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Review Article

ENVIRONMENTAL VULNERABILITY OF BHANDARA & GONDIA DISTRICTS OF MAHARASHTRA STATE, INDIA

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The present paper ardently deals with conceptual model of Environmental Vulnerability Maps of Bhandara and Gondia Districts of Maharashtra State, India. The Environmental Vulnerability maps of the district were prepared according to the guidelines provided by the International Hydrolgeological Programme (IHP), Central Pollution Control Board, New Delhi and WHO. The Bhandara and Gondia districts are the developing districts in the Vidharbha region of Maharashtra state. These districts cover an area of 9280 Sq.Km. with a population of about 2.3 Million. Lithologically the area essentially belongs to Achaean formations. There are many industries in the vicinity and many more are coming up in near future. There are many situations where environment is threatened by these existing industries. The methodology of environment vulnerability assessment and mapping outlined in the paper is an attempt to provide a comprehensive guide to interpret the environment and other relevant information with an understandable format of presenting the data. In order to protect environment of Bhandara and Gondia district, a legend model for Environmental Vulnerability Maps has been prepared, considering various parameters such as the industrial activities in the area, land cover/use data, municipal contaminating activities, mining activities, hydrogeological characteristics of upper aquifers, the lithology and nature of the soil zone for the area, various predominant contaminating sources etc., so as to facilitate the consistent and uniform planning of Bhandara & Gondia districts for sustainable development.

Keywords: Environmental Vulnerability, IHP, Sustainable development

INTRODUCTION

The Districts of Bhandara and Gondia are in the North-Eastern extreme of Maharashtra State lies between 20º 39'and 21º 38' north latitudes and 79º 27' and 80º 42'east longitudes covering an area of 9280 sq. km. The Bhandara district lies entirely within the Wainganga basin. Three major tributaries of Wainganga—the Bagh, the Bawanthari and the Chulband drain the districts.

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There are many different situations where environment is threatened by the existing industries in the districts. There is one ordinance factory at Bhandara town, which discharge hazardous and toxic wastes into the streams. There are about 160 rice mills, 4 oil extraction Plants, 3 steel and alloy units, 2 paper and pulp units 1 sugar and about 70 cottage brass utensils manufacturing units in the districts. The wastewater disposed by these industries contains hazardous elements and contaminates surface water and later on contaminates groundwater.

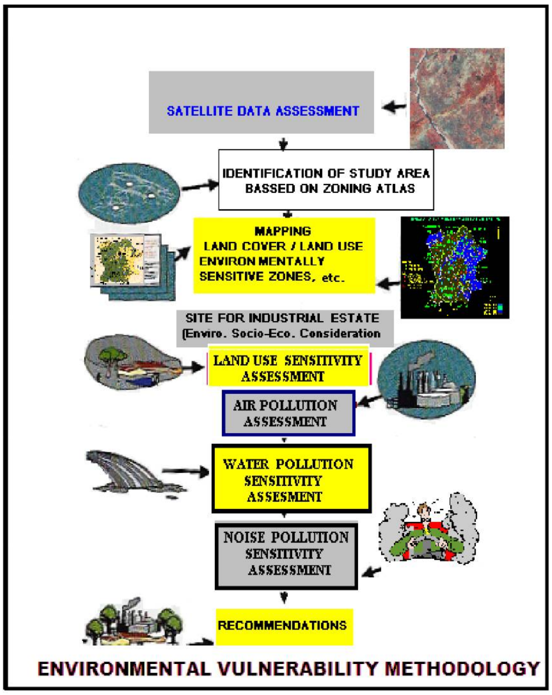
The groundwater contains dissolved solids; possesses physical characteristics such as odor, taste and temperature. The natural quality of groundwater depends upon the physical environment, the origin, and the movement of water. As the water moves through the hydrological cycle, various chemical, physical, and biological processes change its original quality through reactions with soil, rock and organic matter. Natural processes and human activities cause the changes in groundwater quality, directly or indirectly (Pandey, 2005).

The type, extent, and duration of induced changes of groundwater quality are controlled by the type of human influence; the geo-chemical, physical, and biological processes occurring in the ground; and the existing hydrogeological conditions. These parameters are controlled by the volume and flux of water in the system which, in turn, depend on climate, topography, and hydraulic conductivity (Pandey, 1999).

METHODOLOGY

There are different steps in Environmental Vulnerability Mapping where we can use remotely sensed data for better result, faster data acquisition, data processing, decision making, implementation and monitoring, etc. The different steps listed in the Flowchart No.1.

