Study of Water Quality Parameter Assessment using GIS and Remote Sensing in DR. B.A.M University, Aurangabad, MS

Mahesh Ramkrishna Huchhe[1], Dr. N. N Bandela[2]

Dept. of Environmental Science, Dr.BAM University, Aurangabad, Maharashtra, INDIA

***Abstract*- Management of water quality is very important as demand is increases day by day. Water is the most important source for living things on earth which is threatenedon it's quality and quantity.pH, DO, COD, BOD, Chloride and Hardness are basic water quality parameter. Management of water quality in University campus is important as it is the source of drinking for student's hostels, departments and irrigation in campus.Deterioration of water quality receives more attention to mapping the current situation of water quality parameter provides the better management of resources. Water sample collected from various resources located in Dr.BAM University campus during dry period, whereas when entire Marathwada including Aurangabad under great water stress. Interpolation methods facilitate to estimate values for unknown point and create a continuous dataset to study the spatial distribution. The IDW (inverse distance weighted) and Spline tools are deterministic interpolation method and Kriging are based on a statistical model. Krigingthe best fit method of interpolation was used with help of Geographic Information System (GIS) software Arc GIS 10.2 to visualize the spatial distribution of above water quality parameters. This study has shown that kriging interpolation and statistical analysis perform better mapping of water parameter.**

***Keywords* – GIS, Interpolation, Spatial Analysis, Water quality, Geostatistic, GPS.**

I. INTRODUCTION

With the rapid economic and social development in recent decades, non-point source pollution to the environment from livestock, poultry, planting industries and domestic sewage to our living space. Among various pollutions; water environmental pollution, as a vital threat to human being, health, also become most remarkable issue for sustainable management.

Reference [1] reported that human activities mainly impact surface water quality through effluent discharge, using of agriculture chemicals, in addition to increase to increase the exploitation of water resources. Many river and water bodies in the developing countries are heavily polluted due to anthropogenic activities.

Appropriate water quality management measures need reliable quantitative information on water quality parameter behavior.

In recent years, many scientist evaluated accuracy of different spatial interpolation method for prediction water quality parameter. As per [2] used disjunctive Kriging and simulation method to make nitrate risk map in 10, 50(mg/l) threshold, in Modena plain of Italy.The need exist to study the spatial behavior of water quality parameter. Knowledge of behavior of water quality parameter is essential to interpret water quality and for making accurate prediction of water quality of particular area.

According to experimental result of different geostatistical method of spatial interpolation; the most efficient and prominent method for observed data is ordinary Kriging, [3]. Reference [4] GIS and Remote Sensing has been used extensively to the water quality all over the world. Kriging method was also used[5] to predict spatial distribution of some ground water quality parameter.Reference[6]analyzation of the spatial variability of ground water quality in India. They produced probability maps of ground water contaminants using indicator Kriging.

Reference [7] used Kriging to maps ground water quality parameter in Yukatam, Mexico. They classified the study area into different zones in terms of water quality for Agriculture purpose.

Above mentioned researcher, the suitable method of interpolation and spatial distribution is depends on the variable type and regional factor. The aim of this research is to evaluate the spatial distribution of water parameter by interpolation method, Kriging for prediction of some water quality parameter in the Dr. BabasahebAmbedkar Marathwada University campus, Aurangabad, Maharashtra.

II. MATERIAL AND METHOD

A. Study Area

Dr. BabasahebAmbedkar Marathwada University lies between $75^0$17'47.49"E, $75^0$19'13.93"E and $19^0$54'59.56"N, $19^0$53'24.64"N (Fig-1) and an average elevation of university is 577m above mean sea level. The geographical area is approximate 3.01 Km^2.

University situated at foot of hill located at north .the average rainfall of Aurangabad, MS, INDIA is 710mm and temperature ranges from 17 to 33^0c.

