International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 3.45 (SJIF-2015), e-ISSN: 2455-2584
Volume 3, Issue 05, May-2017

WATER QUALITY ANALYSIS USING RS AND GIS- A CASE STUDY FROM HYD

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ABSTRACT
This paper deals with development of decision making tool for mapping of water quality Parameters of Hussainsagar lake of Hyderabad District, Telangana. Mapping was done using satellite data combined with measurement of selected sample points. Water quality data was collected for both pre-monsoon and postmonsoon seasons. The water quality parameters included, TS, DS, SS, pH, COD, BOD, DO, Chloride and TH. Using radiance data of pre-monsoon images and in situ measurement data of water quality parameters correlation were developed and selected most appropriate band combinations. With the help of these multiple water quality parameters obtained through laboratory analysis of water quality and preparation of digital cartographic maps depicting the water quality over the entire study area for both the seasons respectively.

Keywords: ***Hussainsagar Lake, Water Quality Parameters, Remote Sensing, Satellite Data, GPS, Water Quality Maps.***

1 INTRODUCTION

Water quality is the main factor controlling the healthy and diseased states in both humans and animals. Surface water quality is an essential component of the natural environment and a matter of serious concern today. Anthropogenic influences as well as natural processes degrade the surface waters and their use for drinking, industrial, agricultural, recreation or other purposes. The water bodies are suffering because of pollution and are used for disposing of untreated local sewage and industrial effluents. People are becoming the more aware of the complexity of the nature and delicate balance that exist within the global ecosystem. The discharge of effluents and associated toxic compound in to aquatic system represents an ongoing environmental problem due to their possible impact on communities in the receiving aquatic water and a potential effect on human health. Further these materials enter the surface water resulting in pollution.

Many investigations have been conducted on anthropogenic contaminants of ecosystems. Because of the spatial and temporal variation in water quality conditions, a monitoring program which provides a representative and reliable estimation of the quality of surface waters is necessary. The monitoring results produce a large and complicated data matrix that is difficult to interpret to draw meaningful conclusions. Multivariate statistical techniques are powerful tools for analyzing large numbers of samples collected in surveys, classifying assemblage's and assessing human impacts on water quality and ecosystem conditions. The application of different multivariate statistical techniques, such as principal component analysis (PCA), factor analysis (FA), and cluster analysis (CA) assists in the interpretation of complex data for a better understanding of water quality and ecological characteristics of a study area. These techniques provide the identification of possible sources that affect water environmental systems and offer a valuable tool for reliable management of water resources as well as rapid solution for pollution issues.

2. HYDERABAD URBAN AREA

The city lies between 78° 22'30 and 78° 32'30' East Longitude and between 17° 18'30 and 17°28'30 North latitude. The city is situated in the Krishna Basin and River Musi, which is a tributary of river Krishna, is passing through the city of Hyderabad and bifurcates the city as north and south Hyderabad. Out of the 1534 Sq. Km. of Hyderabad development authority area, the Municipal Corporation of Hyderabad (MCH) has 179 Sq. Km. Out of the MCH area Zone- V extends at 78° 26.49' W latitude and 17° 24.5' N longitude with a total area of 18.309 Sq. Km which is selected for the present investigations. Overall, the discharge of municipal sewage, industrial effluents, the storm water discharge containing diluted sewage and other impurities on the land surface from over 240 square kilometers area of watershed have resulted in dumping of high amounts of organic matter, nitrogen and phosphorous in to the water and indicating the increased eutrophication. This situation suggests a strong variability due to presence of anthropogenic sources from the catchment affecting the water quality.

