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Water Quality Assessment in and Around Sandur Taluk, Bellary District, South India

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Abstract Assessment of surface and groundwater quality has been carried out in the parts of the Sandur taluk, Bellary district, Karnataka, South India. Surface and ground water samples collected from different villages in and around Sandur taluk. Sandur taluk is well known for iron ore deposits. At the same time, rigorous and unplanned mining methods causing intensive natural hazards like water pollution, air pollution, noise pollution dust pollution etc. Based on the analysis of these parameters, the villages are classified as safe and unsafe. Results show gradual decreasing of ground water quality and surface water pollution in the study area. GIS interpolation technique performed to represent the concentration parameters in the affected villages of the study area. Northern and central part of the taluk is more affected by mining activity whereas south eastern part of the taluk is well thought-out to be safe. Standard samples the following parameters analyzed as follows pH, Total Hardness (TH), Fluoride (F), Sulphate (SO_4), Nitrate (NO_3), Potassium (K), Magnesium (Mg). The tests carried out for characterization of surface waters and groundwater for the month of August and September 2012, Interpolation technique was performed using ArcMap 9.3.
Keywords *Geographical Information System; Water Analysis; Mining*

1. Introduction

The natural ecosystem of Sandur schist belt environments, in which the Sandur taluk is extremely sensitive to human interference. Open pits, mining dumps and tailing dams are a severe degradation of the environment. Due to the specific climatic and topographic conditions in environment, nature's self-healing capabilities are considerably reduced. Groundwater is the principal source of drinking water in our country and indispensable source of our life (Bajpayee et al., 2012). It is well known that no straight forward reasons can be advanced for the deterioration of water quality, as it is dependent on several water quality constituents (Jothi Venkatachalam et al., 2010; Bajpayee et al., 2012).

The quality of water resources is a subject of ongoing concern. The assessment of long-term water quality changes is also a challenging problem (Biswajeet Pradhan and Saied Pirasteh, 2011). The water required for domestic consumption should possess a high degree of purity and it should be free from suspended and dissolved impurities. The ground water account for nearly 100% of drinking

water supply. It has become an important water resource due to increasing trend of pollution in surface water (Alexander, 2008; Alexander et al., 2011).

According to Central Pollution Control Board, 90% of the water supplied in India to the town and cities in India are polluted, out of which only 1.6% gets treated. Therefore, water quality management is fundamental for the human welfare (Gupta, 1991; Navneet Kumar and Sinh D.K., 2010).

The groundwater is believed to be comparatively much clean and free from pollution than surface water. But prolonged discharge of industrial effluents, domestic sewage and solid waste dump causes the groundwater to become polluted and created health problems (Patil and Patil, 2010).

The Sandur Taluk mining activity has reached up to a depth of more than 500 feet and reached groundwater table. Hazardous chemicals which are used for the blasting purpose (Ammonium Nitrate) can directly interfere with ground water. Mitigative measures needed to be over take seriously in this location. Though the agricultural activity is dominates in Sandur Taluk rapid mining activity decreases agricultural production.

1.1. Study Area

The study area of Sandur taluk as shown in the Figure 1(a, b) is bounded by geo-coordinates 15°00' to 15°15' latitude and 76°15' to 77°00' Longitude within the Dharwar craton. The area fall under 57*A/8*, 57*A/12,* 57*A/16* and 57*B/9* topographical maps. The lowest elevation is 625m above the MSL and the highest elevation is 997m above the MSL. It covers an area of 1224.91 sq km. Hill ranges are cone shaped amphitheater formation and it is covered by dense vegetation.