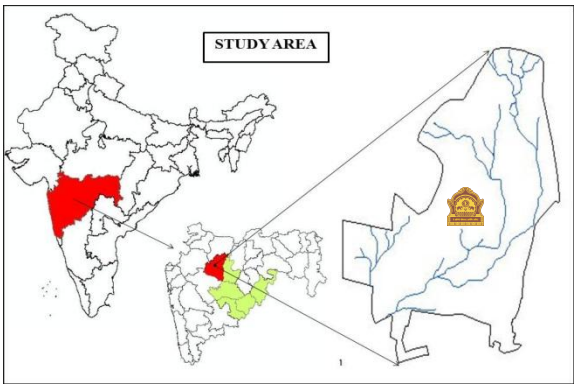

Fig1: Dr. BabasahebAmbedkar Marathwada University

B. Interpolation Method

The IDW (inverse distance weighted) and Spline interpolation are deterministic interpolation methods because they based on specific mathematical formula that determines the smoothness of resulting surface.

Such as geostatistical method Kriging based on the statistical method that includes autocorrelation among the measured point and it provides the accuracy of prediction[8].

The formula is:

$$\hat{Z}(s_0) = \sum_{i=1}^{N} \lambda_i Z(s_i)$$

Where;

$Z(s_i)$ = the measured value at the ith location

λ_i = an unknown weight for the measured value at ith location

s_0 =the prediction location

N =the number of measured value

This is multistep process, it includes exploratory statistical analysis of the data, variogram modeling creating surface.

The Semi-variogram plays a central role in the analysis.it takes into account the spatial autocorrelation in data to create mathematical model of spatial correlation structure commonly expressed by variogram[9, 10]

Generation of spatial distribution maps of various water parameters have been created by interpolation in spatial analysis using Arc GIS 10.2 software accomplished [11, 12, and 13].

III. Result and Discussion

The spatial pattern of various water quality parameter are shown below;

pH:

Value of pH gradually increased from sout-east to north ranges between 7.7 – 8.2. The Figure-2 shows the spatial distribution of pH in campus area. Statistical summary and Hostogram of water pH shows data has fairly symmetrical presented in Table1 & Figure8.

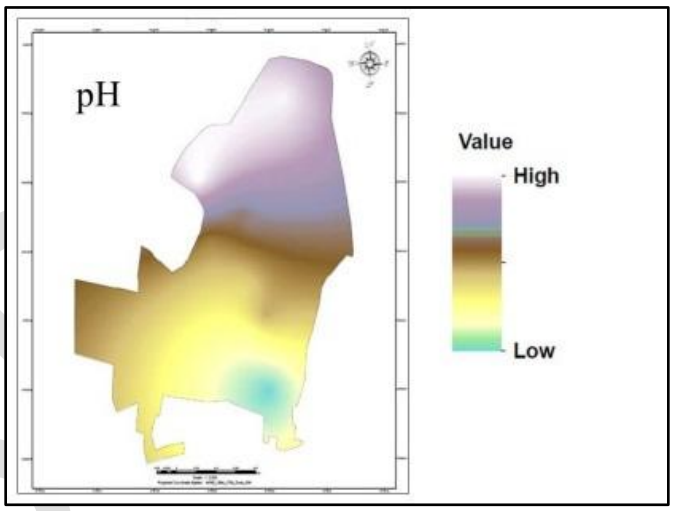

Figure2: Spatial Distribution of pH

DO:

Due to domestic effluent discharge by surrounding area of university; Figure-3 shows DO of southern part of campus low, whereas in northern part it is gradually increases. Statistical summary and Histogram shows the data skewness is 0.86 of water DO presented in Table1 & Figure9.