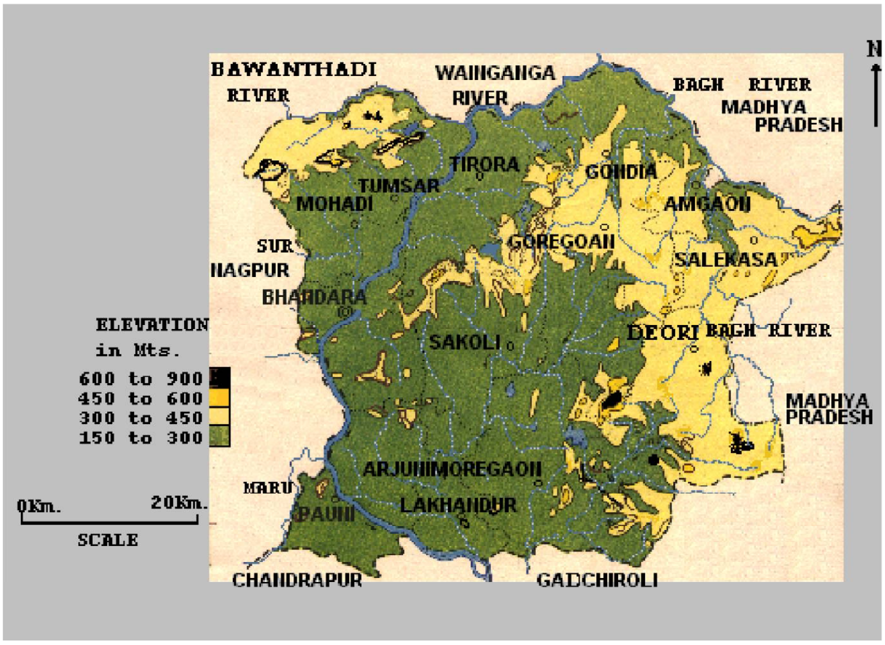
Flow Chart 1: Showing Environmental Vulnerability Methodology



TOPOGRAPHY

The major parts of Bhandara and Gondia districts are characterized by undulating topography with dense forest. The highest contour of 900 meters is situated in the South-East at Navegoan-Dogar hill and lowest contour value is 200 to 300 meters throughout South-East and North sector of the district. The slope is very steep in the East and North-West than the North, South, South-West and West part of South. The central part of the district forms a valley which extent roughly north East-South, East-West direction as shown in the Map No.1.

Map 1: Topographical Map of Bhandara and Gondia District



DRAINAGE

The Wainganga and the Bagh are the main rivers, which drain along the valley and roughly divide the area into two parts. The Wainganga River flows at an average velocity of 10 km/hour, and is having an overall length of about 200 Km. within the area. The Wainganga valley forms a central depression in the districts occupying one third of its area. The valley floor is formed over an Achaean crystalline terrain and is covered by riverine alluvium.

The Bagh valley occupies the eastern part of the district. The Bagh river joins the Wainganga on its left bank as the later enters the in the Gondia district. The Bagh River flows at an average velocity of 18 km/hour, and has an overall length of about 166 Km. the valley floor is formed over grainitic terrain. The other periodical rivers that drain the area are the Sur, the Bawanthadi, the Maru, the Garvhi, and the Chulband as shown in the Map No 2. The elevation of the district ranges between 520 m to 610 m above MSL.

