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ANALYSIS AND MAPPING OF GROUND WATER QUALITY OF BHAUNAK RIVER BASIN OF JALGAON (MS) DISTRICT USING ARC-GIS

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ABSTRACT

Water quality studies of specific hotspots have been undertaken with certain objectives and methodologies. Water is a basic resource for existence of our universe; therefore, it has been termed as elixir of life. Periodic assessment of both surface and ground water potential and continuous monitoring of quality is essential to adopt remedial measures. In present study, we proposed the model for testing the quality of water that could be useful for identification of similar hotspots. Among the physical, chemical and bacteriological characteristics, our group has undertaken first two. Sixteen samples of Bhaunak river basin of Jalgaon district (MS) were tested for their quality.

Key words: ARC-GIS, Mapping, Water quality, Hotspots.

INTRODUCTION

In many ways, water promotes the economic and general well being of society. These are beneficial uses. The relative importance of beneficial uses for any particular stream or lakes depend on the economy of the area and desire of peoples. Many applications are restricted within narrow ranges of water quality, such as public, industrial water supply and unregulated wastewater disposal. Therefore, control of quality of water is required for being capable of supporting aquatic life and to get greater yield of potable water by conventional treatments.

Precautionary measures for water quality[1]

Poisons in water can cause significant damage to plant and animal life in flowing water. The list of toxic agents is quite long.

(i) **Heavy metals:** Zinc, cobalt, cadmium, mercury and lead.

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(ii) **Synthetic organic compounds:** Cynide, phenols, pesticides, (from industries) chlorinated hydrocarbons.

(iii) **Gases:** Hydrogen sulfide, ammonia.

The greater exploitation of ground water for irrigation, industrial purpose and inadequate recharge system in the specified area i.e. Bhaunak water shed has caused depletion of water table and created scarcity of water. This resulted in drying of village ponds, lake; reduction of base flows of many streams and rivers. Main precautions that are required are as follows.

(i) Use of proper wastewater disposal methods.

(ii) Recycling of water for domestic use.

(iii) Animal waste and cow dung stocking (pits for manures) should be banned, instead biogas plant should be encouraged. It prevents pollution, supply fuels and manure.

(iv) Proper use of fertilizer and limited irrigation to avoid leaching of nitrogen, phosphate, potassium etc.

Water quality parameters[2]

The constituents of water for quality point view can be classified into following categories -

Characteristics parameters

Physical: Colour, odor, temperature, solids (suspended and dissolved residues), oils, grease.

Chemical[3,4,6]: Biochemical oxygen demand, chemical oxygen demand, total oxygen demand, total organic carbon, salinity, hardness, pH, iron content, manganese, chlorides, sulfates, sulfides, heavy metals, nitrogen and phosphorus.

Bacteriological[5]: Coliforms, fecal coliforms, specific pathogens, viruses.

Source of water pollution: Source of water pollution can be separated in to two types -

(i) **Point sources:** At a single location, industrial, municipal sewage treatment plant, combined sewer overflow, raw sewage discharges.

(ii) **Non-point sources:** Agricultural, forestry, mining, construction, urban runoff, hydrologic modification and residuals.

Environmental indicators

The water quality indicators are as follows.

Classification of streams, temperature, pH, conductivity, turbidity, total dissolve solids, total suspended solids, color, biological oxygen demand, chemical oxygen demand, dissolve oxygen, hardness, alkalinity, acidity, nitrate, phosphate, sulfate, chloride, fluoride, potassium, sodium, magnesium, iron, chloroform, pesticides etc.

EXPERIMENTAL

Methodology: Sample of water from sixteen samples stations were collected. Standard methods for analysis of various parameters were used and carried out in central instrumentation laboratory, M. J. College, which is well equipped with sophisticated instruments such as atomic absorption spectrometer, gas chromatography, turbidometer, UV-Visible spectrophotometer etc.

G.I.S. (Geographical Information System): Geographic Information Systems (GIS) have become important tools in efficiently solving many problems in which spatial data are important. Natural resources and environmental concerns, including ground water have benefited greatly from the use of GIS. It is becoming powerful computer tools for varied applications ranging from sophisticated analysis and modeling of spatial data to simple inventory and management. Geographical Information System (GIS), which is a tool that allows synergism of map data and tabular data in the most efficient manner. Now-a-days, GIS has been playing a great role in carrying out an easy going analysis. It has number of applications, which force us to be a part of GIS. It involves some important tasks like -

- Organizing integrated spatial and non-spatial databases using the GIS tools in a systematic manner. The spatial data -consisting of maps from remotely sensed data and with conventional sources.
- Generation of spatial outputs, supported by tables/charts, to help the developmental planning and decision-making.

