GIS BASED GROUNDWATER QUALITY MAPPING IN SOUTHERN PART OF AURANGABAD CITY, MAHARASHTRA, INDIA

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ABSTRACT

River and groundwater is the major source of drinking and irrigation water supply in rural and urban area in the country. The annual groundwater withdrawal in the country is 231 BCM out of which 213 BCM is used for irrigation and 18 BCM for drinking and industrial use. Groundwater is the favorite alternative is facing threats due to anthropogenic activities in India, which has lead due to deterioration in groundwater quality. Nitrate is of anthropogenic origin. Beside loading the water with bacterial & nitrate contamination, infiltration of leachates from domestic sewage disposal system in stream and river could impact the groundwater quality as human waste are known to contain sodium, calcium, magnesium and chloride ions. The objective of the study is to analyze groundwater contamination due to anthropogenic activity using Geographical information system (GIS). The paper reports the impact of river water contamination on ground water contamination in six villages of the Aurangabad and Gangapur Taluka beside Waluj MIDC of the Southern part of the Aurangabad district, Maharashtra, India. Hence monitoring of groundwater water quality has become indispensable. GIS not only facilitates data capture and processing but also serve as powerful computational tool that facilitate multimap integrations. In this study groundwater quality analysis was carried out for Aurangabad and Gangapur Taluka in Aurangabad district, Water samples were collected from 40 dug-wells on either side of the Kham River which represents the entire Agricultural area of study are. The samples were systematically analyzed for physical and chemical parameters such as pH, EC, TDS, Cl, NO3 during pre-monsoon and post-monsoon period. Study area is an example of an area where the groundwater is contaminated as a result of infiltration of waste water in low laying areas adjacent to industrial area. The strategically analyzed results are presented in a GIS based water quality mapping.

KEYWORDS: Ground water analysis, Water quality parameter, Electrical conductivity, Geographical information System (GIS), Kham River, Aurangabad (MS), India

I. INTRODUCTION

Water quality is the physical, chemical and biological characteristics of water in relationship to a set of standards. Water quality standards are created for different types of water bodies and water body locations as per desired uses. There are separate quality standards for irrigation, potable and industrial water. Water quality depends on the local geology and ecosystem as well as human uses such as sewage dispersion, industrial pollution. Environmental engineer and researchers have paid much attention to the behavior of water quality in irrigation operation over the last decade. Chemical contamination of river and groundwater is one of the most serious pollution problems, particularly in arid and semi-arid areas where typically there is a deficiency in water resources. Chemical pollutions and waste water pollutions in river and GW are not normally identified until some illness has affected the local population.

1.1 Study area and data available

In Maharashtra, Aurangabad is one of the famous industrial and fastest developing city and which is well known for its Industrial auto cluster. It is situated in the central part of Maharashtra. The summer temperature is max 43º C and Min. 28ºC and winter temperature Max 32ºC to 5ºC. The sources of irrigation are streams, percolation tanks and wells in study area. Ground water plays a major role for irrigation as well as domestic uses. The Study area covers the Aurangabad taluka and Gangapur taluka which lies between latitude 19º 53' north and longitude 75 º 20' east along Kham River. The most important economic activity in the rural area is agriculture, with chief crops being jawar, wheat, maize, fodder crops for dairy animal and vegetable crops like onion, cauliflower, chili, tomato, cucumber. As described earlier, Kham River, which is one of the major tributaries of the Godavari River, receives all domestic and industrial waste water from the Aurangabad city and MIDC waluj. Aquifer parameters are available from ground water exploration carried out in the alluvial area of the district as well as from the pumping tests carried out on dug wells in Basaltic and Alluvial terrain. The transmissivity of shallow basaltic aquifers in the district is generally less than 80 sqm/day. The specific capacity of well also gives an idea about the productivity of well and is controlled by diameter and depth. In basaltic formation the specific capacity of dug wells is generally less than 200 lpm/m of drawdown with an average of 110 lpm/m of drawdown. In Alluvium it ranges from 130-2043 lpm/m of drawdown. The pumping tests conducted on 2 shallow exploratory wells of Alluvium indicates that transmissivity ranges from 369 to 757 m2/day, storativity ranges from 3.3 x 10-5 to 1.7 x 10-3 whereas specific capacity ranges between 0.7 and 3.2 lps/m of drawdown(Report GSDA,Aurangabad-2011).

