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Multivariate Analysis to Assess the Quality of Lake Water in Chikkballapura District

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ABSTRACT:
Chickballapur district consists of many artificial lakes which was constructed for agricultural, domestic water supply and also for recreational purpose. Due to drought, less rainfall the lakes are drying day by day.This study evaluates the water quality of the lakes of Chickballapur, using Irrigation Water Quality Index(1WQI), and multivariate statistical methods (Clustering and principal component analysis). Due to increasingly stringent regulations on the discharge of wastewaters as well as the decreasing availability of freshwater resources, there is a need to consider the expanded use & reuse of marginal quality water for irrigation & other purposes.

I. INTRODUCTION

Sewage is a type of waste water that is produced by community of people, characterized by volume or rate of flow, physical condition, chemical and toxic constituents. The use of sewage water for irrigation is a positive way to dispose of sewage water for irrigation is a positive way to dispose of sewage. Such large volumes of water in a country with persistent droughts and can be of great agronomic and economic importance. It has been estimated that typical wastewater from domestic sources could supply all the nutrients that are normally required for agricultural crop production (FAO, 1992). In hyper-arid Fezzan region of Libya (UNESCO, 1997) in the central Sahara Desert where groundwater is the only natural water resource available, increasing water demand has necessitated reusing treated municipal waste water for irrigation of sandy soils.

The sewage water contains permissible amounts of Total Nitrogen (N), Total Phosphorus (P) and Potassium (K) which are considered essential nutrients for soil fertility. In soil concentration the irrigation with sewage water (SW) induces significant decrease of soil p^H. Electrical conductivity (EC) is greater with SW. For major elements contents and fertilizer as observed in the irrigation with SW led to a significant increase of N, P, K, Ca, Mg and S contents.

In rural and urban areas of most emergent countries, the application of sewerage and wastewater for irrigation is a regular practice. In these areas, polluted water is often the only supply of water for irrigation. Yet small farmers often prefer wastewater where other water sources are also available because wastewater has high nutrient content which may reduce or even eliminate the need for other costly chemical fertilizers. The use of wastewater for crop growth is a centuries old practice in many arid and semi-arid regions of the Globe.

Farmers often have no alternative, so they depend on unprocessed wastewater as there is no wastewater collection and treatment and freshwater is either out of stock or too expensive. The uses of wastewater in agriculture create key risks to the health of the community due to chemical and microbial contaminants. Wastewater use can also produce ecological risks in terms of soil and groundwater contamination. Irrigation with wastewater can have a number of benefits and environmental applications if appropriately planned, implemented, and managed.

Many wastewater irrigators are generally landless people who are not land-owning farmers; they lease small plots to grow income-generating crops like vegetables that flourish when watered with nutrient-rich sewage. Across Africa, Asia, and Latin America, the micro-economies of sewage water support a large number of low-income individuals. Stoppage or overregulation of these practices could take away the only income source of numerous landless people. However, in these countries, the sewage water is not processed before use for irrigation. Wastewater treatment is generally carried out in developed countries, where major investment on wastewater treatment has been

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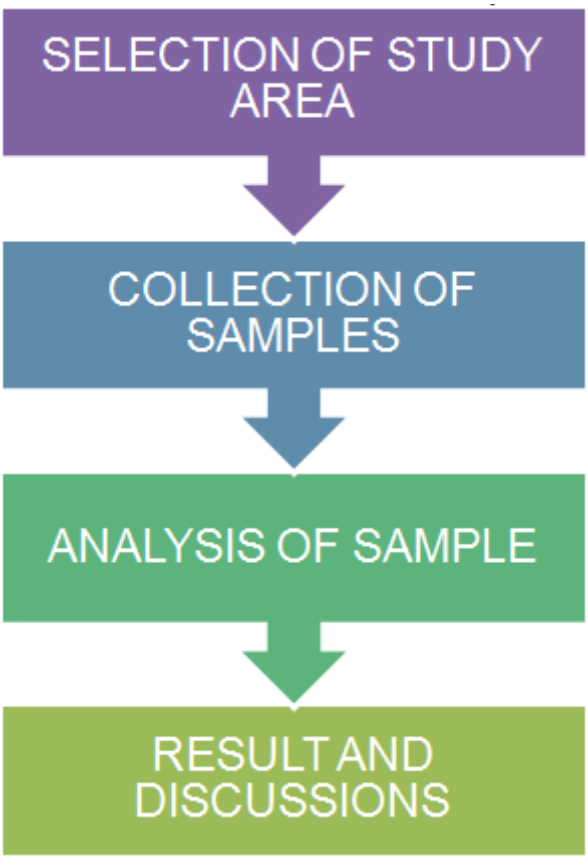
made over the past 40-50 years in order to achieve high treatment levels. Most sewage water is treated in North America, usually up to secondary and, in numerous cases, up to tertiary levels.