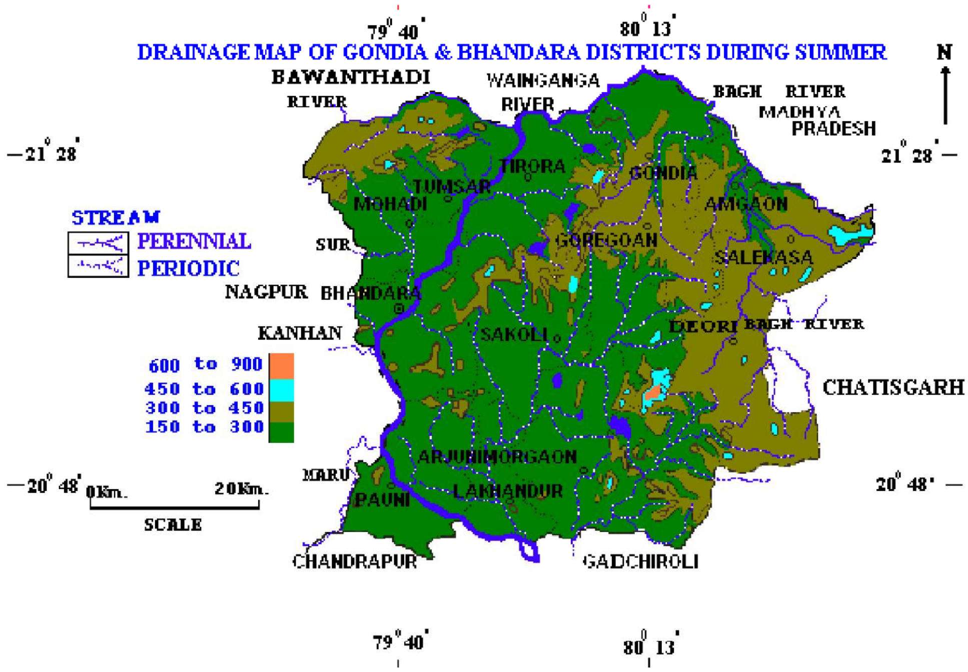
ENVIRONMENTAL SCENARIO OF THE AREA

Nature is constantly changing state, with or without the intervention of man, but industrial activities can hasten these changes and cause them to go in unfavorable directions that result in environmental damages (Rathore and Pandey, 2002). That is why priorities need to be established. Whether or not, changes of natural state are to be tolerable depending on the priority in economic development strategy.

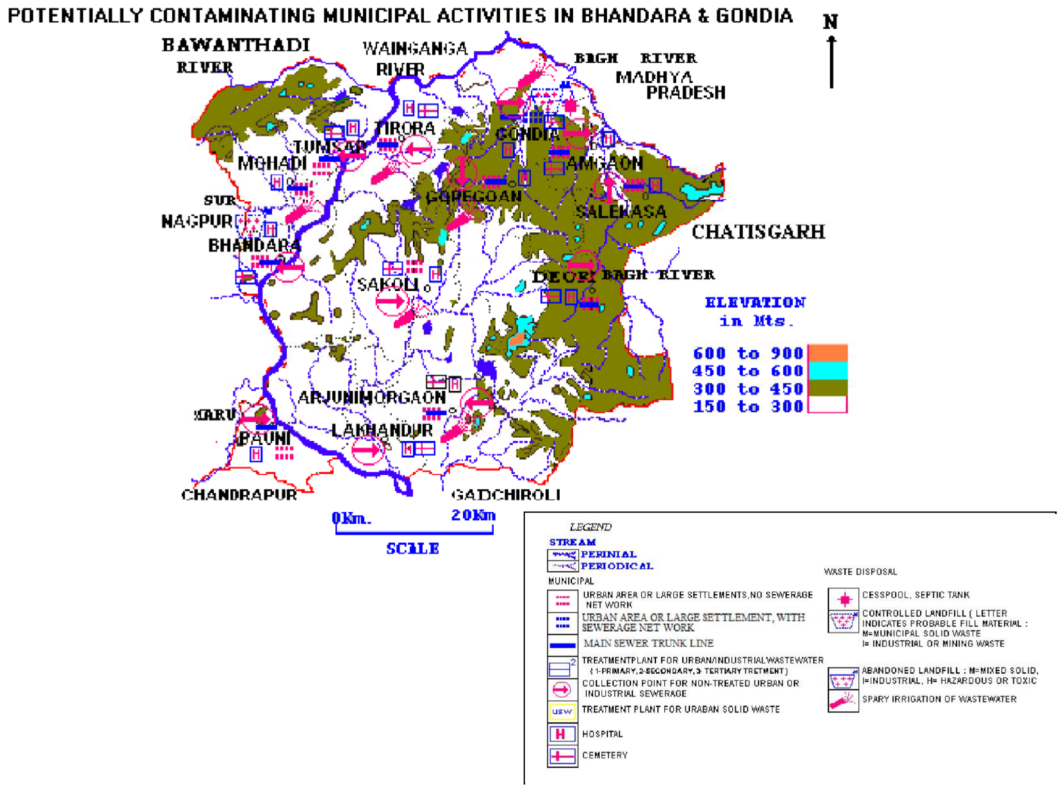
Scarcity arises from the fact that environmental assets, such as clean water and air have a limited capacity to absorb material before they start changing their state. The change of state may be through destruction of water bodies due to excessive nutrients, which support plant life in water.