1.2 Problems in study area

Here in surrounding area of Kham River the groundwater is spoiled due to waste disposal and improper agricultural practices. Total generation of sewage in Aurangabad city is 107 MLD. In Waluj MIDC area, there are 105 units which are water polluting. Out of 105 industries 45 industries generate industrial effluent more than 10 CMD. Total quantity of industrial effluent generated from Waluj MIDC area is 10.72 MLD and total domestic effluent generated is 3.928 MLD. (MPCB report - Aurangabad). Therefore water quality monitoring is necessary in and around Kham River.

1.3 Objectives

Objectives of present study are 1. To analyze various physical and chemical parameters using recommended apparatus 2. To delineate groundwater contamination zone.3. to develop Groundwater quality map of Aurangabad and Gangapur Taluka using GIS

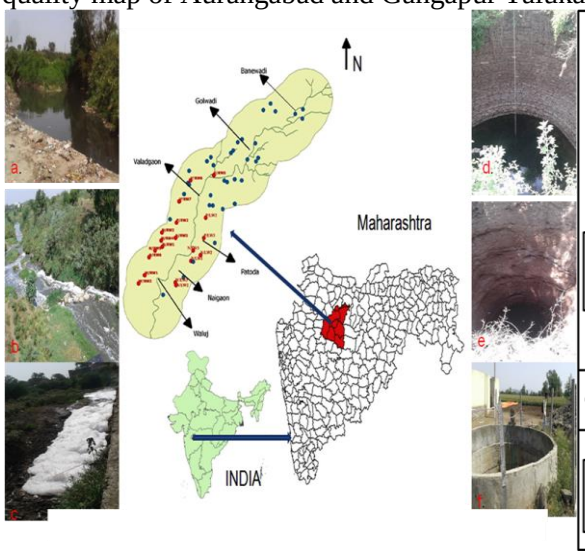

Figure 1: Study area with well water sampling location

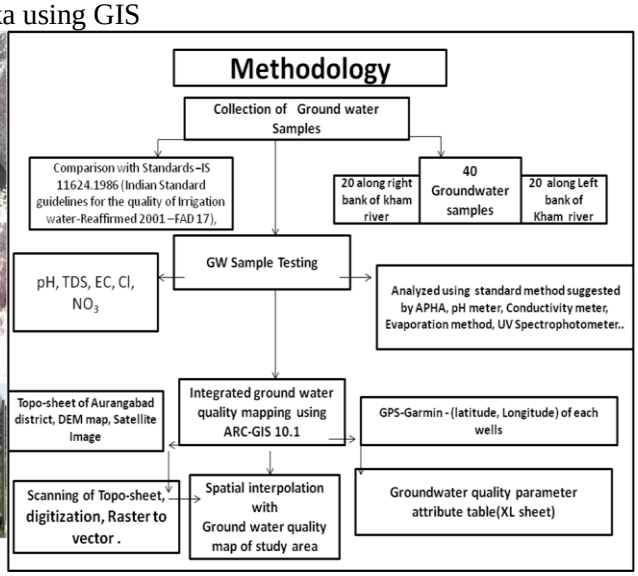

Fig. 2: Methodology used to achieve objectives

II. METHODOLOGY AND EXPERIMENTAL SITE DETAILS

Methodology adopted to accomplish the objectives is as shown in figure 2**.** Preliminary survey is carried out with well inventory survey to get the detail information of selected wells with their accessibility for sampling and planning for collection of sample the points at which major contamination occurs was find out and then following stations were selected as shown in tables.