The sewage flows to a downstream location that is hazardous due to which the population inside the streams and water sources are at risk. Such risks can be decreased or proscribed by wastewater treatment in a wastewater treatment plant consisting of physical, chemical and biological processes.

II. OBJECTIVES:

- Collection of surface water samples at various lakes of chickballapur.
- Characterization of surface water samples.
- Evaluates the water quality of the lakes of Chickballapur, using Irrigation Water Quality Index(WQI)and multivariate statistical methods.
- To compare the obtained results with water quality index(WQI).

III. METHODOLOGY:



The present study deals with studying and analyzing of the physicochemical and biological parameters of water at its different sampling points. The following parameters were analyzed in laboratory using different analytical method i,e PH, Electrical conductivity, Turbidity, Alkalinity, Acidity, Total Hardness, Calcium, Magnesium, Biological oxygen demand (BOD) ,Chemical oxygen demand (COD),Dissolved oxygen, Phosphates & Sulphates.

3.1SELECTION OF THE STUDY AREA

Kandavara Lake, Gopal Krishna Lake, Jathavara lake, Sidlaghatta lake was selected as a study area to analyze and assess its water quality, which is nearly 150 acres in area. These lakes receive water from rainfall covering catchment area localities like Nandi valley region, Sankadagiri mountain region, rural area of Chickaballapur, town area of Chickaballapur& Hebbal- Nagavara valley treated waste water filled.

3.2 COLLECTION OF SAMPLES

Initially, cleaned sample bottles are taken to the sampling site along with the record sheets to make a note of sample name, date of sample collection and other general observations are observed.

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Samples are collected and the sample no's and dates are mentioned on the sample bottles and then they are transferred to the laboratory.

3.3ANALYSIS OF SAMPLE

After transferring sample bottles to the laboratory, analysis of samples is carried out. The following parameters are analyzed in the lab:

- pH
- Turbidity
- Conductivity
- Alkalinity
- Hardness

- Total hardness
- Calcium hardness
- Magnesium hardness

- BOD
- COD
- DO
- Phosphates
- Sulphates

3.3.1METHODS FOLLOWED TO ANALYZING THE SAMPES

Analysis is done as per the standard procedure given in standard method.The data connected to the quantity of wastewater was personally analyzed the samples collected from various sampling stations in Environmental Engineering laboratory, Civil Engineering Department, SJCIT, Chickaballapur.

SL.NO	EXPERIMENT	METHOD FOLLOWED
01	PH	Direct reading p^H meter
02	Turbidity	Direct reading Nephlon Turbidity meter
03	Conductivity	Direct reading conductivity meter
04	Alkalinity	Titrimetric method
05	Total hardness	Titrimetric method
06	Calcium hardness	Titrimetric method
07	Magnesium hardness	Titrimetric method
08	BOD	APHA 23rd Edition5210 BOD B
09	COD	IS 3025(P-58) 2006(RA-2017)
10	DO	IS 3025 (P-38)2019
11	Phosphates	IS 3025 (P-31) 1998 (RA-2019)
12	Sulphates	APHA 23rd Edition4500SO4 2-E

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TABLE 3.3.1 -Analysis for parameters of sample collected

	kandavara lake		Gopalkrishna lake		Jathavara lake		Sidlaghatta lake	
Parameters	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
P^H	8.214	7.452	7.423	7.985	7.746	7.832	7.121	7.346
Electrical con	840	720	980	1050	400	205	430	410
Turbidity	59.9	19.98	54.2	69.2	64.2	24.2	18.5	13.4
Alkalinity	360	308	360	250	371	255	301	274
Total Hardnes	222	147	120	141	211	165	124	153
Calcium	161	96	52	71	161	82	164	98
Magnesium	55	48	44	70	42	31	78	55
Biological oxy	44	4.2	6.8	64	7.1	4.6	8.2	4.8
Chemical oxyg	200	24	40	32	32	32	48	40
Dissolved oxy	7.5	7.4	5.2	4.3	7.5	5.7	5.3	7.5
Phosphates	1	0.9	1.7	0.6	0.27	0.6	0.43	0.95
Sulphates	47	48	13	11	35	1	3	4

IV. CALCULATION OF WATER QUALITY INDEX

In the formulation of a water quality index, the importance of the various water quality parameters depends on the intended use of the water.The method followed for the weighted arithmetic water quality index as follows. In the first place, the more harmful a given pollutant of water, the smaller in magnitude is its standard for drinking water. So, the unit weight W_i for the i^{th} parameter P_i is assumed to be inversely proportional to its recommended standard S_i (i=1,2…n) and N= no of parameters considered. Thus, we have

$$\mathbf{W_i=k/S_i=1/S_i}$$

Where, the constant of proportionality K has been assumed to be equal to unity for the sake of simplicity.The quality rating q_i for the i^{th} parameter P_i is given, for all other parameters except p^H, by the relation

$$\mathbf{Q_i=100(V_i/S_i)}$$

Where, V_i is the observed value of the i^{th} parameter and S_i is its recommended standard for drinking water.For p^H, the quality rating q_{P^H} can be calculated from the relation $\mathbf{q_{p^H}=100[(V_{P^H}\sim 7.0)/1.5]}$

