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Arsenic Hazard Mapping of Ranchi City using QGIS

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Abstract:- Water used for the drinking purpose should be free from any contamination like Arsenic, Nitrite, Iron etc presence of Arsenic can affect millions of people. Arsenic is one of the most hazardous substances found in underground water. It is very difficult to detect the presence of Arsenic in the groundwater and a lot of research is going on in this regard.This paper presents Arsenic hazard map includes known Arsenic-affected areas and previously unaffected areas. Ranchi is capital of Jharkhand state situated at 23.36-degree North to 85.33-degree East. Tropic of Cancer is passing through the city at 23.4-degree North. Ranchi city has a population of about 1.073 million as per 2011 census. This paper presents the arsenic mapping of the Ranchi city. With the help of multivariate interpolation it is found that the maximum value of Arsenic is 212.998 microgram per liter near Tunki Tola. The minimum value of Arsenic is below desired level (BDL) at Sidhu Kanhu Park. This result can be used to aware the people to stop using or installing any new borewell in the Arsenic affected area.

Keyword:- *QGIS, Arsenic, Contamination, Groundwater, BDL.*

I. INTRODUCTION

The major source of drinking water is groundwater all over the world. There are increasing demand of water due to over population and it is unable to meet the per capita requirement. If groundwater gets polluted it can contribute to endemic diseases and poorly treated water or untreated water should make safe before use it. To ensure public health it is necessary to monitor the groundwater quality timely[1-2]. Arsenic presence in the groundwater causes skin and other type of cancer, peripheral vascular disease, melanosis, hyperkeratosis or gangrene[1-3]. Fluoride causes dental and skeletal flrosis [1-5].

Podorski et. al. predicted map of groundwater arsenic exceeding 10 micrograms per liter using a random forest machine-learning model based on 11 geospatial environmental parameters. His new model represents a substantial advancement on a few different level[17].

Nowadays new tools and technique has become emerging tool to various environmental problem. The use of GIS software makes easy in analyzing large data. Hence remote sensing is very useful tool for geographical application like groundwater vulnerability assessment[4-8], flood mapping [9-10], landslide monitoring [11-13] and various disaster mitigation assessment. Nnorom et al. used multivariate statistical approaches to assess the origin of pollutants in water bodies in southwest Nigeria to understand water quality and sources[14].

This study presents the mapping of Arsenic affected area of Ranchi City. The multivariate analysis in QGIS is used to analyze the data. Current research portrayed comprehensive diagrams through QGIS of arsenic distribution.

The objective of this study were

- evaluation of Arsenic content with Water Quality Index at Ranchi during rainy season;
- Preparation of map of Arsenic affected area using QGIS.

The result of this study is essential for the monitoring of groundwater. In addition, these data can be used in future for government policies to protect the population's health and proper management of water resources.

II. MATERIALS AND METHODS

The study area located at 85.2609999999999957,23.2740000000000009 : 85.3679999999999950,23.4089999999999989. It covers 175 km^2 area with an average elevation of 651 m above sea level. It is a southern part of Chhota Nagpur plateau. It has moderate climate due to dense tropical forest. Summer temperature of Ranchi ranges from 20 to 42 degree Celsius while winter temperature ranges from 0 to 25 degree Celsius. In the Ranchi City December and January are the coolest month.