ArcGIS desktop

ArcGIS Desktop is the framework that provides the user interaction and experience for GIS professionals: ArcGIS Desktop is used to perform a number of key GIS tasks like

design and build geographic databases, create and manage GIS workspaces and datasets, perform editing and data compilation, make maps, 3D visualizations and perform geoprocessing. The main application in ArcGIS is ArcMap**,** which is used for all mapping and editing tasks as well as for map-based query and analysis. A map is the most common view for users to work with geographic information. It's the primary application in any GIS to work with geographic information. ArcMap represents geographic information as a collection of layers and other elements in a map view. Common map elements include the data frame containing map layers for a given extent plus a scale bar, north arrow, title, descriptive text, and a symbol legend. These maps are useful to show the spatial distribution of water quality parameters.

RESULTS AND DISCUSSION

The chemical indicators of sixteen different places are as shown in the Table 1.

Table 1(a): Chemical Indicators

Site	Chemical indicators					
	pH	**Conductance 10^{-6} (mhos)**	**Dissolved solid (mg/L)**	**Nitrate (mg/L)**	**COD (mg/L)**	**Acidity (mg/L)**
Shiragad	8.21	5.58	1200	0.32	50	18.0
Kolnhavi	8.32	8.68	1200	0.68	30	28.0
Dambhurni-1	7.86	13.52	1600	5.78	80	40.0
Dambhurni-2	8.31	11.85	1600	6.4	90	67.2
Dongaon-1	8.13	12.64	2400	5.36	20	28.8
Dongaon-2	8.32	7.71	1200	6.7	20	68.0
Kingaon	8.17	7.47	800	3.5	10	60.0
Naygaon	8.05	9.34	400	6.56	00	57.6
Malod	8.03	5.86	800	2.16	10	38.0
Waghziri-1	7.85	6.37	400	0.72	00	38.8
Waghziri-2	8.05	7.49	100	0.48	10	27.2
Giradgaon	8.09	15.19	400	7.10	00	29.2
Waghod	8.27	8.01	800	2.8	00	8.0
Sakali	7.99	11.20	800	1.68	20	32.0
Manwel	8.17	9.55	1200	2.6	50	40.0
Dagadi	8.11	9.08	800	0.56	10	24.4

Table 1(b): Chemical indicators

Site	Chemical indicators				
	Alkalinity (mg/L)	**Total hardness (mg/L)**	**Calcium (mg/L)**	**Magnesium (mg/L)**	**Chlorides (mg/L)**
Shiragad	336	284	49.70	57.17	73.74
Kolnhavi	368	316	44.89	66.15	93.59
Dambhurni-1	360	544	30.46	125.30	181.50
Dambhurni-2	312	460	51.30	99.72	96.42
Dongaon-1	352	552	91.38	112.39	150.31
Dongaon-2	288	428	65.73	88.39	65.23
Kingaon	316	292	44.89	60.29	56.72
Naygaon	292	324	57.72	64.97	96.42
Malod	272	292	65.73	55.21	45.38
Waghziri-1	320	304	72.14	56.57	48.21
Waghziri-2	392	340	46.49	71.62	59.56
Giradgaon	300	580	89.78	119.61	209.86
Waghod	272	288	44.89	59.32	93.59
Sakali	380	420	44.89	91.53	119.11
Manwel	360	348	33.67	76.70	102.1
Dagadi	352	336	17.67	77.68	96.42

The spatial distribution of the chemical indicators for quality drinking water is given in the Figs. 1 to 11.

pH: pH values in the study area varied between 7.85 to 8.32. Almost 100 % of the samples are within the permissible limits as per the Indian Council of Medical Research (ICMR).

Alkalinity: The lowest alkalinity in the ground water has been observed to 272 mgL^{-1} at Waghod and Malod sample stations. However, the highest (380 mgL^{-1}) was observed at Sakali.

Acidity: The acidity level in water in the study area was observed to vary between the range 8.0 and 68 mgL^{-1} at Waghod and Dongaon sample stations, respectively. The lower

rage of acidity at Wghod may be due to percolation of rainwater in acidic constituent soil such as humic acid.