Map No. 3 shows that most of the urban areas with large settlement have no sewerage network except Gondia town. There is no sewage

Map No.2: Drainage Map of Bhandara and Gondia Districts



Map No 3. Potentially Municipal Contaminating Activities in the Area



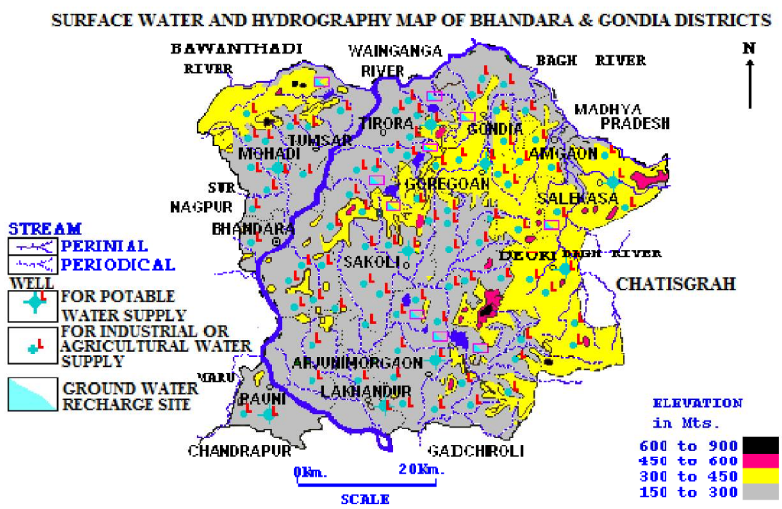
treatment plant in the districts and most of the wastewater and urban solid waste is discharged into the streams. The medical wastes from various hospitals in the districts also contaminate the surface water, as there is no treatment plant for solid waste. Some of the agricultural area in the districts is being irrigated by the industrial wastewater. Therefore, all of the above cited activities ultimately contaminate the groundwater.

Map No. 4 shows the utilization of groundwater in the districts for different purposes. About 80% of the available groundwater is used for agricultural & industrial purposes, whereas 20% is used for potable water supply throughout the districts. There exist a few groundwater-recharging sites in the districts at Bodalkaœa, Navegaon, Totladoh, Kalisarad, Kharwanda, Chulbandh etc. in the districts. Besides this the Wainganga and the Bagh rivers also contribute significantly for recharging ground water in the districts.

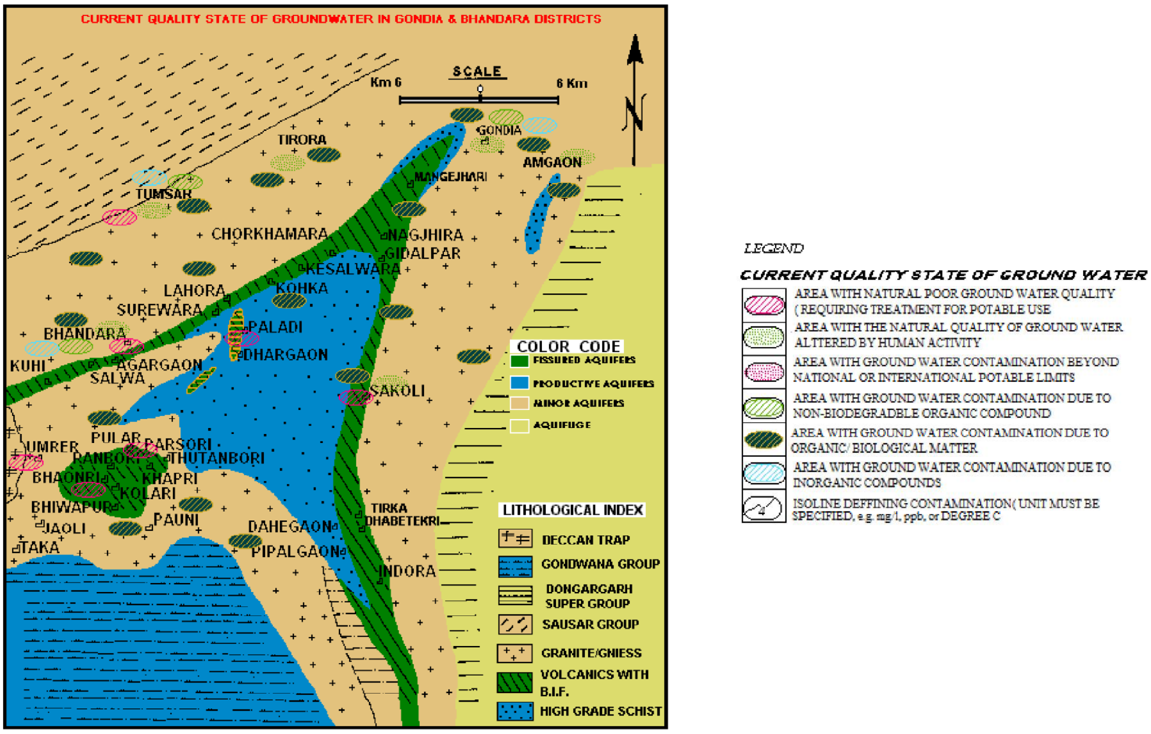
There are 580 large and 13,758 small and medium sized tanks scattered all over the districts (Gazetteer, 1979). These tanks are mainly distributed in the Wainganga, Bagh, Chulband and Garhvi valleys. The catchments area of these tanks ranges from 1 to 40 sq.km. These tanks act as recharging sources to the ground water in the districts (Pandey, 1999) About 26.69% area is under forest where as 55.71% of the total geographical area of the districts are cultivated area. The supply for potable water throughout the districts are by ground water sources except Gondia, Tirora, Tumsar and Bhandara towns where the stream water does it.