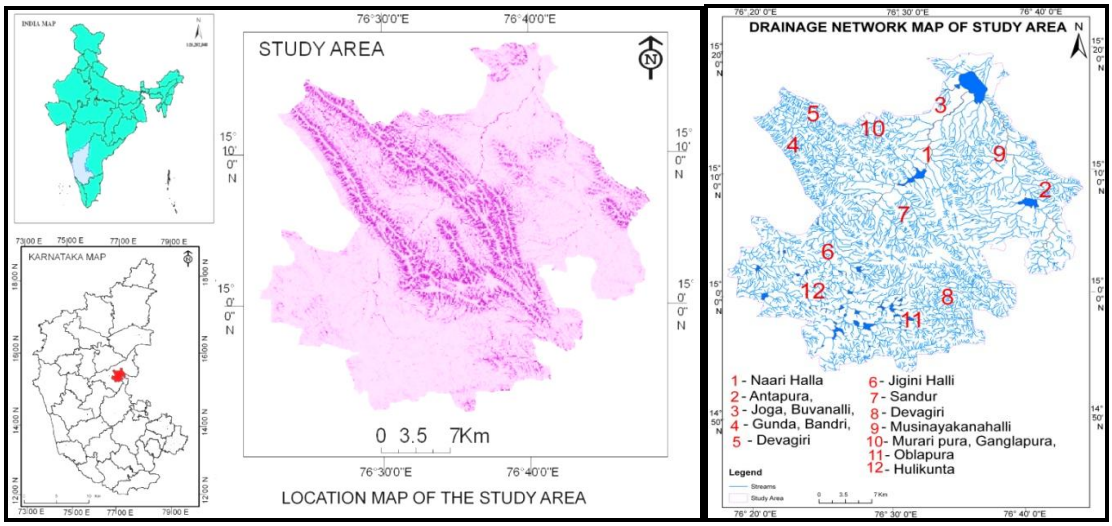

Figure 1a: *Location Map of the Study Area;* ***Figure 1b****: Drainage and Village Location Map*

2. Methodology

2.1. Standard Samples

The various parameters analyzed are as follows: pH, Total Hardness (TH), Fluoride (F), Sulphate (SO_4), Nitrate (NO_3), Potassium (K), Magnesium (Mg) as shown in the Table 1. The tests are carried out in the laboratories for characterization of surface waters and groundwater for the month of August and September 2012,

Interpolation technique was performed using ArcMap 9.3. Generation of maps done by attributing the values to the software.

3. Results and Discussion

Analysis of field samples carried out and results shows north, north-eastern part of the Sandur taluk is unsafe due to pollution. Southern part of the taluk is less affected by the mining activity. Central part of the taluk is highly affected area Interpolation technique was performed to show spatial distribution of pollutants within the Sandur taluk as shown in the Figure 2.

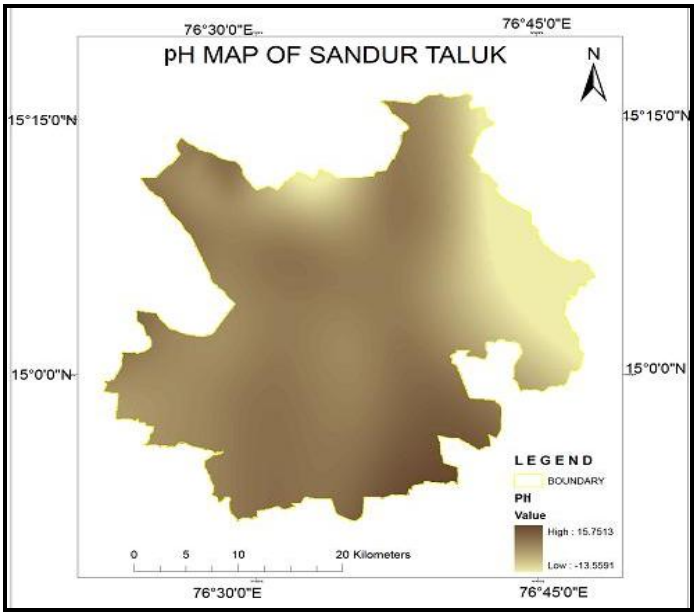

Figure 2: *Map Showing Concentration of pH in the Sandur Taluk*

As shown in Figure 2, Jaisigpur, Emmihatti, Siddapur, Rajapur, Radhanagar and Dhanapur of North, Sandur, Bhujanganagar, Dowlatpur, Susheel Nagar, Ramanmalai and Dharmapur of central and Devagiri, Swamyhalli south western parts of the taluk are showing high concentration in pH (Figure 2). It is because of the toxic chemicals used for mine blasting process. Central parts of the Taluk, mining activity is more, whereas north-eastern parts are literally thought out to be safe, less affected by mining activity.

