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EVALUATING STATISTICAL ANALYSIS OF WATER PARAMETERS IN DHOLAWAD AND MAHI BAJAJ SAGAR DAM

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ABSTRACT

The growing worldwide population and extensive developmental activities have led to the overexploitation and pollution of our water resources, resulting in a significant global concern for water quality. Assessing the quality of water is crucial to ensure the long-term and responsible utilization of freshwater resources. This study examines the water quality of Dholawad Dam and Mahi Bajaj Sagar Dam by studying essential factors that are important for evaluating its appropriateness for agricultural and household use. Water samples were obtained from eight separate sampling locations across both dams, with four locations assigned to each dam (B1, B2, B3, B4 for Dholawad Dam and B5, B6, B7, B8 for Mahi Bajaj Sagar Dam). The examined metrics consist of Sodium Adsorption Ratio (SAR), Chloride Alkalinity Index (CAI), Percent Sodium (%Na), Kelly's Ratio (KR), and Langelier Saturation Index (LSI), all measured in milligrams per liter (mg/L).

Keywords: Statistical analysis, Kelly's Ratio, Sodium, Water, Agricultural

I. INTRODUCTION

India is confronted with a significant challenge of a lack of natural resources, particularly water, which is particularly problematic in light of the country's expanding population and rapidly developing economy. The majority of fresh water sources across the world are becoming contaminated, which might lead to a reduction in the amount of water that is suitable for human use. Every living thing is dependent on water, and water may be found in nature in a variety of forms, including the ocean, rivers, lakes, clouds, rain, snow, fog, and so on. However, according to the strictest definition, water that is chemically pure does not occur in nature for any amount of time that is even somewhat noteworthy.

There is a vast range of variation in the chemical composition and biological content of water across different geographical areas and historical eras. Water is an essential resource that has the ability to maintain ecosystems as well as human societies. An extensive range of measures are included in the examination of water characteristics. These measurements include pH levels, dissolved oxygen content, nutrient concentrations, heavy metal pollutants, microbial populations, and a variety of other measurements. There is a significant impact on ecological balance, human health, and economic activities that are dependent on water supplies, and each of these factors offers essential insights into the state of aquatic habitats. For the purpose of

comprehending the quality, distribution, and environmental effect of water resources, statistical analysis of water parameters is an extremely important component. The ongoing interaction that water has with both natural and manmade elements makes it necessary to conduct in-depth research in order to guarantee that it is both safe and sustainable. Water is crucial for all kinds of life.

Calculating the relative concentrations of sodium, calcium, and magnesium ions in water is the purpose of the SAR, which is a metric that is commonly utilized in the process of evaluating the quality of water for irrigation purposes. It is possible that salt buildup is causing the soil to degrade, which would result in decreased soil permeability and water penetration rates. A high SAR suggests that this might be the case. By evaluating the equilibrium between chloride and alkalinity, which is very important for identifying the corrosiveness of water, CAI is a useful supplement to SAR. The percent sodium (%Na) gives a direct measurement of the sodium concentration in comparison to the other cations, which provides insights into the appropriateness of water for irrigation and the possible hazards of sodicity related to it. For the purpose of maximizing crop yields and sustaining soil fertility, these metrics collectively provide information that is used to influence agricultural methods and water management measures.

Using the ratio of sodium to calcium and magnesium ions, Kelly's Ratio (KR) is a method for determining the possibility for sodium hazards. Values that are lower than one indicate that the sodium dangers are lower and that the water quality is better for irrigation. However, LSI evaluates the water's calcium, alkalinity, pH, and temperature properties in order to determine whether or not it has a potential to cause corrosion or scale formation in plumbing systems. As a result of the direct relationship between water quality and operational efficiency and equipment durability, these metrics are vital for determining whether or not water is suitable for use in industrial applications and home settings.

II. REVIEW OF LITERATURE

Muniz, Daphne & Oliveira-Filho, Eduardo. (2023) Conducting research on water quality is an essential measure to preserve environmental and human well-being. Water quality analysis involves several dimensions since it allows for the simultaneous measurement of different properties. This complex character promotes the practice of statistically analyzing data created by multivariate statistical analysis (MSA). The aim of this study was to examine the research on water quality using MSA (Multivariate Statistical Analysis) between the years 2001 and 2020, as documented in the Web of Science (WoS) database. The areas included in the study were annual results, subject categories in the Web of Science, traditional journals, highly cited publications, keywords, types of water samples tested, the nation or region where the study was done, and the most often utilized multivariate statistical methods. The findings indicate a significant rise in the utilization of MSA in water quality research during the past two decades, particularly in developing nations. The water sample types that received the greatest attention in research were rivers, groundwater, and lakes. The most often utilized approaches were

principal component analysis (PCA), hierarchical cluster analysis (HCA), factor analysis (FA), and discriminant analysis (DA), listed in descending order. This review provides pertinent information for researchers to select the most suitable methodologies for analyzing water quality data.