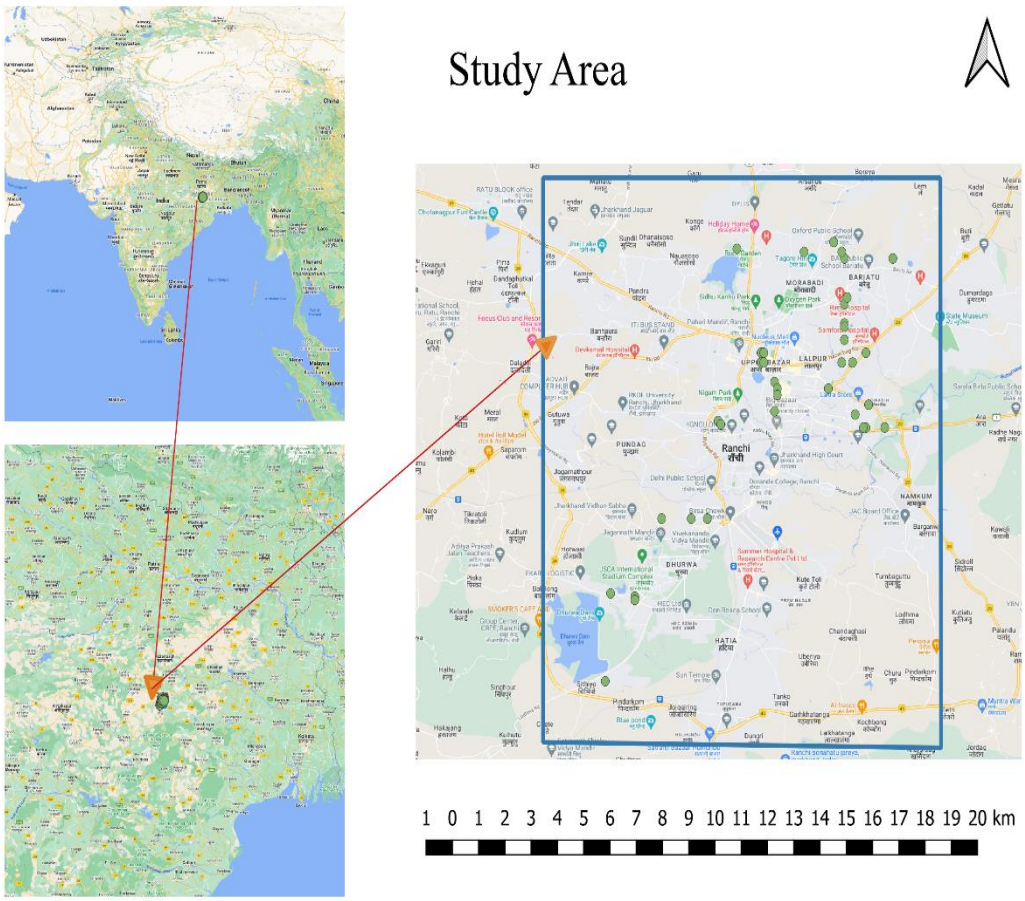

Fig. 1: Study Area of Ranchi

Samples were collected in monsoon season from bore wells, hand pumps and wells from various location from the municipal corporation area of Ranchi city. Table 1 shows the value of sample data. Few samplings site was in the rural areas.

For this study multivariate interpolation method is used to analyze the Arsenic content and QGIS is used to produce Arsenic affected area. Multivariate interpolation method is the process by which the areas is allocated on the basis various of attributes that the selected area possess. In this study Arsenic data with their attributed is imported into the QGIS and after processing it is interpolated to produce Arsenic affected area map. This map is further used to produce a contour map to find the area which has the same Arsenic value.

Figure 2 shows the location of sampling site of the study area of Ranchi city with Arsenic concentration.

