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GROUNDWATER MONITORING OF KOLHAPUR

Samruddhi Patil, Prathamesh Gharad, Sanika Shetye, Srujani Shrawne

BE, Department of Environmental Engineering, KIT's College of Engineering,
Kolhapur, Maharashtra (India)

ABSTRACT

Water plays a very crucial role in the ecosystems at the surface and below ground stratums. Potable water, water supply system, agriculture, industry, etc. are the high stature economic, social and environmental uses of ground water. The matter of contention related to ground water pollution due to various activities has drastically increased in recent areas. Hence, in India attention should be equally divided among issues regarding surface and under surface water contamination. Ground and surface water being interlaced the effects of pollution in any one stratum is reflected on the other. The parameters of the pollution of the ground water are magnified along the flow whereas the quality of water is attenuated thus leading to multiplied crisis.

In Kolhapur district, apart from surface water ground water is also preferred for drinking, irrigation as well as industrial purposes. Water quality being vital concern iron, fluoride, chloride and nitrate content were analyzed with 5 samples from bore wells situated over different places in Kolhapur. Apart from river panchaganga people in and around Kolhapur being mostly dependent on ground water for drinking purpose, it's a very disturbing scenario because the value of most of the parameters were exceeding the limits. The main cause of ground water pollution are briefed as domestic sewage intrusion, leaching from solid waste dumps and chemical runoff. The negative impacts on ecology and life become difficult to be avoided or diminished once the ground water pollution exceeds a certain level.

A brief report regarding this scenario of ground water pollution in Kolhapur is discussed in the paper based on the leading trends of pollution and availability of ground water in future.

I. INTRODUCTION

In recent times ground water has become the most crucial natural resource. Ground water has many advantages regarding water supply as compared to surface water. Groundwater is an important water resource in India for domestic, irrigation, and industrial needs (Mamatha and Rao, 2010). According to Jha and Sinha, (2009) groundwater has come out into view as the primary democratic water source and poverty reduction tool in rural areas in countries like India. As the preference for groundwater increases the quality of the water becomes a very crucial point. Rapid urbanization and increased agriculture activities has resulted in the degradation of the water quality. As the stats clearly reflect in recent years there is significant decline in the below ground water levels in many parts of Maharashtra. During pre monsoon on of year 2009, water levels recorded in many parts in state are mostly in the range of 5-10mbgl (meter below ground level) except western Maharashtra where water level is generally less than 5mbgl. However, during August 2009 water level recorded was mostly in range of 2-5 mbgl except wastern Maharashtra where water level was generally less than 2 mbgl. And during post monsoon in western parts of the country deeper water level is recorded in range of 10-20 mbgl. In the west coast water level is generally less than 10m than in western parts of Maharashtra. During January 2010 in western parts of the state isolated pockets of water level, less than 2m, has also been observed. In the state groundwater development was 48% only. In maharashrta out of 318 total numbers of assessed units 23are semi-critical, 1 was exploited and 7 are over exploited during year 2009 and 2010in the 756 wells analyzed and depths to water level (mbgl) were found to be 0.35 minimum and 55.30 maximum (November 2009) and 57.38 maximum during January 2010 (central ground water board, ministry of water resource government of India, Faridabad, 2010). According to the agriculture contingency plan of Kolhapur district groundwater level is exploited.

Profile:

Kolhapur City-

• Location: 160 42" N Latitude to 74o 14" E Longitude.
• Height from mean sea level: 544 m to 580 m.
• Area adjoining: Western Ghats, area in Panchaganga river Basin.
• History: Settlement since 200 AD. Ruled by Shaliwan, Yadav, Bhoje Maratha dynasties.
• Geology: Black and red soil, Deccan Plateau, Basalt rock.
• Temperature: Minimum 150C, Maximum 400C and average 270C
• Humidity: 55 %
• Average wind speed: 5 km / hr
• Wind: from West
• Rainfall: Average 1025 mm Lowest: 534.50 mm (1972) Highest: 1642 mm (1961), 1148.6 mm (2005), 1170.8 mm (2006).
• Average rainfall day: 65
• Average Flood Line: 543.90 m
• Maximum Flood Line: 548 m
• Geographical Area: 6682 hectares.
• Population: 4,93,167 (2001census)
• Solid Waste per day : 150 to 165 tons
• Treatment on: Biodegradable waste – Zoom Biofertilizers Pvt. Ltd. Linebazar.
Biomedical Waste – Das Enterprises, Linebazar.
• Sewage per day: 120 M.L.D
• Centres to measure: 3 (Mahadwar road, Dhabolkar Corner, Shivaji University) Air pollution
• Environmentally ideal:

1) Kalamba lake to Panyacha Khajina, 36 areas given water Water distribution by gradient (Non- Functional at present) System.
2) A plan to provide water to Dhunyachya Chavya (washing taps) from Rankala Lake since 1883 (partially functional).