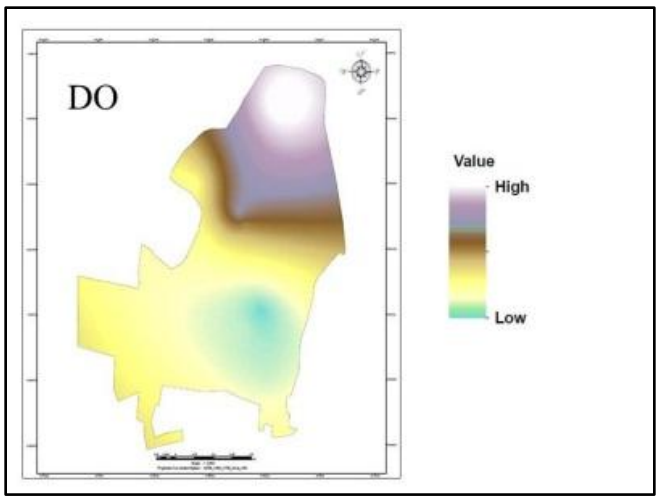

Figure3: Spatial Distribution of DO

BOD:

Spatial distribution of BOD values ranges from 3 to 35 mg/l shown in Figure-4. Maps shows that BOD values are more in north top and it is decreases towards south. Skewness of water BOD data is 1.24 presented in Table1 & Figure10.

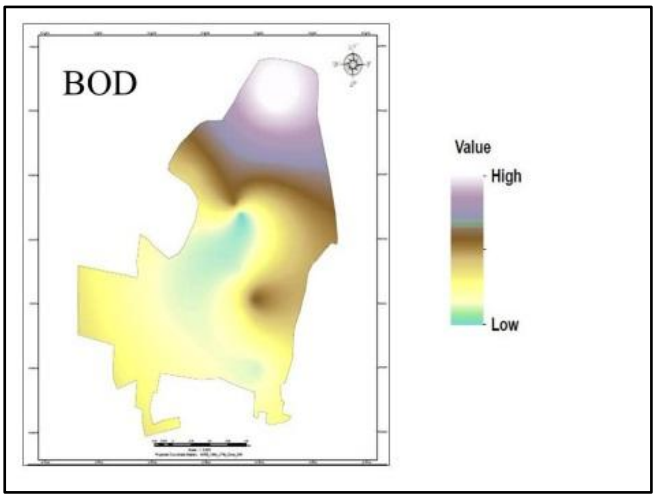

Figure4: Spatial Distribution of BOD

COD:

Spatial distribution map of COD in Figure-5 shows that as compare to northern part of university campus the value of COD in southern part is less, the values are in northern part ranges 60-140 mg/l and southern part ranges between 38-60 mg/l. Data Skewness of water COD presented in Table1 & Figure11are 1.24.

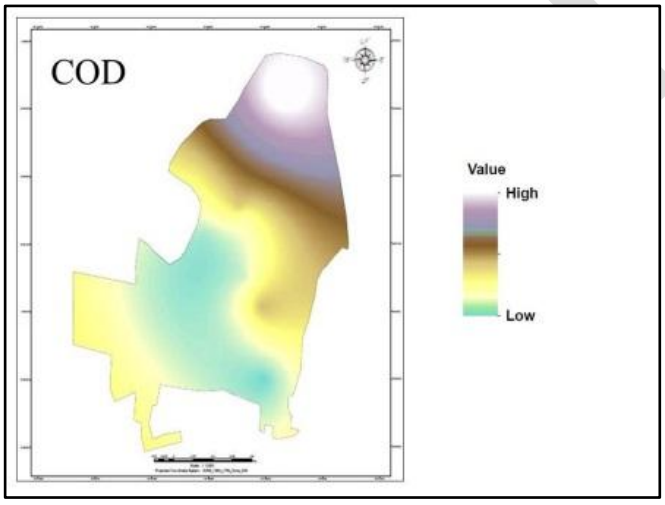

Figure5: Spatial Distribution of COD

Chloride:

Chloride is one of the most important parameter in assessing the water quality and high concentration of chloride indicates higher degree of organic pollution. As per WHO [14]standard permissible limit of drinking water is 250mg/l. Figure-6 Spatial distribution of chloride in university campus fluctuating within standard limit except south-east part of campus. This is due to natural process such as the passage of water through natural salt formation or it may be an indication of discharge from domestic use or industrial. Statistical summary and Histogram of water Chloride presented in Table1 & Figure12.