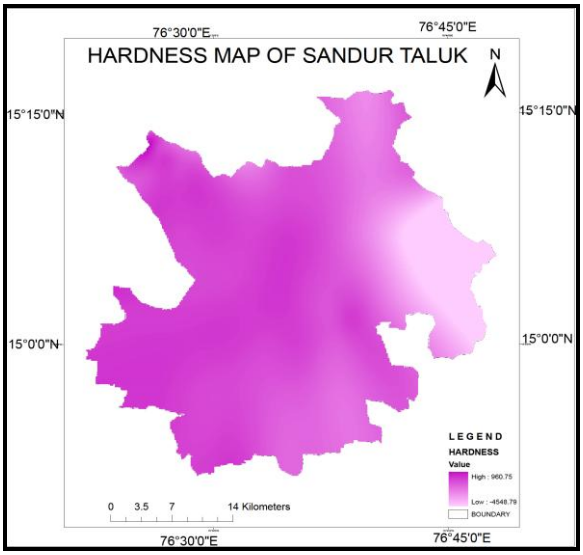

Figure 3: *Map Showing Concentration of Water Hardness in the Sandur Taluk*

Similarly, the hardness of the water is more in villages of Jaisingpur, Rajapur, Radhanagar and Emminahatti of North, and Sandur, Bhujanganagar, Dowlatpur, Susheel Nagar, Ramanmalai and Dharmapur of central, Devagiri, Swamyhalli, and Agrahara of South-western parts of the taluk as depicted in the Figure 3. More number of salts was induced by the mining activity to the ground water, which results in the high hardness.

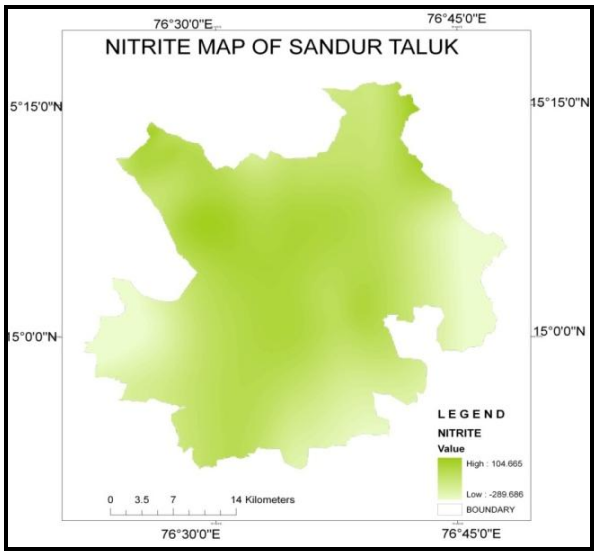

Figure 4: *Map Showing Concentration of Nitrite in the Sandur Taluk*

Figure 4, shows the nitrite distribution in the study area. As it indicates in the villages of Jaisingpur, Emmihatti, Sddapura, Rajapura, Radhanagar and Danapuram of North, Joga, Buvanahalli, Vaddu, Nagalapura, Muraripura and Gangalapura of North-eastern parts of the taluk and Sandur, Bhujanganagar, Dowlatpur, Shusheel nagar, Ramanmalai, Krishna Nagar and Dharmapura of central parts of the taluk are showing high concentration nitrite, because of the toxic chemicals like ammonium nitrite used for mine blasting process which directly contaminates ground water. Central parts of the taluk mining activity are more whereas northeastern parts are literally safe and less affected by mining activity.

