−1), sulfide (1.98–40.43 mg/L), sediment texture sand (39.54– 87.31%), silt (9.89–32.97%), clay (3.06–31.20%), and organic matter (0.94–4.64%). pH, temperature, salinity, sand, silt, clay, and organic matter indicated a correlation at $P<0.01$. CA grouped the four seasons in to four groups (pre-monsoon, monsoon, postmonsoon, summer) and the sampling sites in to three groups. PCA identified the spatial and temporal characteristics of tropic stations and showed that the water quality was worse in stations 3 and 4 in the Pondicherry mangroves.

J. Sirajudeen et al (2013) in their work Statistical approach and assessment of physico-chemical status of ground water in near proximity of South Bank Canal, Tamil Nadu, India done the physico-chemical status of water samples from five major part of locality in Karur and Tiruchirappalli cities, Tamil Nadu was assessed. The sampling points were selected on the basis of their importance. The physicochemical parameter like, temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), total hardness (TH), calcium (Ca) magnesium (Mg), sodium (Na), potassium (K), nitrate (NO3) sulphate (SO4) and phosphate (PO4) of ground water was determined. It was found that the ground water was contaminated at few sampling sites namely Mayanur, lalapet and Petavaithalai. While the sampling sites showed physicochemical parameters exceed the water quality standards and the quality of water is bad and it is not fit for drinking purpose. For the statistical analysis, correlation co-efficient (r) were also calculated for these water quality characteristics.

S. Venkatramanan et al (2013) in their research A multivariate statistical approaches on physicochemical characteristics of ground water in and around Nagapattinam district collected Ground water samples at different locations in and around the Nagapattinam district and analyzed for their physicochemical characteristics. The ground water

samples were collected from fifty two dug and deep wells during the monsoon and summer seasons in June and December, 2011. They investigated on the determination of physico-chemical parameters such as pH, EC, TDS, Ca, Mg, Na, K, HCO_3, SO_4 and Cl. Factor analysis indicated that seawater intrusion and agriculture runoff are dominant factors controlling the hydrogeochemistry of ground water in the study area. This study also elucidates that multivariate statistical analyses can be used to improve the understanding of ground water status and assessment of ground water quality.

Salim Aijaz Bhat et al (2014) in their research Statistical Assessment of Water Quality Parameters for Pollution Source Identification in Sukhnag Stream: An Inflow Stream of Lake Wular (Ramsar Site), Kashmir Himalaya statistically analyzed the deteriorating water quality of the Sukhnag stream, one of the major inflow stream of Lake Wular. Statistical techniques, such as principal component analysis (PCA), regression analysis, and cluster analysis, were applied to 26 water quality parameters. PCA identified a reduced number of mean 2 varifactors, indicating that 96% of temporal and spatial changes affect the water quality in this stream. First factor from factor analysis explained 66% of the total variance between velocity, total-P, NO3–N, Ca2+, Na+, TS, TSS, and TDS. Bray-Curtis cluster analysis showed a similarity of 96% between sites IV and V and 94% between sites II and III. The dendrogram of seasonal similarity showed a maximum similarity of 97% between spring and autumn and 82% between winter and summer clusters. For nitrate, nitrite, and chloride, the trend in accumulation factor (AF) showed that the downstream concentrations were about 2.0, 2.0, and 2.9, times respectively, greater than upstream concentrations.

Hussien M EL- Shafei (2014) in his work Assessment of some water quality characteristics as guide lines for the management of pond fish culture in Lake Manzala, Egypt Hussien M EL- Shafei demonstrated the usefulness of multivariate statistical approaches for analysis and interpretation of water quality data, identification of pollution sources and understanding of temporal variations in water quality for effective lake water quality management.

Kumar Manoj et al (2014) in their research Multivariate statistical techniques and water quality assessment: Discourse and review on some analytical models discussed basic knowledge of the five multivariate data mining approaches, namely, cluster analysis, principal component analysis, factor analysis, multiple linear regression analysis and discriminant analysis, and highlights their applications in the characterization and classification of the surface water quality. The review also presents some of the basic concepts of the newly employed source apportionment receptor modeling technique involving multiple linear regression (MLR) and absolute principal component scores (APCS-MLR model) for extensive water quality assessment.

Deepa P et al (2016) in their work Seasonal variations of physicochemical parameters of Korattur lake, Chennai, Tamil Nadu, India carried out a study to assess the physicochemical parameters of Korattur lake. The samples were analysed for a number of physicochemical parameters viz., colour, odour, temperature, turbidity, Electrical conductivity (EC), pH, alkalinity, Total dissolved solids (TDS), Total hardness (TH), Dissolved oxygen (DO), chloride, fluoride, calcium, magnesium, ammoniacal nitrogen, nitrate, nitrite, sulphate and phosphate using standard protocols.

SUMMARY OF LITERATURE:

After thorough evaluation of the related literature, it can be revealed that, Physico-chemical characteristics of lake or river water have been significantly altered by human activities as well as natural dynamics which consequently affect the water quality and quantity, biodiversity & ecological imbalance. The different water quality characteristics are calculated by developing Regression Equations & are compared with the observed values. The correlation analysis on water parameters revealed that all parameters more or less co-related with each other.

Regular monitoring and comprehensive assessment of water quality and its associated processes require sophisticated analytical models to reveal concealed instruments controlling their properties. This information is essential to design monitoring frameworks and sustainable management of the water resources. Intelligent data analysis techniques like multivariate statistical models can greatly assist in water quality management programs.

Also the agricultural and domestic sewage drained into the surface water from urban and rural lands have an adverse effect on water quality characteristics of the lake or river water.

CONCLUSION:

Lakes and their surrounding areas are fragile ecosystems that face increasing threats from water abstraction, fast growing townships and human population. Unchecked destruction of lakes has been halted by the intervention of the local government and the untiring efforts of Non-Governmental Organizations. However, continued monitoring of water quality and

stricter conservation measures are needed to preserve these beautiful natural repositories of flora and fauna.

The correlation regression study provides a mean for easier & faster monitoring of water quality at the location & to predict the various water quality parameters. The study also helps in selecting the treatment methods to minimize contaminants in lake or river water.

The water quality index (WQI) study is aimed to assess the environmental impacts on the lake or river water quality and to check the level of pollution at the located stations. However, the WQI depends on the intended use of the water.

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