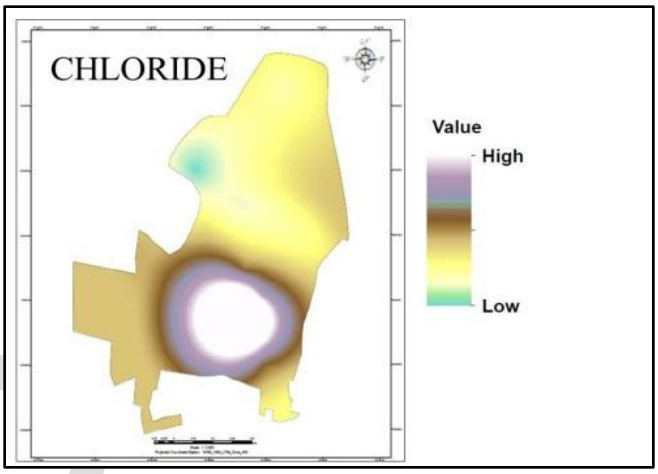

Figure6: Spatial Distribution of Chloride

Hardness:

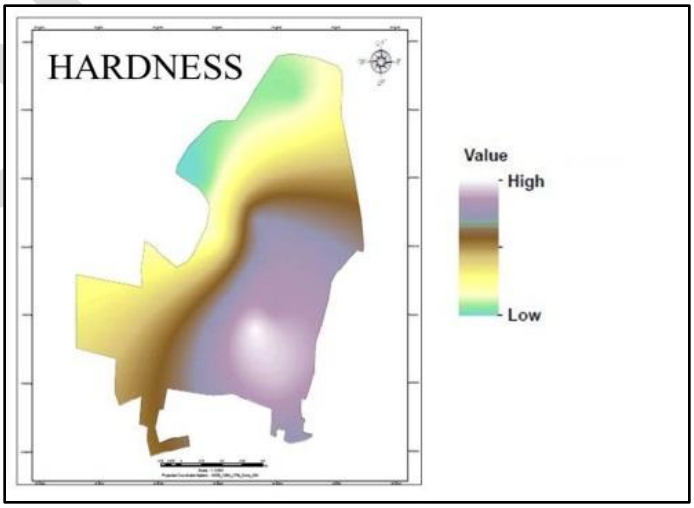

Figure7: Spatial Distribution of Hardness

Asper WHO [14] the standard permissible limit of hardness values of drinking water is to be within 300 mg/l of $CaCO_3$. Figure-7 shows the spatial distribution of the water hardness in the campus area varies from 126.07 mg/l to 429.94 mg/l. The higher concentration of hardness found in the south-east part of campus; it may be due to natural accumulation of salt, surface runoff or direct enter of pollutant in water by human activities. Low concentration values of hardness shows in north part of campus. Data of water Hardness negatively skewed presented in Table1 & Figure13.

Table1:

Statistical summary of water quality parameter properties is presented in table1.

Descriptive Statistics: pH, DO, BOD, COD, CHLORIDE, HARDNESS						
Variable	Mean	StDev	Minimum	Maximum	Skewness	Kurtosis
PH	7.9	0.5	6.9	8.9	0.14	-0.45
DO	4.9	2.9	0.0	12.1	0.86	0.82
BOD	15.0	11.0	2.4	43.5	1.24	1.05
COD	57.2	46.5	9.0	172.0	1.24	0.72
CHLORIDE	114.1	66.3	18.4	316.6	0.94	1.85
HARDNESS	286.7	110.3	126.0	456.0	-0.15	-1.46