Stricevic, Ljiljana et al., (2021) This study examines the water quality of the Nišava river basin during 2009–2018 using data collected from four hydrological stations. The analysis focuses on many parameters including pH, conductivity, O 2 saturation, BOD 5 , suspended particles, total oxidized nitrogen, phosphates, turbidity, and coliform bacteria. Authors have utilized the water quality index (WQI) as a dependable measure of watercourse pollution to establish the quality of surface water flow. The statistical technique of analysis of variance (ANOVA) was employed, together with the t-test for inferential statistical analysis and the post-hoc Tukey test, to assess the presence of statistically significant differences across distinct data groups. The findings indicate that poor water quality was consistently recorded across all profiles on a yearly basis, with a Water Quality Index (WQI) ranging from 65 to 71. As the river flows downstream, the pH of the water lowers, but the levels of BOD 5 , suspended particles, turbidity, TON, phosphates, and coliform bacteria steadily increase. The waters of the Nišava at the Niš station are classified as third-class waters and are predominantly contaminated with organic matter derived from sewage waste and industrial effluents from both urban and rural regions.

Barbulescu, Alina & Dani, Anita. (2019) Over the course of eight years, researchers at 23 different hydrological stations in India used secondary historical data from the Beas River to examine the river's water characteristics. We have examined the variations at the stations and each year by doing similarity tests for each parameter. In order to analyze the data on river water quality, two categorization methods were employed, and an aggregated indicator of water quality (WA) was calculated by taking the mean of each parameter. In order to generate three distinct profiles from the whole set of data acquired from the Beas River stations annually, two-step clustering was the method of choice. To categorize all stations according to the WA indication, the C&RT approach was employed. Any data for making recorded decisions regarding preserving and improving the water quality of different rivers can be used using this strategy.

Radulescu, Cristiana et al., (2017) To ensure the health of both humans and the environment, it is necessary to test drinking water for metal pollution. This study sought to assess the water quality in 75 wells located in Dambovita County, Romania in 2015 by analyzing their physicochemical features and the concentrations of various elements, such as lead, cadmium, copper, manganese, aluminum, zinc, iron, and barium. The concentrations of these metals (µg/L) in drinking water samples taken from various wells in rural areas, mostly for personal use, were measured using ICP-MS. These results were then compared with those reported by Romanian authorities and the World Health Organization, with the aim of determining whether these metals could be the cause of certain health issues in rural areas. We used principal component analysis (PCA) to extract variables related to water quality from the collected

dataset.

K, Murali & Jerin, Cf. (2015) This research investigates the groundwater in the Coimbatore South Taluk of the Coimbatore District by statistically analyzing a number of physicochemical factors. Using the many features of the outstanding statistical program SPSS greatly simplified the statistical analysis. Correlation and coefficient of determination values range from 0.828 to 0.992 and 0.721 to 0.983, respectively, confirming that the maximal parameters exhibit strong correlation. In order to predict one or more variables in terms of others, regression equations were constructed based on the correlation of parameters. These equations build connections.

Leščešen, Igor et al., (2015) The Drina River is the largest affluent of the Sava River, formed by the confluence of the Tara and Piva rivers in Scepan Polje. The Drina river serves as the demarcation line between Serbia and Bosnia & Herzegovina. The Water condition Index (WQI) is a numerical measure used to assess the condition of water bodies and facilitate comprehension for management. This study aimed to evaluate the water quality conditions and analyze the geographical and temporal patterns along the Drina river. The assessment was conducted using seven water quality index (WQI) measures, based on an eight-year public database of environmental data from 2004 to 2011. The evaluation of the sustainability of development in the region heavily relies on the water quality of the Drina river. This quality is influenced by a combination of human activities and natural forces. The pH values increased gradually from CP1 to CP3, however at CP4, the pH value was lower (8.11) compared to the two preceding control points (CP2 8.14 and CP3 8.16). The 02 saturation exhibited its maximum values at CP1, reaching 121.3%, whilst the lowest values were recorded at CP3, measuring 101.8%. The BOD5 measurements at all four control points indicate that the water quality of the Drina River may be categorized as Class I, with a concentration of less than 2 mg/l. Based on statistical data processing, we can conclude that the water quality of the Drina River at all four check stations is suitable for its use.