Location of Kolhapur District is 16042" North 74015" East on the North West plateau of Maharashtra. The district is surrounded by the steep ridges of Sahyadri to the west, the Deccan plateau on the east, and boundaries of Goa on the south and Karnataka on east. The area of the district is 7746 sq. km. and it is 2-5% of the state area (Collector, Kolhapur District, 2012). The type of rock pattern in the district is weathered basalt having 10 to

34 % porosity, specific yield 2 to 6 %, Transsmissivity 100 to 140 m2 / day, specific capacity of wells 80 to 170 LPM /m (Deolankar, 1980).Geology of the Kolhapur district two distinct trends in the hill ranges are seen in the district. One runs roughly north-south, along the main range of the Western Ghats presenting wild and picturesque hill slopes and valleys. The other one comprises the narrow broken-crested ridges and flat topped masses stretching eastwards and merging gradually into the plains in the east. The rivers Hiranyakeshi, Vedganga, Dudhganga, Bhogvati and Panchganga drain the area towards east.

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Table 1-Land use pattern of Kolhapur district

Sr No.	Land use pattern of district	Area (hectares)
1.	Geographical area	776.3
2.	Cultivable area	427.0
3.	Forest area	147.2
4.	Land under non- agricultural use	36.4
5.	Permanent pastures	41.6
6.	Cultivable waste land	36.4
7.	Land under misc. tree crops and grooves	6.4
8.	Barren and un-cultivable land	44.1
9.	Current fallows	12.6
10.	Other fallows	24.6

The population of Kolhapur district has increased up to 38, 74,015 in 2011 which represent 9.96 percent increase in the population above 2001, having density of 504 individuals per square km (Census, 2011). Total crop area under agriculture is Kharif – 376600, Ha Rabi - 34900 Ha (http://kolhapur.nic.in). There are 13 MIDC's in the district with 3928 industries (390 red type industries, 406 Orange type industries and 3132 green industries). In sub-region Kolhapur predominantly large number of sugar, distillery, small foundries and cloth processing industries are in existence. Among them the major industries are 21 spinning mills - co-operative and private, 21 textile mills and 15 sugar industries. Remaining 53 units are of engineering, poultry and animal food. The geology of Kolhapur consists of Deccan traps with inter-trapped beds. These volcanic lava flows are spread out in the form of horizontal sheets and beds. The rock is mainly of igneous basalt types. The soil type of Kolhapur consists of black soil and red soil. The city has ample supply of water, good quality of soil, plentiful green areas, etc. which are responsible for overall growth and development of the city.

II. SOURCES OF GROUND WATER CONTAMINATION

Water percolating through soil dissolves naturally occurring minerals, salts and organic compounds. As, the water travels through different layers of soil the concentration of minerals goes on increasing and this process is known as mineralization rendering the ground water unfit for domestic use as well as for irrigation, without treatment.

There are different sources of groundwater contamination. Ground water gets contaminated due to anthropogenic activities, or due to naturally existing contaminants such as iron, manganese, and other substances like arsenic. Another form of contamination results from radioactive decay of nuclear compounds such as uranium in bedrock. Methane and other gases create various problems. Salt water intrusion is a common problem in coastal areas that result in ground water pollution.

The sources of ground water contamination can further be classifies as:

- Point sources
- Non-point sources

Point source refers to the contaminants originating from a single source (or point), whereas non- point sources refers to contaminants that do not originate from a specific sourceand instead originate from the cumulative effect of number of factors or activities.

Some of the examples of Point and Non-point sources are as follows:

- Point Sources:

1. Leaky tanks or pipelines containing various products
2. Underground injection wells
3. On-site septic systems
4. Leaks or chemical spills
5. Municipal landfills
6. Leaky sewer lines
7. Wells for disposal of liquid wastes
8. Sludge disposal areas at petroleum refineries
9. Land spreading of sewage or sewage sludge

- Non-point sources:
- Runoff from agricultural land
- Contaminants in rain, snow and dry atmospheric fallout

Storage Tanks

May contain gasoline, oil, chemicals, or other types of liquids and they can either be above or below ground. There are estimated to be over 10 million storage tanks buried in the United States and over time the tanks can corrode, crack and develop leaks. If the contaminants leak out and get into the groundwater, serious contamination can occur.

Septic Systems

Onsite wastewater disposal systems in homes, offices or other buildings that are not connected to a city sewer system are a major reason of ground water contamination. Septic systems are designed to slowly drain away human waste underground at a slow, harmless rate. An improperly designed, located, constructed, or maintained septic system can leak bacteria, viruses, household chemicals, and other contaminants into the groundwater causing serious problems.

Uncontrolled Hazardous Waste

The number of known abandoned and uncontrolled hazardous waste sites grow every year. Hazardous waste sites can lead to groundwater contamination if there are barrels or other containers lying around that are full of hazardous materials. If there is a leak, these contaminants can eventually make their way down through the soil and into the groundwater.

Landfills

Landfills are the common waste disposal sites. Landfills are supposed to have a protective bottom layer to prevent contaminants from getting into the water. However, if there is no layer or it is cracked, contaminants from the landfill (car battery acid, paint, household cleaners, etc.) can make their way down into the groundwater.