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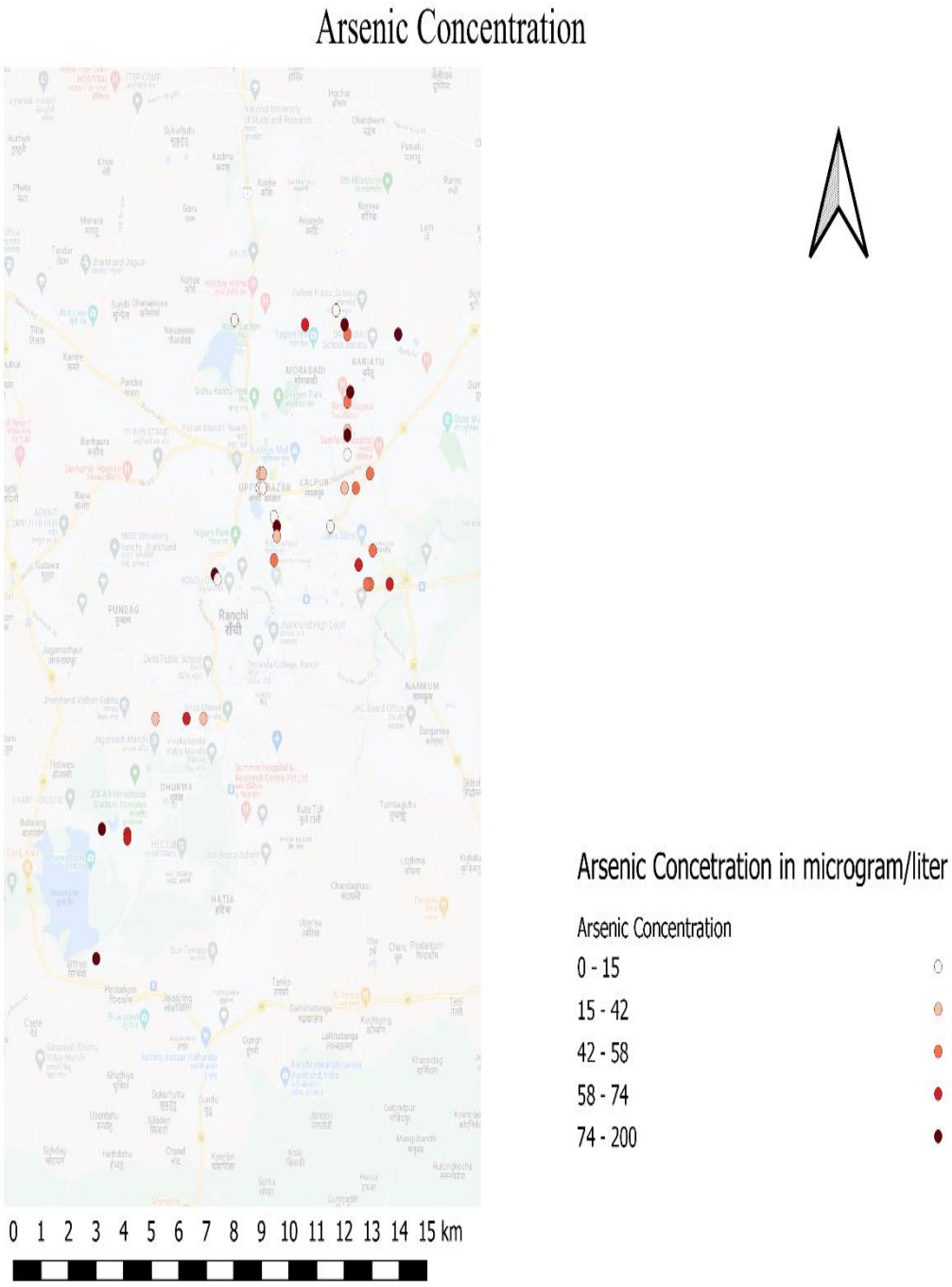

Fig. 2: Sampling sites of Ranchi city

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No.	Latitude	Longitude	Classification	Source	Arsenic in microgram/l	Sample Taken (Depth in m)
GW 1	23.2740	85.2610	Rural/residential	Well	81.00000	15
GW 2	23.3010	85.2630	Rural/residential	Tube well	90.00000	60
GW 3	23.3000	85.2720	Peri-urban/residential	Well	69.00000	62
GW 4	23.2990	85.2720	Rural/residential	Tube well	66.00000	60.2
GW 5	23.3240	85.2820	Peri-urban/residential	Tube well	20.00000	69
GW 7	23.3240	85.2930	Peri-urban/residential	Tube well	68.00000	62
GW 8	23.3240	85.2990	Peri-urban/residential	Tube well	16.00000	60
GW12	23.4060	85.3350	Rural/residential	Bore well	68.00000	120
GW 13	23.4040	85.3680	Rural/residential	Well	87.00000	18
GW 14	23.4040	85.3500	Rural/residential	Well	53.00000	16
GW 15	23.4060	85.3490	Rural/residential	Tube well	96.00000	60
GW 16	23.4090	85.3460	Rural/residential	Tube well	15.00000	62
GW 17	23.3840	85.3500	Peri-urban/residential	Well	22.00000	16
GW 18	23.3900	85.3500	Peri-urban/residential	Tube well	58.00000	60
GW 20	23.3830	85.3500	Peri-urban/residential	Tube well	200.00000	60
GW 21	23.3790	85.3500	Peri-urban/residential	Tube well	4.0000	62
GW 22	23.3640	85.3440	Urban/residential	Tube well	4.0000	60
GW 24	23.4070	85.3100	Urban/residential	Tube well	10.0000	62
GW 26	23.3920	85.3510	Urban/residential	Tube well	86.0000	60
GW 27	23.3520	85.3580	Industrial	Tube well	53.0000	60.5
GW 28	23.3520	85.3650	Peri-urban/residential	Tube well	60.0000	62.5
GW 29	23.3560	85.3540	Peri-urban/residential	Well	65.0000	17
GW 30	23.3720	85.3490	Industrial	Tube well	30.0000	62
GW 31	23.3750	85.3580	Industrial	Tube well	50.0000	60
GW 32	23.3720	85.3530	Industrial	Well	52.0000	16
GW 33	23.3590	85.3590	Peri-urban/residential	Bore well	54.0000	122
GW 34	23.3540	85.3030	Urban residential	Well	97.0000	15
GW 35	23.3530	85.3040	Urban residential	Boring	8.0000	120
GW 36	23.3720	85.3190	Commercial	Tube well	10.0000	60
GW 37	23.3720	85.3200	Commercial	Tube well	10.0000	59.5
GW 38	23.3750	85.3190	Commercial	Tube well	26.0000	59
GW 39	23.3750	85.3200	Commercial	Tube well	38.0000	60
GW 40	23.3660	85.3240	Commercial	Tube well	0.0000	60.5
GW 41	23.3640	85.3250	Commercial	Tube well	75.0000	60
GW 42	23.3570	85.3240	Commercial	Tube well	58.0000	60
GW 43	23.3620	85.3250	Commercial	Tube well	20.0000	61.5
GW 44	23.3520	85.3570	Industrial	Well	48.0000	17