2.1 Sample collection procedure and details:

All the dug well were equipped with electrical pumps. GW samples collected from the dug-well at a depth of 10 to 12 m below the ground level at 40 locations in which 20 wells are present along right bank and 20 wells present along left bank of Kham River as shown in figure 1. Two water samples were collected for one year per sampling station covering both pre and post monsoon seasons. A total 80 groundwater samples and 22 river water samples collected tested and analyzed in the year 2014 during pre-monsoon and post monsoon period. GW samples were collected after long standing discharges and floating matter removed using cellulose nitrate membrane filters with 0.45 mm-pore size, collected samples of one liter plastic bottles and then stored in the refrigerator in order to sustain low temperature ($<4^0$C) for further analysis work. Sample collection was usually completed during morning hours between 6.00 am to 9.00 am for further analysis**.**

Fig. 3: Use of Garmin –GPS system for Well inventory survey for preparation of Spatial variation map using QGIS

Fig. 4 Pre-monsoon and post monsoon well water sampling location at village Patoda with Litho logical study

Table 3: Pre-monsoon and post-monsoon river and well water (GW) sampling location details for the year - 2014

Sr. No	Name Of sampling location	Well water Sampling location along Left bank	Well water sampling location along right bank	Total GW Samples
1	Banewadi	2	2	4
2	Golwadi	2	2	4
3	Valadgaon,	2	2	4
5	Naigaon	2	2	4
6	Waluj	2	2	4
	Total	20	20	40

III. GEOGRAPHIC INFORMATION SYSTEM

A GIS is an information system designed to work with data referenced by spatial/ geographical coordinates. The Four functions of GIS are 1. Data acquisition and pre-processing 2. Data management, storage and retrieval 3. Manipulation and analysis 4. Product generation. Conventional data collected are 1. Layout map of Aurangabad and Gangapur Taluka, Groundwater quality parameters analyzed of 40 dug-wells 2.. Instrument used are GPS-Garmin 3. Water quality field Kit 3. Software used for preparation of groundwater quality maps are ARC-GIS 10.1
The water quality parameters were tested in the laboratory. The lab test procedure was done as per Indian standard code of practice. The water quality parameters are given in the data base to GIS. The Aurangabad and Gangapur map was scanned and digitized. Digitization was done by ARCGIS 10.1. finally integrated groundwater quality maps was created using ARC-GIS10.1

3.1 Ground water quality analysis

The quality of ground water sources are affected by the characteristics of the media through which the water passes to the ground water zone of saturation. Ground water quality may be affected by natural factors, such as (i) the quality of irrigation water which depends primarily on the presence of dissolved salts and their concentration. (ii)Sodium adsorption ratio is the most important quality criteria. Sodium hazard depends on relative proportion of sodium to calcium and magnesium ions. Which influence the water quality and its suitability for irrigation (iii) the higher Electrical Conductivity, the less water is available to plant, even though soil may appear wet. Usable plant water in soil solution decreases dramatically as EC increases.

3.2 Ground water quality mapping using GIS

GIS is used to evaluate the quality of groundwater in Aurangabad taluka. Spatial variation map major water quality parameter like pH, EC, TDS, NO_3, Cl, were prepared for Aurangabad based on these spatial variation maps of major water quality parameters, integrated ground water quality map of study area was prepared using GIS. This groundwater quality map helps us to know the existing GW condition of the study area. The spatial distribution of NO_3 concentration in twenty well water samples along left bank and right bank of Kham River is illustrated in Figure 7.