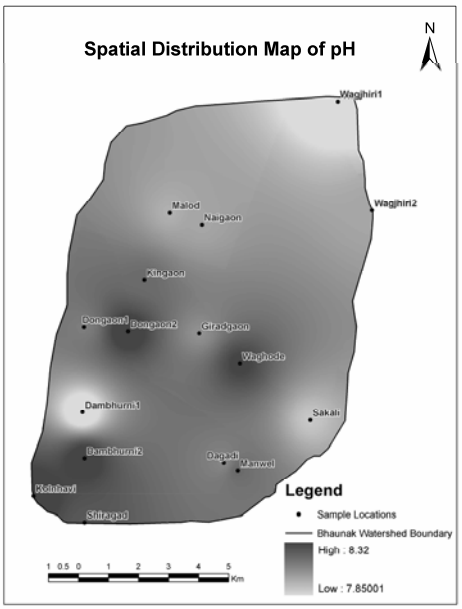

Fig. 1: Spatial distribution map of pH

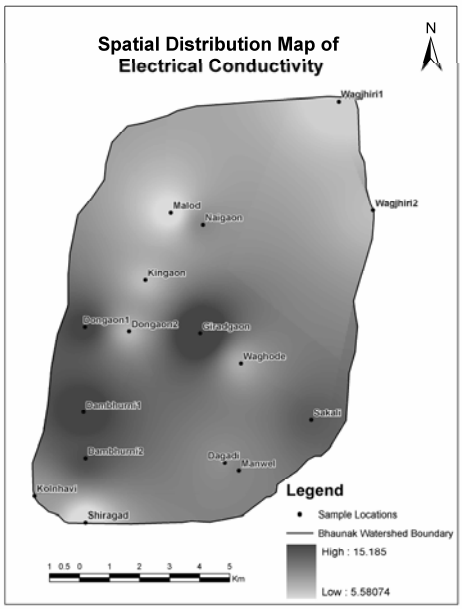

Fig. 2: Spatial distribution map of EC

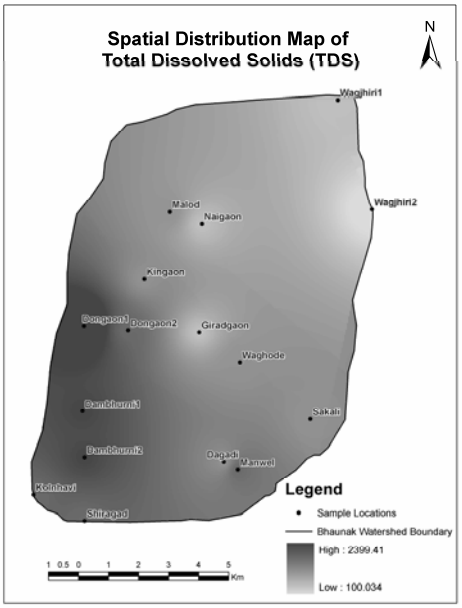

Fig. 3: Spatial distribution map of TDS

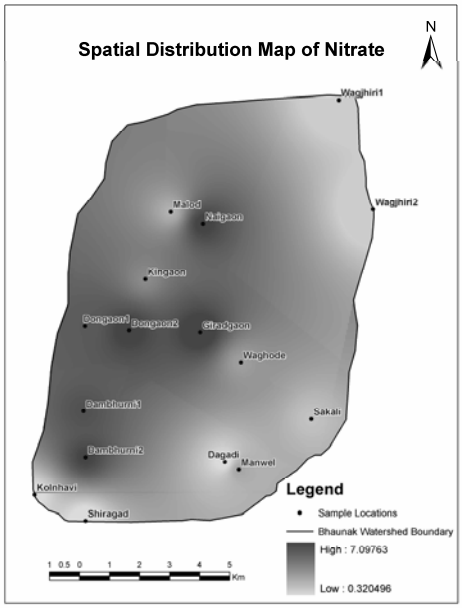

Fig. 4: Spatial distribution map of nitrate

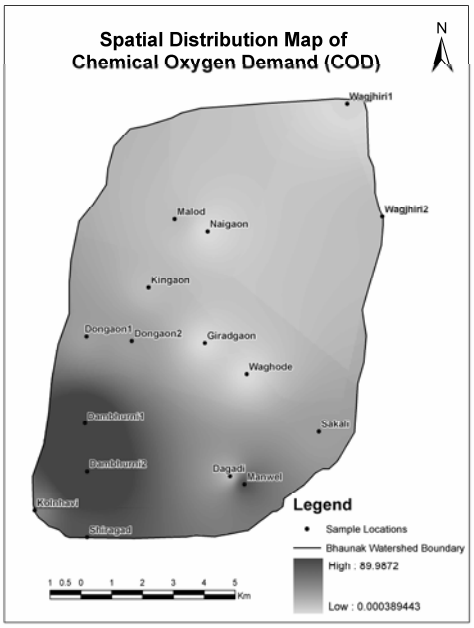

Fig. 5: Spatial distribution map of COD

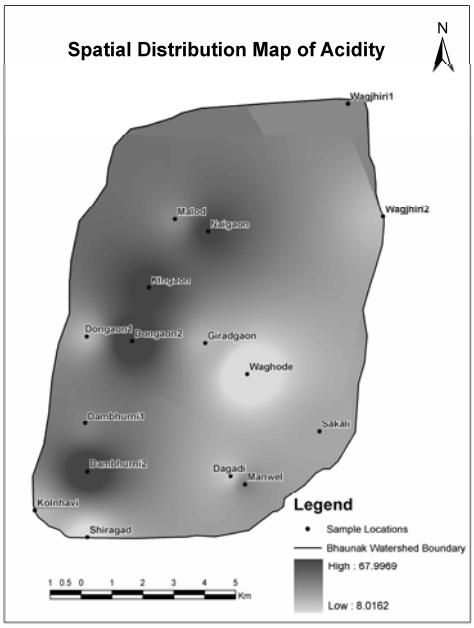

Fig. 6: Spatial distribution map of acidity

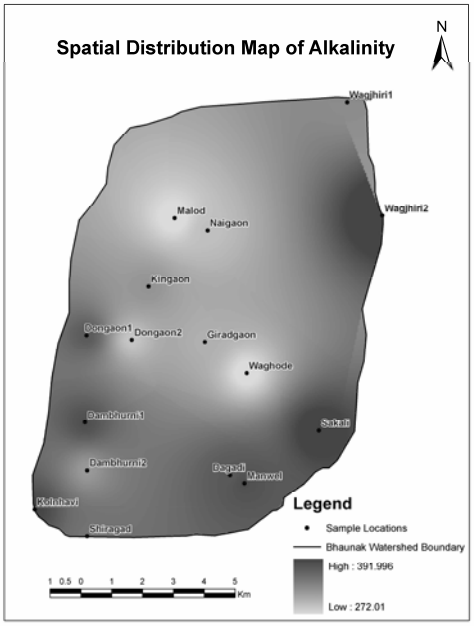

Fig. 7: Spatial distribution map of alkalinity

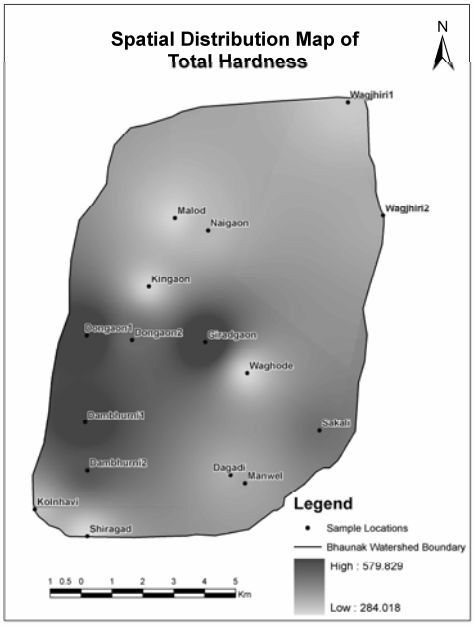

Fig. 8: Spatial distribution of hardness

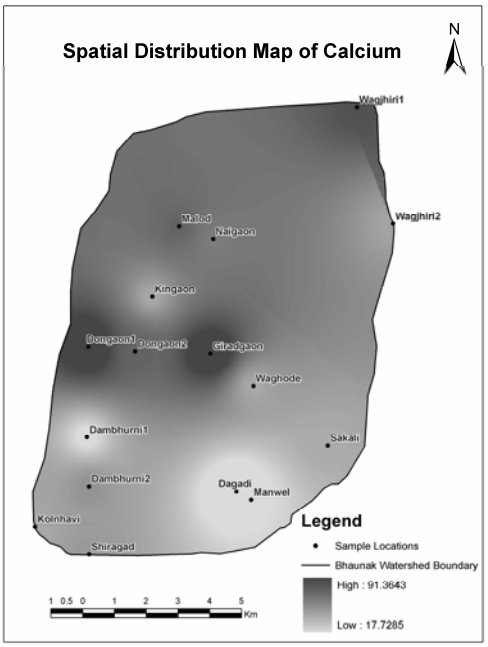

Fig. 9: Spatial distribution map of Ca

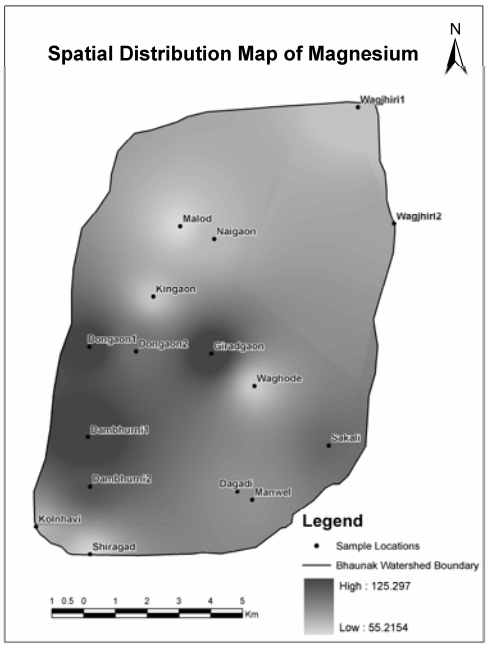

Fig. 10: Spatial distribution of Mg

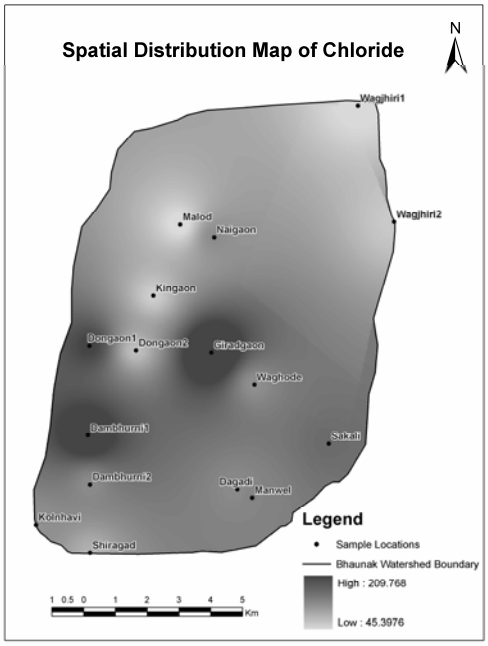

Fig. 11: Spatial distribution map of chloride

Electrical conductivity (EC): The EC of ground water ranged from as low as 6.37 millimhos at Waghod to as high as 13.52 millimohos at Dambhurni-1 sample station. The spatial distribution of EC is shown in Fig. 2.