Map No. 5 Shows the current quality ground water in the districts. Almost major area in the districts has been naturally poor ground water quality and in many places the natural quality of the ground water has been altered by human activities. Large portion of the ground water in the district is under threat due to organic/biological matter from various agro-industries. Whereas some portion of the ground water is being contaminated due to non-biodegradable organic and inorganic compounds from the industries

Map No 4. Surface Water and Hydrographic Map of the Districts



Map No 5: Current Quality State of Groundwater in Gondia and Bhandara Districts



(Pandey et al., 1998). The demand for freshwater has increased, mainly consists of groundwater, for potable, domestic, irrigation, and industrial uses. It is a well-known fact that clean water is absolutely essential for healthy living. Adequate supply of fresh and clean drinking water is a basic need for all human beings on the earth, yet it has been observed that millions of people worldwide are deprived of this.

Freshwater resources all over the world are threatened not only by over exploitation and poor management but also by ecological degradation. The main source of freshwater pollution can be attributed to discharge of untreated waste, dumping of industrial effluent, and run-off from agricultural fields. Industrial growth, urbanization and the increasing use of synthetic organic substances have serious and adverse impacts on freshwater bodies. It is a generally accepted fact that the developed countries suffer from problems of chemical discharge into the water sources mainly groundwater, while developing countries face problems of agricultural run-off in water sources. Polluted water like chemical in drinking water causes problem to health and leads to water-borne diseases, which can be prevented by taking measures can be taken even at the household level. The increased demand and related supply has caused the water table to decline and groundwater quality to deteriorate. The results of analyses of hydro-chemical data from 214 groundwater samples from selected locations in the vicinity of the Bhandara & Gondia District's rural areas have been evaluated to determine the temporal changes in water quality. To aid in evaluating the hydro-chemical changes associated with land-use change, are showing the Table 1 affected Villages (Exceeding Desirable

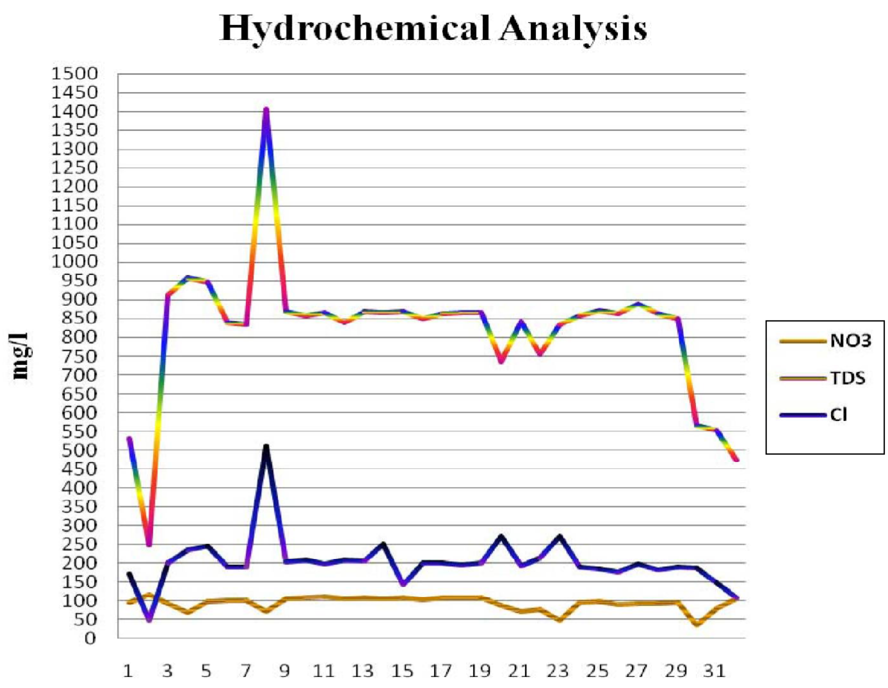
Limits of Nitrate, TDS, Fluorite and Chlorite). TDS and Cl used in this paper as an indicator of groundwater salinity contamination in Gondia and Bhandara Districts and Nitrate was used as an indicator of anthropogenic contamination of groundwater. High levels of Cl and TDS in the

