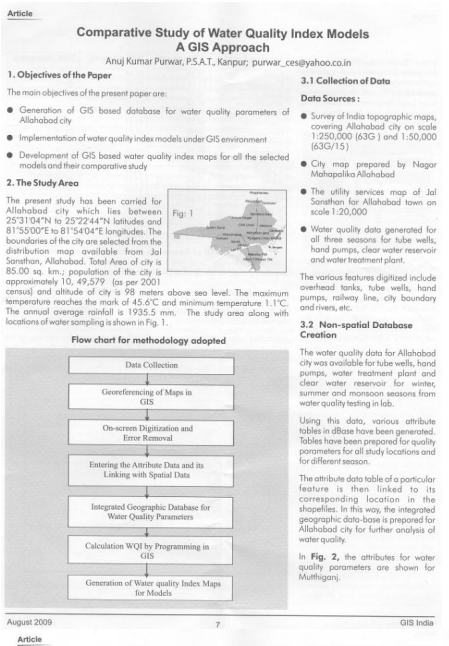
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Comparative Study of Water Quality Index Models A GIS Approach

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1. Objectives of the Paper

The main objectives of the present paper are:

- Generation of GIS based database for water quality parameters of Allahabad city
- Implementation of water quality index models under GIS environment
- Development of GIS based water quality index maps for all the selected models and their comparative study

2. The Study Area

The present study has been carried for Allahabad city which lies between 25°31'04"N to 25°22'44"N latitudes and 81°55'00"E to 81°54'04"E longitudes. The boundaries of the city are selected from the distribution map available from Jal Sansthan, Allahabad. Total Area of city is 85.00 sq. km.; population of the city is approximately 10, 49,579 (as per 2001 census) and altitude of city is 98 meters above sea level. The maximum temperature reaches the mark of 45.6°C and minimum temperature 1.1°C. The annual average rainfall is 1935.5 mm. The study area along with locations of water sampling is shown in Fig. 1.

Fig: 1

Flow chart for methodology adopted

Data Collection
↓
Georeferencing of Maps in GIS
↓
On-screen Digitization and Error Removal
↓
Entering the Attribute Data and its Linking with Spatial Data
↓
Integrated Geographic Database for Water Quality Parameters
↓
Calculation WQI by Programming in GIS
↓
Generation of Water quality Index Maps for Models

3.1 Collection of Data

Data Sources :

- Survey of India topographic maps, covering Allahabad city on scale 1:250,000 (63G) and 1:50,000 (63G/15)
- City map prepared by Nagar Mahapalika Allahabad
- The utility services map of Jal Sansthan for Allahabad town on scale 1:20,000
- Water quality data generated for all three seasons for tube wells, hand pumps, clear water reservoir and water treatment plant.

The various features digitized include overhead tanks, tube wells, hand pumps, railway line, city boundary and rivers, etc.

3.2 Non-spatial Database Creation

The water quality data for Allahabad city was available for tube wells, hand pumps, water treatment plant and clear water reservoir for winter, summer and monsoon seasons from water quality testing in lab.

Using this data, various attribute tables in dBase have been generated. Tables have been prepared for quality parameters for all study locations and for different season.

The attribute data table of a particular feature is then linked to its corresponding location in the shapefiles. In this way, the integrated geographic data-base is prepared for Allahabad city for further analysis of water quality.

In **Fig. 2,** the attributes for water quality parameters are shown for Mutthiganj.

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Water Quality Index (WQI) computation under GIS environment is done by customizing the ArcGIS Desktop applications through VB. Programmes have been developed for calculating water quality index from three water quality models