Where V_{P^H} is the observed value of p^H Finally, the water quality index (WQI) can be calculated by taking the weighted arithmetic mean of the quality ratings q_i, thus,

$$\mathbf{WQI=[\sum_{i=1}(q_iW_i)/\sum W_i]}$$

Table 4.1: WQI range and water type

WQI VALUE	STATUS
>75	VERY BAD WATER QUALITY
50 to 75	BAD WATER QUALITY
30 to50	MEDIUM WATER QUALITY
10 to 30	GOOD WATER QUALITY
<10	EXCELLENT WATER QUALITY

TABLE 4.2 : RESULTS OF WQI

LAKE NAMES	INLET	OUTLET
Kandavara Lake	164.46	79.59
Gopal Krishna Lake	123.24	156.28
Jathavara lake	142.7	76.86
Sidlaghatta lake	69.02	67.42

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V. MULTIVARITE ANALYSIS

Data analytics is all about looking at various factors to see how they impact certain situations and outcomes. When dealing with data that contains more than two variables, you'll use multivariate analysis. Multivariate analysis isn't just one specific method—rather, it encompasses a whole range of statistical techniques. These techniques allow you to gain a deeper understanding of your data in relation to specific business or real-world scenarios. So, if you're an aspiring data analyst or data scientist, multivariate analysis is an important concept to get to grips with.

What is multivariate analysis?

In data analytics, we look at different variables (or factors) and how they might impact certain situations or outcomes. For example, in marketing, you might look at how the variable "money spent on advertising" impacts the variable "number of sales." In the healthcare sector, you might want to explore whether there's a correlation between "weekly hours of exercise" and "cholesterol level." This helps us to understand why certain outcomes occur, which in turn allows us to make informed predictions and decisions for the future.

There are three categories of analysis to be aware of:

- Univariate analysis, which looks at just one variable
- Bivariate analysis, which analyzes two variables
- Multivariate analysis, which looks at more than two variables

As you can see, multivariate analysis encompasses all statistical techniques that are used to analyze more than two variables at once. The aim is to find patterns and correlations between several variables simultaneously—allowing for a much deeper, more complex understanding of a given scenario than you'll get with bivariate analysis.

Advantages of multivariate analysis

The one major advantage of multivariate analysis is the depth of insight it provides. In exploring multiple variables, you're painting a much more detailed picture of what's occurring—and, as a result, the insights you uncover are much more applicable to the real world.

Remember our self-esteem example back in section one? We could carry out a bivariate analysis, looking at the relationship between self-esteem and just one other factor; and, if we found a strong correlation between the two variables, we might be inclined to conclude that this particular variable is a strong determinant of self-esteem.

However, in reality, we know that self-esteem can't be attributed to one single factor. It's a complex concept; in order to create a model that we could really trust to be accurate, we'd need to take many more factors into account. That's where multivariate analysis really shines; it allows us to analyze many different factors and get closer to the reality of a given situation.

Table5.1: Correlation coefficients between the measured water quality parameters

	P^H	Conductivity	Turbidity	Alkalinity	Total Hardness	Calcium	Magnesium	BOD	COD	DO	Phosphates	Sulphates
P^H	1											
Conductivity	0.296356829	1										
Turbidity	0.677847096	0.680957552	1									
Alkalinity	0.069468775	0.204373656	0.4346134	1								
Total Hardness	0.697665449	-0.186329489	0.4014353	0.44029	1							
Calcium	0.057173809	-0.361209607	0.0224088	0.4304142	0.591015849	1						
Magnesium	-0.231562163	0.313701199	-0.0001405	-0.2139471	-0.337167188	0.294153	1					
BOD	0.700338894	0.657051979	0.6608402	-0.173035	0.196449836	-0.0245	0.46815775	1				
COD	0.570506961	0.255535968	0.3088188	0.4190843	0.613879616	0.480805	0.11868957	0.493467	1			
DO	0.063112532	-0.336055751	-0.2040249	0.433001	0.657012772	0.477021	-0.3542911	-0.35436	0.329129	1		
Phosphates	-0.101200175	0.549879291	0.049802	0.2856981	-0.314818893	-0.56473	-0.2172714	-0.07518	0.187016	-0.05041	1	
Sulphates	0.395083692	0.312612334	0.3266227	0.6127071	0.600636097	0.36936	-0.1784462	0.140601	0.466121	0.633761	0.05540205	1

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- There is a positive or less correlationship between conductivity anf pH factor.
- Turbidity and conductivity has a positive correlation
- Hardness and conductivity has a negative correlation which means there is significant relationship between conductivity and hardness

In Statistics, the correlation coefficient is used to measure the extent of the relationship between two variables. It is scaled between the range, -1 and +1. The coefficient of correlation between two intervals or ratio level variables is represented by 'r'

Since the numerical value of correlation coefficient lies between -1 to +1 ie, $-1 \leq r \leq +1$ hence we can say that both the variables perfectly corelated.