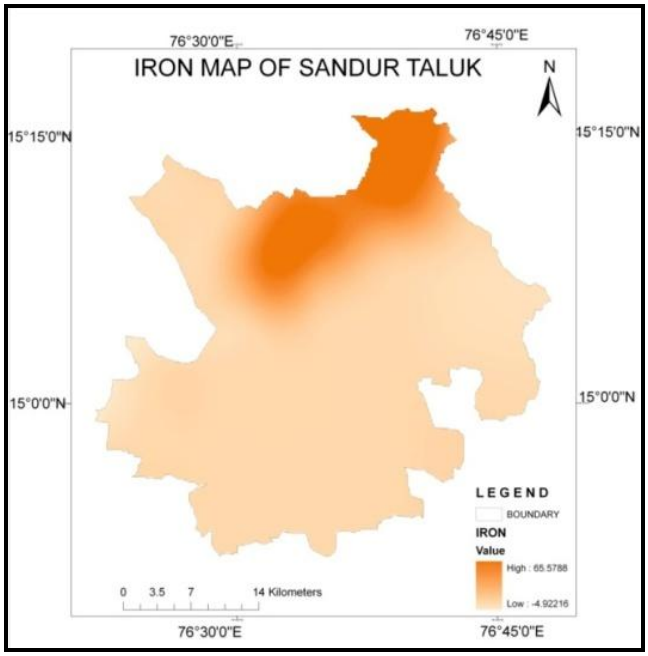

Figure 5: *Map Showing Concentration of Iron in the Sandur Taluk*

Even though the mining activity is more in central part of the taluk and because of the gradient towards villages of Joga, Buvanahalli, Vaddu, Nagalapura, Muraripura, and Gangalapura at North eastern part, the accumulation of the iron ore with runoff more as shown in Figure 5. This accumulated water with iron percolates deep in the ground and contaminates the ground water. The rest of the area is comparatively less affected.

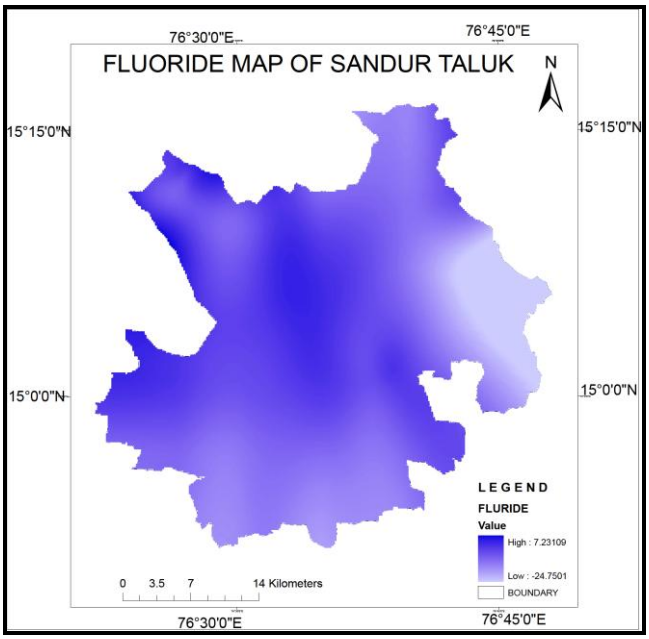

Figure 6: *Map Showing Concentration of Fluoride in the Sandur Taluk*

As shown in the Figure 6, the fluoride content is distributed in parts of Jaisingpur, Rajapur, Sandur, Bandri, B. Gollarahatti, Devagiri, Bommaghatta, Somalapura, Jambainatti, Toranagal and Siddanahalli. These villages spans in the north, Jiginihalli, Nidugurthi, Hulikunta, Chickerehalli of

western and Devagiri, Swamyhalli, Agrahara, Obalapura and Devarabudenahalli of southern parts of the Sandur taluk, which is unsafe.