Table 1: Showing Affected Villages Exceeding Desirable Limit of NO3, Cl, F and TDS)

S. No.	Village Name	Census	Source Type	Location	F	Fe	NO3	TDS	Cl
01'	Jagantola	707	Hand Pump	Near H/o Laharu Bisen	0.258	0.028	96	533	174
02	Jagantola	707	Hand Pump	Opp. Z.P. School	0.279	0.111	118	249	50
03	Jagantola	707	Well	Near H/o Sudhakar H.	1.265	0.028	94	913	203
04	Jagantola	707	Well	Near H/o Bhayalal Ukey	0.320	0.028	70	959	237
05	Jagantola	707	Well	Near H/o Anat Bataikar	1.940	0.022	100	948	247
06	Jagantola	707	Well	Near H/o Khemraj Baleva	0.323	0.017	102	841	191
07	Jagantola	707	Well	Near H/o Likhiram Gajane	0.254	0.028	103	835	191
08	Damangaon	1380	Hand Pump	Opp. H/o S. Meshram	0.198	0.028	73	1409	513
09	Kochewahi	1305	Hand Pump	Near H/o Kogu Karsape	0.201	0.028	108	868	205
10	Kochewahi	1305	Hand Pump	Near H/o Laxman Patle	0.210	0.021	109	858	209
11	Kochewahi	1305	Hand Pump	Near H/o Hemraj Singh	0.209	0.028	113	866	199
12	Kochewahi	1305	Hand Pump	Opp. Bus Stand	0.256	0.017	107	840	210
13	Kochewahi	1305	Well	Near H/o Yograj Dhanusban	0.204	0.028	109	868	207
14	Kochewahi	1305	Well	Near H/o Kapoor Chand	0.206	0.033	107	867	251
15	Kochewahi	1305	Well	Near H/o Durgasingh	0.205	0.028	111	868	144
16	Kochewahi	1305	Well	Near H/o Shiv Kumlwar	0.226	0.028	104	850	203
17	Kochewahi	1305	Well	Near H/o Kanai Neware	0.212	0.111	111	864	201
18	Kochewahi	1305	Well	Near H/o Shivdas Bhaladhre	0.205	0.028	111	866	197
19	Kochewahi	1305	Well	Near H/o Khiliram Bisen	0.206	0.033	110	866	201
20	Murpar	1005	Hand Pump	Opp. H/o Sarpanch	0.301	0.028	88	738	272
21	Batana	1859	Well	Opp. H/o Jagdish Ramteke	0.167	0.033	73	843	193
22	Batana	1859	Well	Opp. H/o Devialal Bisen	0.121	0.724	77	756	215
23	Mundipar	1200	Well	Near H/o Khirchand Thakur	0.251	0.028	50	835	272
24	Irri	2441	Hand Pump	Near H/o Ramchandra Doye	0.167	0.017	97	860	190
25	Irri	2441	Hand Pump	Opp. H/o Chandra Darfase	0.170	0.011	99	872	186
26	Irri	2441	Well	Near H/o Rupesh Meshram	0.165	0.028	91	863	177
27	Irri	2441	Well	Opp. H/o SomMaharwade	0.169	0.017	95	891	200
28	Irri	2441	Well	Opp. H/o Sitaram Doye	0.165	0.022	95	865	184
29	Irri	2441	Well	Opp. H/o Sewak Dhurve	0.170	0.011	97	852	190
30	Irri	2441	Well	Near H/o Bhaurav Lilhare	0.117	0.028	35	566	188
31	Jartal	131	Hand Pump	Near Hanuman Mandir	0.209	0.167	82	553	149
32	Jartal	131	Well	Near Grampanchayat	0.201	0.028	107	474	111