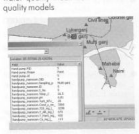


Fig. 2: Quality parameter values of hand pumps of Mutthiganj

Sampling Location	WQI (winter)	WQI (summer)	WQI (monsoon)
SulemSarai	75.34	92.68	95.2
CivilLines	93.69	96.86	96.43
Ashok nagar	92.10	94.84	99.09
Mumfordganj	90.30	94.05	95.01
Rasulabad	91.12	90.21	93.83
Phaphamau	94.23	93.41	95.12
Govindpur	90.98	94.69	50.88
Churchlane	76.72	91.31	95.82
Allahpur	86.50	88.39	88.14
Daraganj	70.24	77.96	73.86
Kydganj	72.07	90.89	90.87
Kareli	75.56	95.12	96.74
Mohatsimiganj	62.22	24.68	86.33
Mutthiganj	81.48	96.65	95.41
Mirapur	76.70	78.02	75.72
Karbala	50.53	71.44	72.82
Naini	88.42	90.92	92.23
Avantika colony	93.90	95.56	93.53

Table 2: WQI at Tube wells locations for three seasons

For computation WQI, enter the values of water quality parameters, then click the 'CALCULATE' button for displaying water quality index in the menu. After computation of each WQI, click ADD button to add all WQI in a dBase table. This dBase table can be linked directly to spatial feature as attributes.

3.3 Water Quality Index (WQI) Mapping in GIS

After calculating WQI by selected models in GIS environment for all study locations, water quality index maps have been developed for all three seasons. Comparative graphs of water quality index models also have been prepared for the study area. WQI study has been done for selection of areas that have potable water based upon the combined study of all the three water quality models. The WQI calculated from Models using GIS are presented tabular as well as in thematic map form. The WQI calculated from Bhargava Water Quality Index Model under GIS environment are presented in tabular and spatial form for all three seasons, i.e., winter, summer and monsoon.

3.4 Comparative Study of WQI for Models

The WQI computed through three models under GIS environment at various locations of hand pumps and tube wells has been compared for all seasons and the results obtained are analysed with the help of bar charts and spatial maps derived using GIS

GIS based water quality index maps have been prepared for comparing the water quality of tube wells for all seasons. It can be seen from the Fig. 3 that Sulemsarai, Karbala, Churchlane, Mohatsiganj, Kydganj, Daraganj, Kareli, Mirapur and Naini water sampling locations are showing water quality index below 90 in winter season by all the three selected models.

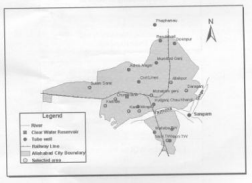


Fig. 3: WQI less than 90 for selected models in winter season

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4.0 Conclusions

In the present work, an integrated geographic database has been created using GIS consisting of water quality parameters of Allahabad city. The evaluation of the quality of water has been done by computing Water Quality Index (WQI) using three models, namely, Bhargava Water Quality Index model, Social Accounting System model and National Sanitation Foundation model. All these three models have been implemented under GIS environment for water quality indexing. Based upon the analysis of the results carried out, the following conclusions have been drawn:

1. The GIS based evaluation have given the spatial, graphical and statistical representation of groundwater and surface water parameters for assessing the quality of water for drinking purpose in Allahabad city by three water quality indexing models and for the computation of WQI for winter, summer and monsoon seasons.
2. The results of water quality mapping of Allahabad city shows that nearly 30% of sources are non potable due to physiochemical or bacteriological reasons or both in the case of tube wells.
3. Based upon the analysis carried out, it may be concluded that almost all the hand pumps require treatment of water for bacteriological contamination to make it safe for drinking or else the consumption of this water may be stopped to reduce the outbreak of health hazards.
4. The water quality index models selected for the present work includes all important water quality parameters for computing WQI but Social Accounting System model and National Sanitation Foundation model are not sensitive to each parameter separately. However, Bhargava Water Quality Index model is sensitive to each parameter separately and in particular for Fecal Coliform and Total Coliform. Thus, it is concluded that Social Accounting System model and National Sanitation Foundation model can be used effectively for river water quality mapping while Bhargava model can be adopted for water quality mapping of drinking water.
5. It is suggested that effective chlorination should be done for water from tube wells and hand pumps for protection from bacterial contamination.
6. The GIS based database and spatial models developed for water quality indexing for Allahabad city are modular and can be updated or modified easily for further use in a different city.

(For list of references please send email to gisindia.in@gmail.com)