If r=0 ,then it is not corelated

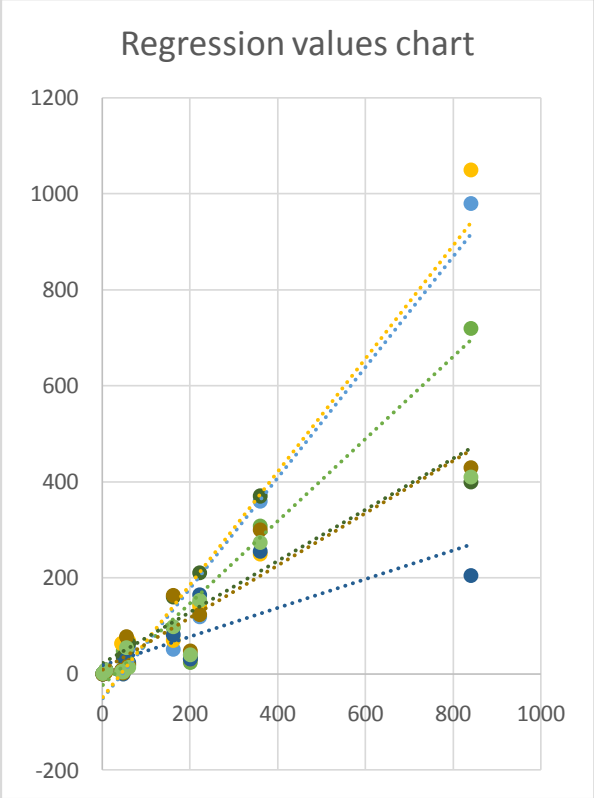
Y= ax+b

X= ay+b

r = ± sqrt of (cof x + cof y)

Multiple linear regression

Multiple linear regression is a dependence method which looks at the relationship between one dependent variable and two or more independent variables. A multiple regression model will tell you the extent to which each independent variable has a linear relationship with the dependent variable. This is useful as it helps you to understand which factors are likely to influence a certain outcome, allowing you to estimate future outcomes.



- ❖ Hardness is dependance variable
- ❖ pH and conductivity are independent variable.
- ❖ Turbidity Alkalinity are independent variable.
- ❖ BOD , COD & DO are independent variable.
- ❖ Phosphates & Sulphates are independent variable.

Regression is a statistical method used in finance, investing, and other disciplines that attempts to determine the strength and character of the relationship between one dependent variable (usually denoted by Y) and a series of other variables (known as independent variables).

Regression equations can help you figure out if your data can be fit to an equation. This is extremely useful if you want to make predictions from your data--either future predictions or indications of past behavior. For example, you might want to know what your savings are going to be worth in the future. Or, you might want to predict how long it can take to recover from an illness.

VI. CONCLUSION

- ➢ The physico chemical parameters which were analyzed for Kandavara lake, Gopalkrishna lake, Jathavara lake, Sidlaghatta lake are P^H, Conductivity, Turbidity, Alkalinity, Total hardness, Calcium hardness, Magnesium hardness, DO, BOD, COD, Sulphates , Phosphates.

- The analyzed values were compared with water quality index, the samples analyzed were not suitable**.** (Drinking purpose)
- After comparing with water quality index, it is concluded that water stored in lakes cannot be used for domestic purpose.
- As there is water crisis in Chickballapur district, lake water can be suggested for the purpose of irrigational and other domestic use after tertiary treatment only.

REFERENCES

[1]. Ravindra M.V, Sharada S.A "Water Quality Index For Groundwater of Southern Part of Bangalore City".Volume:04 May 2015.

[2]. K.K.Tanji ,"Irrigation with Marginal Quality Waters : Issues", Journal of irrigation and drainage engineering, 67/02976, 2017/165.

[3]. Mohamed Elsayed Gabr, Hoda ussa, Ehab Fattouh, "Groundwater Quality Evaluation for Drinking & Irrigation Uses in Dayrout City Upper Egypt", J Elsevier,2020

[4]. Ramesh N, Krishnaiah S, "Scenario of Water Bodies (lakes) In Urban Areas- A case study on Bellandur lake of Bangalore Metropolitan city. IOSR journal of Mechanical and Civil engineering (IOSR-JMCE), Volume-7, PP 1-6, 2013.