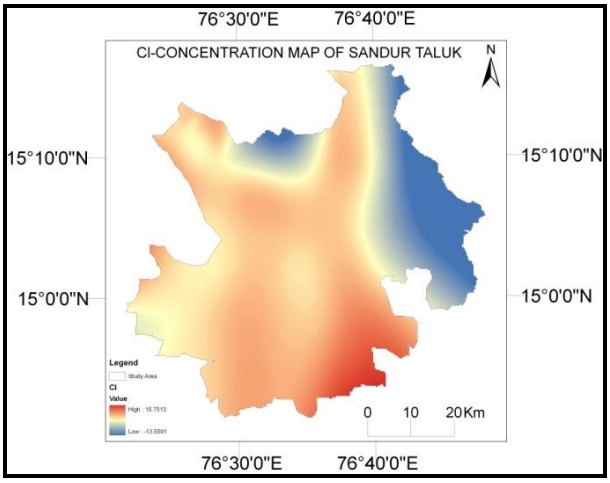

Figure 7: *Map Showing Concentration of Chlorine in the Sandur Taluk*

Figure 7, Describes the Chlorine content is distributed in parts of Jaisingpur, Rajapur, Sandur, Bandri, B. Gollarahatti, Devagiri, Bommaghatta, Somalapura, Jambainatti, Toranagal and Siddanahalli These villages spans in the north, and Devagiri, Swamyhalli, Agrahara, Obalapura and Devarabudenahalli of southern parts of the Sandur taluk.

Table 1: *Analysis Report of the Villages in and Around Sandur Taluk*

Sl. No.	Village Name	Location	Latitude	Longitude	pH	TDS	Cl	F	NO_3	Fe	Turbidity	Hardness	Remarks
1	Bommagatta	Hand Pump Near High school	14^0 59' 37.49	76^0 31' 21.8	7.98	3000	298	1.55	50	0.20	10	620	Un safe
2	Jaisingpur	Hand Pump near field side	15^0 56' 11.8	76^0 34' 19.7	7.80	1900	230	2.00	40	0.20	10	280	Un safe
3	Rajapur	Hand Pump Gowripura Road	15^0 55' 7.28	76^0 34' 34.0	7.50	1300	190	1.60	30	0.20	10	160	Un safe
4	Bommagatta	Open well water Near Ag field	14^0 59' 41.2	76^0 30' 27.1	7.84	3000	315	1.58	60	0.30	10	600	Un safe
5	Gollarahatti	Pond near Ag field	14^0 84' 9.11	76^0 34' 8.28	7.97	1500	185	1.60	30	0.30	10	230	Un safe
6	Bandri	Hand Pump Giddi gurthu road side	14^0 59' 20.4	76^0 27' 10.8	7.00	1020	98	1.51	25	0.20	10	200	Un safe
7	B. Gollara hatti	Hand Pump Karigunur chitappana house	14^0 59' 89.2	76^0 29' 20.2	7.50	1000	96	1.51	25	0.50	10	310	Un safe
8	Kodihalli	Hand Pump near Durgamma temple	14^0 59' 07.2	76^0 27' 50.8	7.90	2200	250	2.00	45	0.30	10	300	Safe
9	Swamyhalli	Hand pump near camp road	14^0 58' 31.4	76^0 36' 58.2	7.00	1203	117	1.00	25	0.50	10	231	Safe
10	Chornur	Hand Pump Near kere	14^0 58' 44.6	76^0 31' 59.7	7.00	1200	115	0.50	25	0.50	10	219	Safe
11	Chornur	Hand pump Near Bus stand	14^0 58' 46.5	76^0 32' 0.51	7.40	1300	89	1.50	30	0.40	10	247	Safe
12	Hale vaddinakatti	Open well in village	14^0 55' 1.22	76^0 31' 0.42	6.80	1230	113	1.50	60	0.30	10	290	Safe