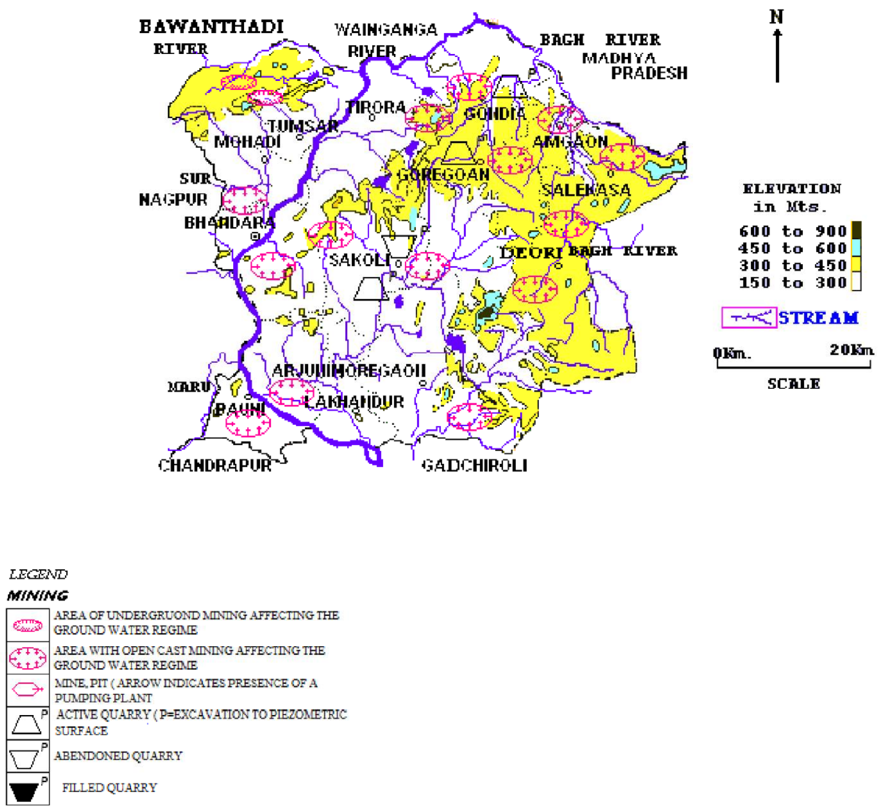
groundwater cause high salinity in the water supply. Table 1 summarizes the average concentration of TDS, Cl and NO_3 for drinking water wells in some part of districts. The average TDS concentration is 816.75mg/l in some part of districts, though which is within the limit. The average Cl concentration is 205 mg/l in some part of districts. The average concentration of NO_3 is 95 mg/l in some part of districts. As shown in Table 1, level of TDS, Cl and NO3 were higher than WHO standard, i.e., 1000, 250 and 50 mg/l, respectively (Figure 1), for the in some part of districts where the concentration of TDS were less than standards. Table 1 presents the percentages of drinking water wells that exceed WHO standards of TDS, Cl and NO3. For TDS, about 8% of drinking rural water wells exceed WHO standard (1000 mg/l). Like TDS, the concentrations of Cl in 15.42% of rural water wells were higher than WHO standard (250 mg/l). The major source of salinity in the aquifer in the districts is derived from the flow of natural saline ground water from the eastern part of an additional source of pollution in the districts is NO_3 concentration was used in this paper for indicate of groundwater contamination by wastewater, solid waste infiltrate and agriculture fertilizers. NO_3, Cl, and Fluorite concentrations strongly express the impact of surface contamination sources such as agricultural and domestic activities, on groundwater quality. As shown in Table 1, about 16% of rural wells in the districts have NO_3 concentrations that exceed WHO guidelines of 50 mg/l. The level of NO_3 contamination has been rising so rapidly that most of district's drinking water wells are no longer suitable for human consumption. Nevertheless, domestic wells continue to supply ground water of poor quality to local communities for drinking water (Pandey and Rathore, 2011).

Figure 1: Hydrochemical Analysis for Estimation of NO_3, TDS and Cl



Map No. 6 Shows various mining activities affecting the groundwater regime in the districts. There are several opencast mines in progress, where as there exist a few underground mines at Sitasawangi and Chikhla Manganese ore. There are few active and abandoned quarries in the districts. Some of the old abandoned quarries have not been complies the norms of mining standards of the country. The opencast mines in the districts are mainly associated with excavation of building materials, which are operating in the districts in unorganized manner. These quarries are violating the norms and standards and contaminating the environments. The ecology of the area has been threatened by large scale environmental degradation caused by extensive deforestation, overexploitation of natural resources and other anthropogenic activities coupled with unprecedented rise in human population. During recent year's unscientific mining in the districts has further aggravated the problem. As a result, soil erosion, scarcity of water, pollution of air, water and soil, reduced soil fertility and loss of biodiversity are some of the serious problems of the area. These localities like Phohara, Kaneri, Wards, Turdapuri, Dogargaon, Meragaon, Umarajhari, Sandhurbapa, Palasgaon in the Sakoli Tehsil, Mohaghata in Lakhani Tehsil, Ambhora, Irri, Rajegaon, Navegaon in Gondia Tehsil, Senda, Sukari in Tirora Tehsil, Thana, Chircharband, Sakritolla, Morbhahi in Amgaon Tehsil, Khazari in Sadak Arjuni Tehsil, Shihora , Chandpur,Gaimukh in Tumsar Tehsil and Runda, Dhimartoly in Salekassa Tehshil.