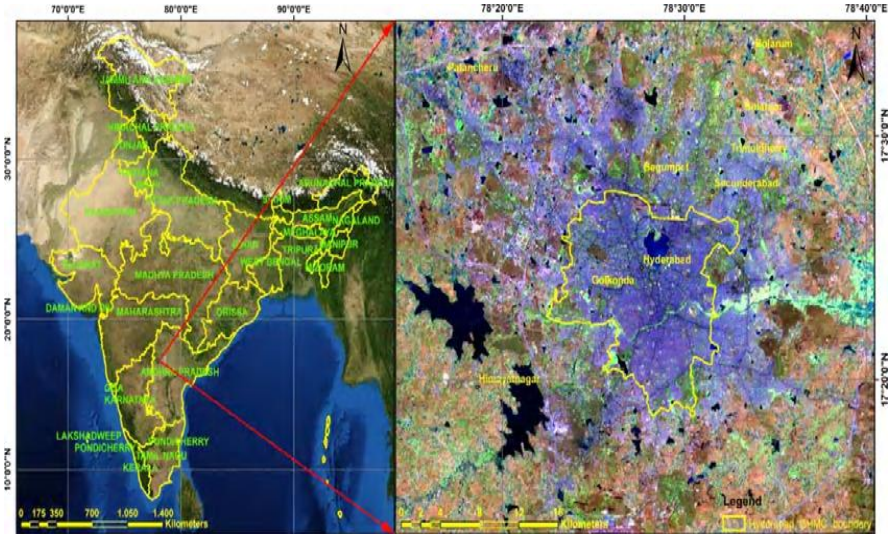


Figure 1.1 showing the location map of the study area

3. RESULTS AND DISCUSSION

a) Collection and laboratory analysis of water quality samples

The five sites were selected for the water quality parameters in Study area. Samples from 3 points (1/4, 1/2, & 3/4) across the river width, from each sampling site was collected in the each sites of the lake, which covers the 15 representative sampling points. Coordinates of each sample point locations were recorded in field through handset GPS.

b) Data used

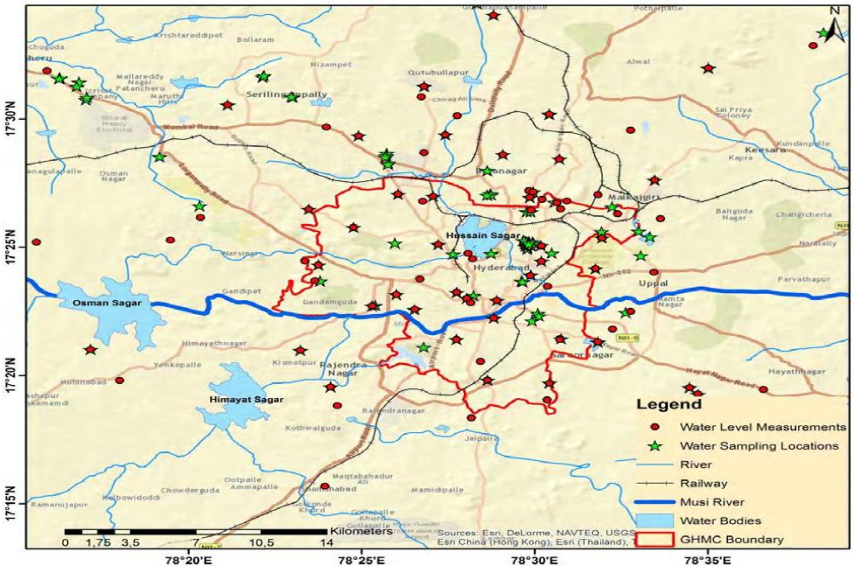
The study area was demarcated using Toposheets of 1:50,000 by identifying the district boundaries by Scanning, projecting, geo-referencing and digitizing toposheets of the area manually using ERDAS. Various land use / land cover features were studied and a base map was prepared by visual interpretation using toposheets and false colour composite image of LISS III sensor. Water samples were taken from the area using random sampling techniques and with the help of GPS (Global Positioning System) the co-ordinates were noted down

c) Spatial database

The spatial database is prepared by using different thematic Thematic layers like base map of the study area, land use / land cover, drainage network from SOI toposheets on 1:50,000 scale using ERDAS, Arc/Info GIS software to obtain baseline data. All maps are digitized to convert data into vector format. Landuse / land cover maps are prepared by using GIS software through supervised classification. SOI toposheets, satellite data and GPS (global Positioning data) together used with ground truth data.

d) Attribute database

Ground water samples were collected from predetermined locations that is, Urban and Suburban areas selected from the satellite imagery (Figure 2). The water samples taken from these locations and the area were then analyzed for eight water quality physico-chemical parameters adopting standard protocols. The water quality data thus obtained is used as database for present study (Table 1.2). The standards prescribed by BIS were used foe the calculation of water quality indices (BIS, 1991)