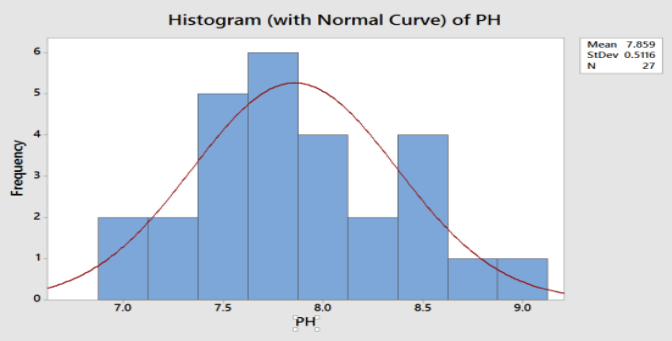

Figure8: Statistic summary of pH

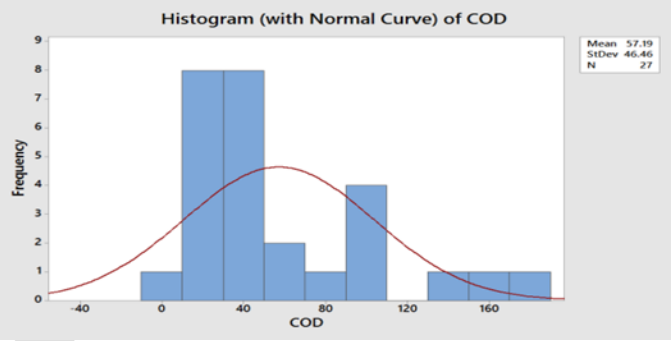

Figure11: Statistic summary of COD

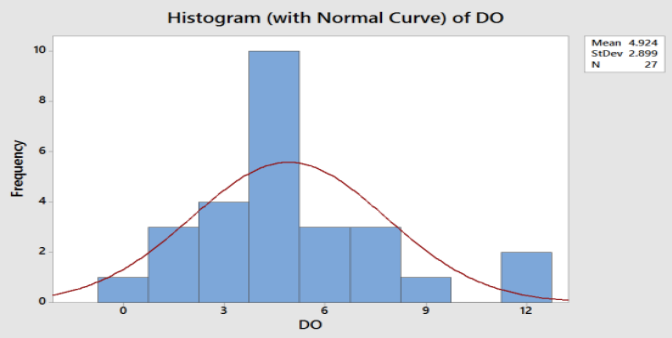

Figure9: Statistic summary of DO

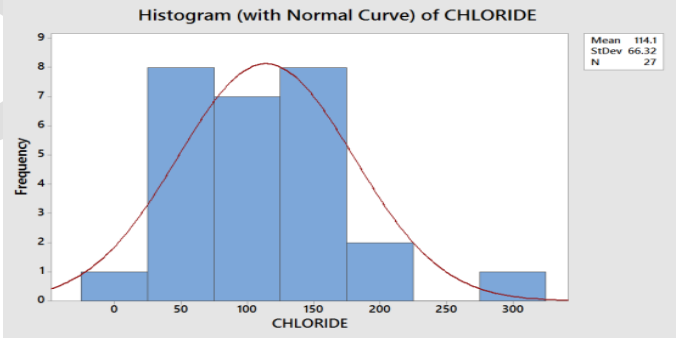

Figure12: Statistic summary of Chloride

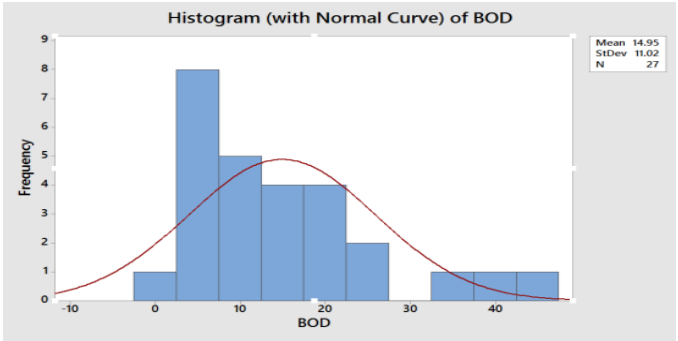

Figure10: Statistic summary of BOD

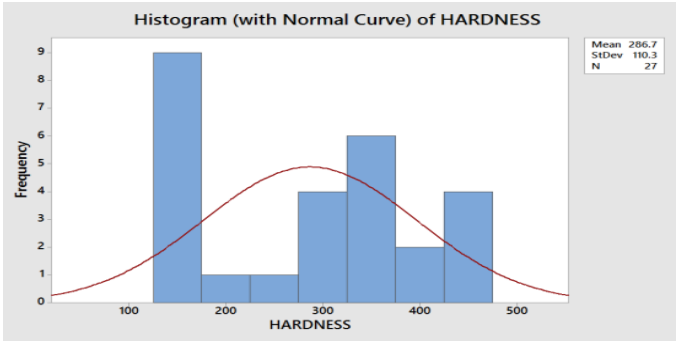

Figure13: Statistic summary of Hardness

IV. CONCLUSION

The water quality parameters of the Dr. BabasahebAmbedkar MarathwadaUniversity campus was studied for better understanding by using the spatial analysis tools in ArcGIS software.

The Spatial distribution of interpolated maps of pH, DO, COD, BOD, Chloride and Hardness shows that these parameters distribution behavior within campus and by statistically it shows that except hardness, all other parameter data are fairly to moderately skewed.

This study has shown that the use of kriging interpolation method by using of spatial analysis tools for assessment of water quality help us for better mapping and management of water quality parameter.

REFERENCES

[1]. Niemi GJ, D. P. (1990). Overview of case studies on recovery of aquatic system from disturbance. Environmental management, 14:571-587.
[2]. Barca, E. a. (2008). Spatial evaluation of the risk of ground water quality degradation.A comparison between disjunctive kriging and Groundwater geostatistical simulation. Environ Monit Assess, 137.
[3]. Deutsch, C. (1996). Correcting of negative weight in ordinary kriging.Computers & Geoscience, (22)7: 765-773.