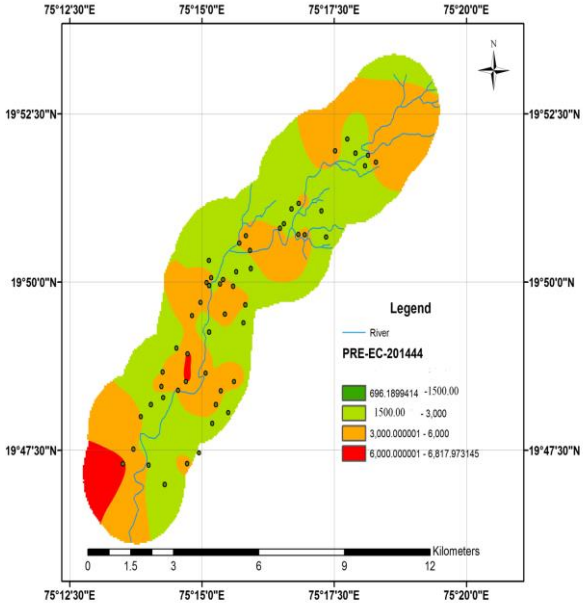

Fig. 7 Pre-Monsoon Spatial variation map of EC Concentration in groundwater of wells along either side of Kham river at village Banewadi, Golwadi, valadgaon, Patoda, Naigaon and Waluj

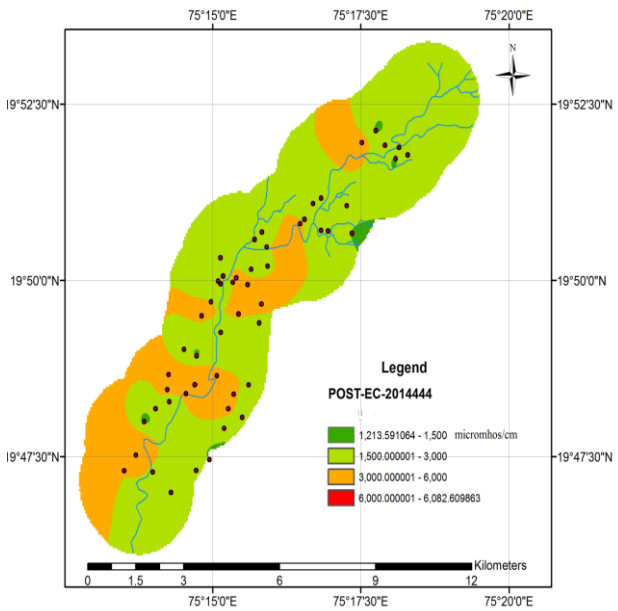

Fig. 8 Post-Monsoon Spatial variation map of EC Concentration in groundwater of wells along either side of Kham river at village Banewadi, Golwadi, valadgaon, Patoda, Naigaon and waluj

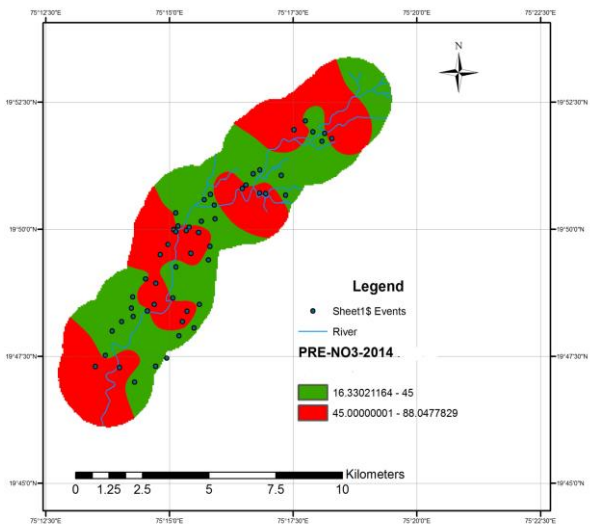

Fig. 9 Pre-Monsoon Spatial variation map of Nitrate Concentration in groundwater of wells along either side of Kham river at village Banewadi, Golwadi, valadgaon, Patoda, Naigaon and Waluj