Total hardness: The total hardness ranged between 2400 mgL^{-1} (Dongaon-1) and 400 mgL^{-1} (Giradgaon). All the samples stations have total hardness below 600 mgL^{-1}, which is permissible limit of drinking water as per ICMR**.**

Calcium: All the samples of water for calcium were within the permissible limit of drinking water quality. The calcium hardness level in the ground water varied between 17.67 mg L^{-1} and 91.38 mgL^{-1} at Dagadi and Dongaon-1 sample station, respectively. About 81 % of the samples were found to have calcium level above 40 mg L^{-1}.

Magnesium: The magnesium level in the gorund water varied between 50 to 99 mg L^{-1}. 75% of the sample have this range of magnesium content. The highest magnesium level was found to be at Malod sample station (55.21 mg L^{-1}) and lowest at Dambhurni-1 (125.3 mg L^{-1}).

Nitrate: The nitrate level in the ground water varied between 0.32 mg L^{-1} (Shiragad) and 6.56 mg L^{-1} (Naygaon). It was found that almost all samples are in permissible limit of drinking water as per ICMR.

Chlorides: The lowest level of the chloride is 45.38 mg L^{-1} (Malod) and highest level is 209.86 mg L^{-1} (Girdgaon). All samples contain chloride within the permissible limit as per ICMR.

Dissolved solids: Dissolved solids in the study area varied between 400 mg L^{-1} to 2400 mg L^{-1}. About 81% of the samples are within permissible limit.

CONCLUSION

The geospatial model proposed by us reveals that the ground water quality depends on the use of fertilizers, types of fertilizers and evapotranspiration. Water from most of the location have parameters pH, TDS, chloride, magnesium and nitrate within the permissible limits for drinking water as recommended by ICMR (1993). It is difficult to understand the issues related to water, simply by groundwater quality analysis as it lacks spatial information. Therefore, combination of both groundwater quality parameters and GIS methods is very useful to researchers to model the health related issues as GIS provides efficient capacity to visualize the spatial data. Customized maps created using GIS software

will be helpful to gain a better understanding of the water quality to common people and Government sources for better water quality management.

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