13	Somalapur	Kudligi road side	14^0 54' 8.31	76^0 31' 0.07	8.50	1200	210	2.00	25	0.40	10	250	Un safe
14	Swamyhalli	Hand Pump Key pumpu	14^0 58' 41.0	76^0 36' 51.3	8.00	800	78	1.00	40	0.20	10	150	Safe
15	Tumbaragudi	Kempa kere (Tank)	14^0 57' 20.5	76^0 34' 31.2	8.00	1000	87	1.00	30	0.30	10	190	Safe
16	Siddanahalli	Open well near Hand Pump	14^0 55' 10.3	76 31 034	7.68	2400	268	1.20	45	0.30	10	400	Safe
17	Hale vaddinakatti	Well in village	14^0 55' 28.0	76^0 31' 0.42	7.89	1500	185	0.80	25	0.30	10	220	Safe
18	Vaderahalli	Open well near Tank	14^0 55' 31.4	76^0 30' 6.39	7.00	1400	171	1.40	30	0.30	8	250	Safe
19	Devagiri	Hand Pump Kumarswami temple	15^0 00' 54.8	76^0 33' 29.4	8.00	800	411	1.00	40	0.20	10	150	Un safe
20	Devagiri	well near sahukar marenna land	15^0 06' 19.3	76^0 54' 9.20	8.50	1400	130	1.50	30	0.20	10	220	Un safe
21	Jambainatti	mwss honakere road	15^0 06' 21.0	76^0 54' 14.9	7.50	1700	316	2.00	40	0.30	10	295	Un safe
22	Kalingeri	Hand Pump in front of Govt. school	14^0 56' 15.5	76^0 31' 23.7	7.50	1900	252	2.50	40	0.30	10	300	Un safe
23	Yeshwanthnagar	Hand Pump near hatti	14^0 56' 33.1	76^0 30' 20'4	7.50	2000	319	2.50	40	0.30	10	360	Un safe
24	Sandur	Hand Pump near theater	15^0 05' 10.10	76^0 32'35.06	7.10	920	93	2.50	25	1.00	10	120	Un safe
25	Sandur	Borewell in Agri field	15^0 04' 45.90	76^0 32' 40.10	9.00	940	95	1.50	10	0.30	10	120	Un safe

4. Conclusion

Analysis of field samples carried out and results shows north, western, central and southern part of the Sandur taluk is unsafe due to contamination by unplanned mining activity. Sandur taluk environment facing severe problems such as water, air, dust and noise pollution. Agricultural crop yield gradually declaimed. Eastern part of that is less affected by the mining activity. Central part of the taluk is highly affected area. Village wise details of pH, TDS, Cl, F, NO_3, Fe, Turbidity and hardness were analyzed. The surface and ground water shows concentration of pH, Nitrite, Fluoride, Chlorine, Fe and Hardness of Water in the villages of Jaisingpur, Emmihatti, Sddapura, Rajapura, Radhanagar and Danapuram of North, Joga, Buvanahalli, Vaddu, Nagalapura, Muraripura and Gangalapura of North-eastern parts of the Taluk. Sandur, Bhujanganagar, Dowlatpur, Shusheel nagar, Ramanmalai, Krishna Nagar and Dharmapura of Central parts and Devagiri, Swamyhalli, Agrahara, Obalapura and Devarabudenahalli of southern parts of the Sandur taluk, because of the toxic chemicals like ammonium nitrite used for mine blasting process which directly contaminates ground water. At central parts of the taluk mining activity is more whereas eastern parts are less affected by mining activity and literally safe. The Narihalla stream flows from central part of the taluk to Naarihalla Dam at Taranagar is entirely polluted by the mining waste and is not suitable for drinking as well as agriculture purposes. Majority of the surface water bodies present around the Sandur, Torangallu and Taranagar are highly contaminated and silted by the mining waste.

Agricultural land is also gradually decreased due to mining activity, but fortunately it maintains the area statistics, because most of the waste lands (scrubland) are converted into agricultural land. The turbidity level increase drastically in surface water bodies due to sedimentation of mine wastes leads to disappearance of surface water bodies. GIS technologies coupled with spatial modeling are useful tools in providing a solution for future water resources planning.

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