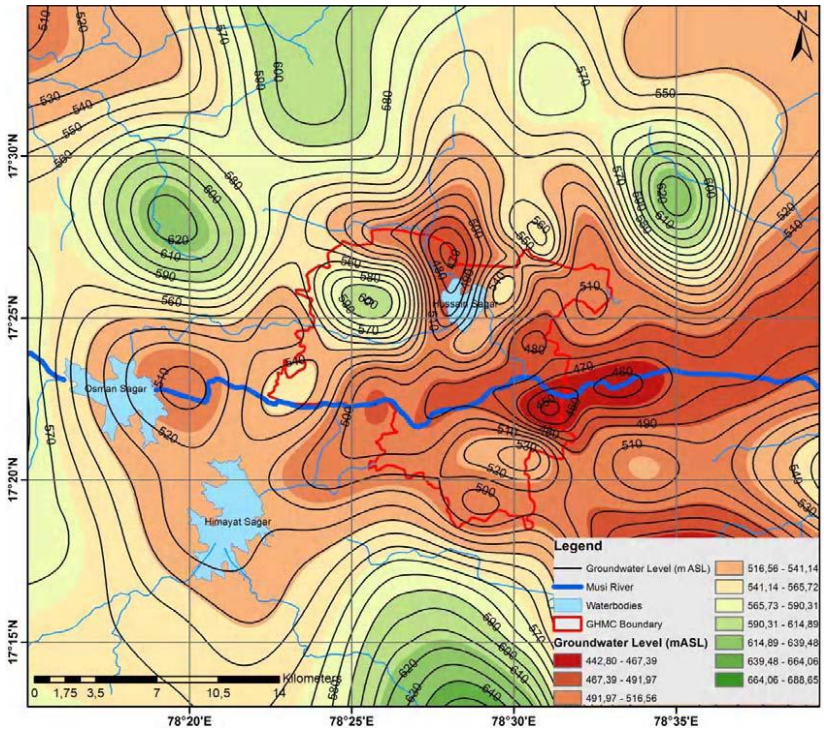


Figure 1.2 showing the GPS point and contour map of study area

Calculation Water quality index (WQI)

Water quality index is regarded as one of the most effective way to communicate water quality (Sinha et al., 2004; Srivastava et al., 1994) WQI of water collected from 52 (22 + 30) locations of urban and sub-urban areas of study area were calculated. It is very useful method for assessing water quality. In this a rating scale is fixed on the basis of importance and incidence on the overall quality of drinking water I terms of different physic-chemical parameters. For calculating WQI different formulas given below are used.

(i) Water Quality Rating,

Qn = [(Va- Vi) / (Vs- Vi)] x 100 (1)

Qn = Quality rating for total water quality parameter.

Va = Actual value of parameter obtained from Laboratory analysis.

Vi = Ideal value of the parameter obtained from the standards. (For pH it is 7 and for others it is zero).

Vs = Value recommended by BIS India of water quality.

(ii) Unit weight (Wn) = K / Sn (2) Sn is accepted drinking water quality standards by ISO

K = Proportionality Constant Calculated by

K = [1 / (n n = i 1/Si]

Sn = Standard values of the water quality.

Based on the above water quality values, the water samples quality is categorized as Excellent, Good, poor, Very Poor, Unfit for Drinking (Tiwari et al., 1985) (Table 1.1).

Table 1.1 showing the water quality parameters of the study area

Parameters	Mean Premonsoon (2013)	Mean Post Monsoon(2013)	Mean Premonsoon(2014)	Mean Post Monsoon (2014)	BIS (IS 10500-91)
pH	7.78	8.1	8.04	8.4	6.5-8.5
Sacchi depth(cm)	28	30	30	1	--
Chl-a	8	10	10	6	--
Turbidity(NTU)	7.2	2.4	8.2	8.5	5
TSS (mg/l)	1200	1036	1400	1500	100
TP(mg/l)	7.2	13.38	9.6	8.9	No Relaxation
NO3-N(mg/l)	5.4	5.36	6	4.2	45
Temperature(°C)	30	29	30	28	--
Total Hardness(mg/l)	43.6	635.6	156	175	200
DO(mg/l)	2.26	2.35	2.15	2.03	5
BOD(mg/l)	269	351	216	205	30
TDS(mg/l)	680	376	820	862	500
FC(MPN/100ml)	1800	1980	1500	1654	10
WQI	35.42	35.14	34.14	34.28	Poor

4. CONCLUSION

The water quality data have been examined by different multivariate statistical techniques were used to evaluate spatial and temporal variations of the lake basin. Similar water quality characteristics and confirmed the existence of three types of water quality (moderately, highly and less polluted stations). Based on obtained information, it is possible to design a future, more optimal sampling strategy, which could reduce the number of sampling stations and associated costs. The *Principal component analysis* (*PCA*) and factor analysis assisted (FA) to extract and recognize the factors or origins responsible for water quality variations.

PCA/FA identified seven latent factors that explained 73.06% of total variance, broadly organic matter, organic nitrogen and industrial pollution factors controlling their variability in waters of Hussainsagar basin. The multivariate statistical approaches show that, the domestic sewage and uncontrolled industrial effluent discharges are highly influencing the water quality. Migration patterns of heavy metals released in to the environment in the form of untreated effluents by industries in Hussainsagar lake catchment indicate the point sources of pollution. Thus, this study illustrates the usefulness of multivariate statistical techniques for analysis and interpretation of complex data sets, and in water quality assessment, identification of pollution factors and understanding spatial variations in water quality for effective lake water quality management

5. RECOMMENDATIONS

The uncontrolled and untreated waste water from the lake must be diverted through Interception and Diversion facilities. The effluents must be monitored for maintaining the standards prescribed by the pollution control board for various industries in the catchment area. The present study provides the baseline data for assessment of polluting sources and indicating the increased eutrophication.

6. ACKNOWLEDGEMENTS:

The author is thankful to Dr.M.Anji Reddy, Director-R&D, JNTUH, for his continuous support throughout this study.

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