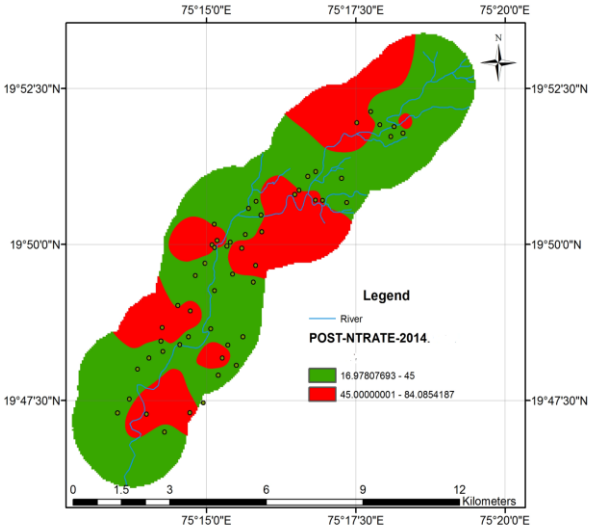

Fig. 10 Post-Monsoon Spatial variation map of Nitrate Concentration in groundwater of wells along either side of Kham river at village Banewadi, Golwadi, valadgaon, Patoda, Naigaon and waluj

The NO_3 concentration of ground water sample of wells along left bank of Kham River having range from 21.9 mg /lit to 58.0 mg /lit during pre-monsoon period and 21.4 mg /lit to 64.0 mg /lit during post-monsoon period. This map illustrates that the six well water sample, these are V/LW1, V/LW4, V/LW5, V/LW6, V/LW7, V/LW8, P/LW1, P/LW2 have nitrate concentration in excess of 45 mg/lit during pre-monsoon period which is shown by red well spot on map and Eight well water sample have NO_3 concentration in excess of 45 mg/lit during post-monsoon period. during pre-monsoon period as shown in fig. 9 and 10. To determine the suitability of water for irrigation based on EC, the spatial distribution of electric conductivity in 40 well water samples along left bank and right bank of kham river is illustrated in Figure 7 and 8. It indicates total eighteen ground water sample of wells along left bank and seventeen groundwater sample of wells along right bank of kham river having range for EC from 1500 to 3000 micromhos/cm during PRM season. This map illustrates that the four well water sample along left bank, these are V/LW4, V/LW7, W/LW1, W/LW2 having range for EC from 3000 to 6000 micromhos/cm during post-monsoon period.

The TDS concentration in well water sample range from 1089 mg/lit to 2442 mg/lit during pre-monsoon period and 830 mg/lit to 2189 mg/lit during post-monsoon period. Spatial variation map for TDS illustrates that the eight well water sample out off 20 selected wells have TDS concentration in excess of 2000 mg/lit during pre-monsoon period and One well water Sample out off 20 selected wells have TDS concentration in excess of maximum permissible limit during post-monsoon period and twelve well water sample out off 27 selected wells at right hand side of kham river have TDS concentration in excess MPL, it is observed that majority of well water sample period at right hand side kham river have TDS concentration below maximum permissible level during post monsoon period .

IV. CONCLUSIONS

The hydro chemical studies carried out in the study area distinctly reveal the effect on groundwater pollutants on the croplands. The Kham river carries industrial effluents which is highly red/black coloured, alkaline and rich in organics and other soluble salts. Groundwater sample analysis shows increased concentration of Nitrate, total dissolved solids, electrical conductivity, chloride which indicates domestic and industrial effluents are influencing groundwater hydrochemistry in village waluj, patoda, Naigaon and Valadgon of Aurangabad and Gangapur taluka which was clarified in spatial relationship between river and groundwater in this study using GIS, which will be applicable to effective management of river and groundwater quality. Hence monitoring the groundwater quality

is indispensible. GIS technologies can provide appropriate platform for convergent analysis of large volume of multi disciplinary data and decision making for ground water studies can be effectively done.

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