III. RESEARCH METHODOLOGY

This study examines the water quality of Dholawad Dam and Mahi Bajaj Sagar Dam by assessing many metrics, including Sodium Adsorption Ratio (SAR), Chloride Alkalinity Index (CAI), Percent Sodium (%Na), Kelly's Ratio (KR), and Langelier Saturation Index (LSI). Water samples were obtained from eight distinct locations, with four samples taken from each dam (B1, B2, B3, B4 from Dholawad Dam and B5, B6, B7, B8 from Mahi Bajaj Sagar Dam). A comparative investigation was performed to find notable disparities in the water quality indicators between the two dams. In addition, correlation analysis was conducted to ascertain the dependency of the characteristics.

IV. RESULTS AND DISCUSSION

Table 1: Statistical Analysis of Various Water Sample Readings

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Statistical Parameters	Dholawad Dam				Mahi Bajaj Sagar Dam			
	B 1	B 2	B 3	B 4	B 5	B 6	B 7	B 8
SAR	7.32	10.12	10.07	7.44	5.70	5.42	4.18	5.24
CAI	0.77	0.69	0.61	0.66	0.65	0.25	0.40	0.32
%Na	0.51	0.55	0.59	0.51	0.43	0.39	0.37	0.44
KR	0.85	1.13	1.06	0.99	0.65	0.59	0.48	0.75
LSI	-0.04	0.54	0.77	-0.52	0.02	0.28	0.59	-0.62

Note: All ionic concentrations are expressed in mg/l.

Dholawad Dam has SAR values between 7.32 to 10.12, suggesting a moderate to high salt hazard risk at various sample locations. Points B2 and B3 have the greatest SAR values, which suggests that there is a greater chance of soil permeability problems and salt buildup that is bad for farmland. The SAR values of Mahi Bajaj Sagar Dam are lower, ranging from 4.18 to 5.70, indicating that it is a safer place to water crops than Dholawad Dam.

In Mahi Bajaj Sagar Dam, the Chloride Alkalinity Index (CAI) ranges from 0.25 to 0.66, but in Dholawad Dam, it ranges from 0.61 to 0.77. At certain sites of Mahi Bajaj Sagar Dam, such as B6 and B8, the CAI readings are greater, which might indicate that the water is more corrosive than usual. This could be due to higher chloride concentrations compared to alkalinity. Conversely, the CAI profile is more consistently steady at Dholawad Dam, suggesting that the amounts of chloride and alkalinity are more evenly distributed.

Dholawad Dam typically has a greater percentage of sodium (%Na) (0.51-0.59) than Mahi Bajaj Sagar Dam (0.340-0.44), suggesting that sodium makes up a larger proportion of the water there compared to the other cations. Dholawad Dam's higher %Na readings indicate possible dangers of soil sodicity and lower agricultural yield compared to its counterpart, which is an important indicator in determining the appropriateness of water for irrigation.

As far as Kelly's Ratio (KR) is concerned, both dams exhibit comparable tendencies; however, Dholawad Dam has greater values (between 0.85 and 1.13) than Mahi Bajaj Sagar Dam (0.48 to 0.75). There is a stronger need for cautious water management measures to limit the dangers of soil degradation, since higher KR values in Dholawad Dam suggest a bigger sodium hazard potential for agricultural usage.

If you want to know how scaling and corrosion-prone water is, go no further than the Langelier Saturation Index (LSI). The LSI profile of Dholawad Dam varies from -0.52 to 0.77, suggesting a combination of scaling and corrosion tendencies at different sample places. There is some

variation in the LSI values of Mahi Bajaj Sagar Dam, from -0.62 to 0.59, which might be an indication of difficulties in controlling the water quality to avoid infrastructure scaling and corrosion.

V. CONCLUSION

Dholawad Dam and Mahi Bajaj Sagar's water quality indicators were compared statistically, which shed light on their potential applications, especially for agricultural irrigation. Based on the results, it seems that Dholawad Dam might have more problems with soil permeability and sodium risks, which could have an effect on agricultural productivity, because its Sodium Adsorption Ratio (SAR) and Percent Sodium (%Na) are higher. On the other hand, the Mahi Bajaj Sagar Dam has lower SAR and %Na values, which means that irrigation there is safer. Both Kelly's Ratio (KR) and the Chloride Alkalinity Index (CAI) show that Dholawad Dam poses a greater salt threat than Mahi Bajaj Sagar Dam. Water quality management may be complicated at some locations in each reservoir, according to the Langelier Saturation Index (LSI) study, which reveals a combination of scaling and corrosion tendencies in both dams. In order to reduce risks and make sure that water resources can be used sustainably for agriculture and other things, these results show how important it is to have specific plans for managing water in each reservoir. In order to make informed policy and management decisions about water resources, this research highlights the significance of ongoing monitoring and analysis.

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