Map No 6: Mining Activities in the Districts

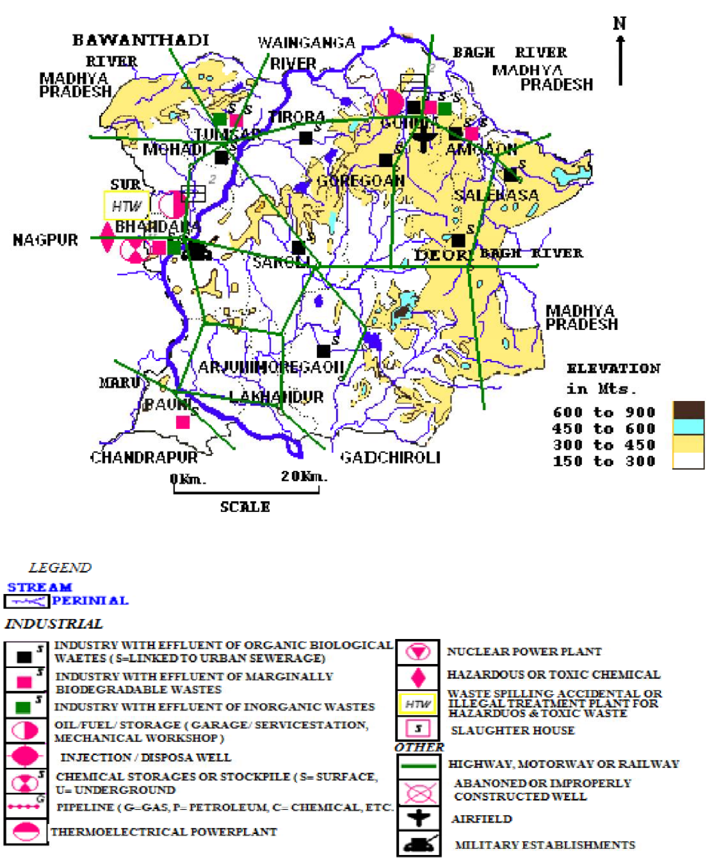


Map No.7 Shows that there are many industries in the districts which contaminate the groundwater recharge with their effluent of organic, inorganic and biodegradable waste. There are five densely populated towns in the districts; the industrial establishment and the industrial wastewater along with the municipal sewage discharge into the streams heavily surround Gondia, Bhandara, Tumsar, Tirora and Amgaom. The wastewaters disposed by the numerous industries contain hazardous elements and contaminate surface water and later on groundwater. The Bhandara town also knows as Brass City of Maharashtra State these cottage brass units are manufacturing brass utensils in the residential area. The wastewater disposed by the brass industries contains Copper as Cu 418.3 mg/l. and Zinc as Zn 39.18 mg/l. The Sunflag Iron & Steel Industry is located at Warthi, Bhandara manufacturing steel. The wastewater disposed by the Sunflag industry contains Iron as Fe 55.85 mg/l. The maximum limits of these elements are 3.0mg/l., 5.0 mg/l. & 3.0mg/l. as per APHA, 2005. The wastewater disposal points should meticulously be selected in such a way that they do not contaminate precious groundwater resources.

CONCLUSION

Drinking water that gets contaminated with nitrates can prove fatal especially to infants that drink formula milk as it restricts the amount of oxygen that reaches the brain causing the 'blue baby' syndrome. It is also linked to digestive tract

Map No 7: Potentially Contaminating Activities in Gondia & Bhandara Districts



cancers. It causes algae to bloom resulting in eutrophication in surface water. Chlorinated solvents are linked to reproduction disorders and to some cancers. Water-borne diseases are infectious diseases spread primarily through contaminated water. Though these diseases are spread either directly or through flies or filth, water is the chief medium for spread of these diseases and hence they are termed as water-borne diseases. Water-borne epidemics and health hazards in the aquatic environment are mainly due to improper management of water resources. Proper management of water resources has become the need of the hour as this would ultimately lead to a cleaner and healthier environment. In order to prevent the spread of water-borne infectious diseases, people should take adequate precautions. These environmental vulnerabilities maps will be defiantly facilitate the consistent and uniform planning of Bhandara and Gondia districts for sustainable development.

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