[4]. Shomar. B. et, a. (2010). Assessment of Groundwater Quality in the Gaza Strip, Palestine Using GIS Mapping. Journal Water Resource and Protection, 93-104.
[5]. Rawat KS., M. A. (2012). Spatial Variability of Ground Water Quality in Mathura District (Uttar Pradesh, India) with Geostatistical Method. Int. J Remote SensAppl, 1-9.
[6]. Adhikary, P. e. (2010). Assessment of Groundwater pollution in West Delhi, India using geostatistical approach. Environ Monit Assess, 167:599-615.
[7]. Delgado, C. e. (2010). Quality of groundwater for irrigation in tropical karst environment: The case of Yucatan, Mexico. Agr Water Manage, 97:1423-1433.
[8]. Gundogdu, K. a. (2007). Spatial analyses of groundwater levels using universal kriging. J Earth Sys Sci, 49-55.
[9]. Uyan, M., & Cay, T. (2010). Geostatistical method for mapping groundwater nitrate concentration. Presentation: Int conference on cartography and GIS, Bulgaria.
[10]. Hooshmand, A., &Delghandi, M. e. (2011). Application of Kriging and Cokriging in spatial estimation of groundwater quality parameters.Afr J Agr Res, 6(14):3402-3408.
[11]. Oliver, M. (1990). Kriging: A method of interpolation for Geographical Information System. International Journal for GIS, 4: 313-332.
[12]. Press, M., Teukolsky, S., & Flannery, W. V. (1988). Numerical Recipes inc: The art of Scientific Computing. CambridgebUniversity Press, New York.
[13]. Royle, A. e. (1981). Practical Universal Kriging and Automatic Counting.Geoprocessing, 1:377-394.
[14]. WHO. (2004). Water, Sanitation and Hygiene links to health - facts and figure. Geneva: World Health Organization.