Chemicals and Road Salts

The widespread use of chemicals and road salts is another source of potential groundwater contamination. Chemicals include products used on lawns and farm fields to kill weeds and insects and to fertilize plants, and other products used in homes and businesses. When it rains, these chemicals can seep into the ground and eventually into the water. Road salts are used in the wintertime to put melt ice on roads to keep cars from sliding around. When the ice melts, the salt gets washed off the roads and eventually ends up in the water.

Atmospheric Contaminants

Since groundwater is part of the hydrologic cycle, contaminants in other parts of the cycle, such as the atmosphere or bodies of surface water, can eventually be transferred into our groundwater supplies.

Factors affecting ground water pollution:

The extent of groundwater pollution depends on the following factors:

1. Rainfall pattern
2. Depth of water table
3. Distance from the source of contamination and
4. Soil properties such as texture, structure, filtration rate

Ground water level at various places in Kolhapur:

Declines in groundwater levels:

Widespread and continuous depletion of groundwater tables in many areas in Maharashtra has become a cause of major concern over the past 10 years, The developmental sequence for groundwater observed since the mid-1980 decade has been; most dug wells drying-up ever earlier in the dry (rabi) season initially those at the margins of the main groundwater bodies, deepening of dug wells as dug-cum-bore wells, (Foster, et al.; 2007). According to the ground water survey in the major portion of Kolhapur district there were about 0-1 meter decrease in the ground water level. Kolhapur is included in list of districts in India which experience a drop in ground water level of over 4 meters for 20 year period or a drop of over 2 meters over a ten year period (Centre for Water Policy, 2005). It is revealed from a survey of open wells from Kolhapur city by Patil and Raut, (2010), that more than 200 wells were present in Kolhapur city in the recent past, but now most of them are either destroyed or not in good condition. Increase in population, urbanization and industrialization has created unhygienic conditions enhancing the problem of these water resources. The current use of wells is as waste dumping sites. Considering rapid expansion of Kolhapur city and other cities and towns in the district for the future demand of water, old wells once used for water supply will need to be rejuvenated. Changing ground water levels in the past five years at some of the identified sites in Kolhapur district are given in Table 3. Ground water level in the Kolhapur district at selected location are as follows.

Sr No	Location	2007	2008	2009	2010	2011
1.	Gokul Shirgaon	1.05	0.59	2.05	1.01	0.65
2.	Shiroli	4.84	5.76	5.1	5.31	5.63
3.	Amba	5.26	5.11	4.44	4.92	4.96
4.	Panhala	8.86	10.08	5.65	1.35	1.13
5.	Radhanagari	4.99	5.93	4.68	4.66	4.2

(Source: - Ground water Information System, Ministry of Water resources, Central ground water Board, Government of India accessed from: -http://gis2.nic.in/cgwb/Gemsdata.aspx).

From the above table No 3 it is clear that there were fluctuations in ground water level during years 2007 to 2011. There was slight increase in the values at some sites (Shiroli) and other sites (Radhanagari, Panhala, Amba) of Kolhapur district had declining trends of water level as compared to the previous year's. This shows general declining trend in ground water level in Kolhapur district. The major factors responsible for this decline are change in land use pattern, agriculture expansion, increasing population, urbanization and industrialization casing stress on these ground water resource in the Kolhapur district Problem associated with surface water and quarries: According to Winter, et al.; (1998) the flow between ground water and surface water creates a dynamic habitat for aquatic fauna near the interface determining the contributions of ground water to contamination of lakes and streams is a critical step in developing effective water-management practices. Due to poor quality of river water, from the above table No 3 it is clear that there were fluctuations in ground water level during years 2007 to 2011.This shows general declining trend in ground water level in Kolhapur district. The major factors responsible for this decline are change in land use pattern, agriculture expansion, increasing population, urbanization and industrialization casing stress on these ground water resource in the Kolhapur district Problem associated with surface.

Sr No	Parameter	Standard
1	pH	6.5-8.5
2	Turbidity (NTU)	2.5
3	Hardness (mg/l)	200
4	DO (mg/l)	Above 4
5	TS (mg/l)	200
6	TDS (mg/l)	150
7	Alkalinity (mg/l)	200

III. CONCLUSION

- From the above results it was concluded that the ground water present in the industrial region is more polluted than the residential area of the city.
- In the industrial area the concentration of heavy metals especially iron, copper, nickel, zinc etc and other parameters found beyond the limits prescribed by WHO standards.
- It was observed that majority of hand pumps are located on road side near sewage gutters.
- Due to higher concentration of heavy metals as well as other parameters the ground water in selected sites is not potable as compared with standards provided by WHO.

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RECOMMENDATIONS

- There is a need of improving, recharging of ground water and also developing the traditional water retention practices by using appropriate techniques. Both surface and ground water should be regularly monitored. Surrounding contaminant sources and flow directions should be considered.
- Excess use, exploitation or overuse of ground water where ever possible must be avoided which leads to depletion of ground water level and available quantity.
- Dumping sites should be designed properly by using materials such as cement. This is to avoid leaching which can contaminate ground water in agriculture instead of chemical pesticides. Use of bio pesticides will reduce intensity of groundwater pollution. Direct injection of untreated effluent into ground should be avoided.

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