Table 1: Arsenic concentration in groundwater in microgram/liter of Ranchi city

III. RESULT

The result shows that the concentration of Arsenic can impact a large area. As shown in Figure 3, the highest concentration of the Arsenic is nearTunki Tola. The interpolation result of this source shows that it can affect the area of 10^5 square meter.

Figure 4 shows the contour map of arsenic concertation of Ranchi city. This result shows the how much area is affected by each source. In the study area various places has Arsenic concentration below desired level (10 microgram/liter). This can be visualized in Figure 4.The Sidhu Kanhu Park, Birsa Nagar and Indira Nagar has below desired level Arsenic content. While on the West side of Birsa Nagar has Arsenic concentration of nearly 50 microgram per liter.

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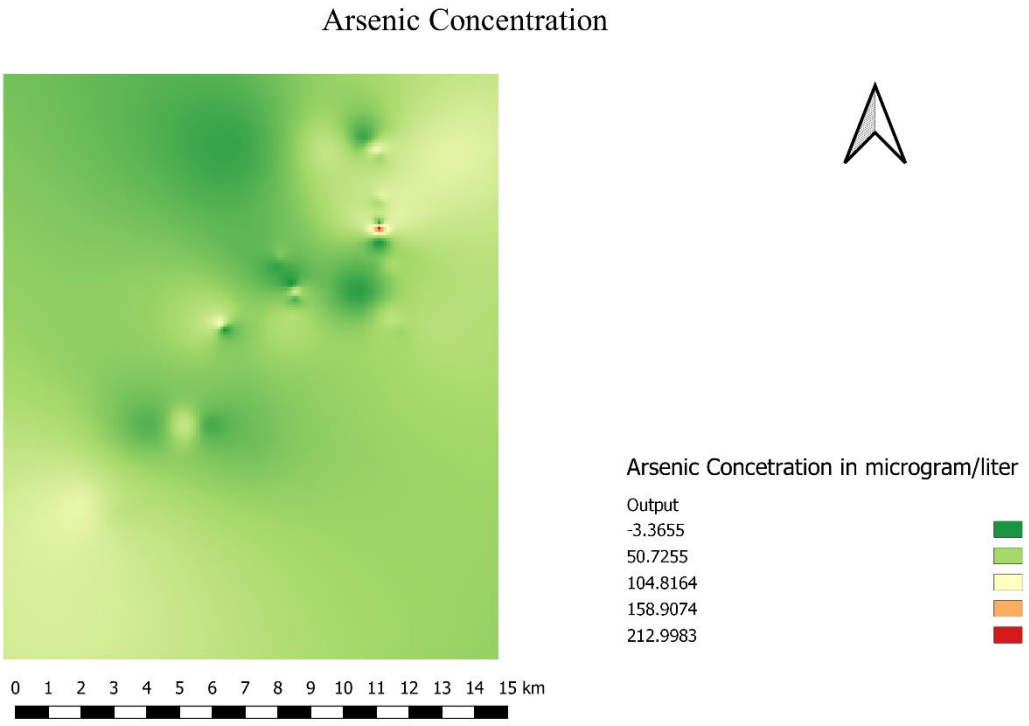

Fig. 3: Arsenic concentration of the study area after analysis using QGIS

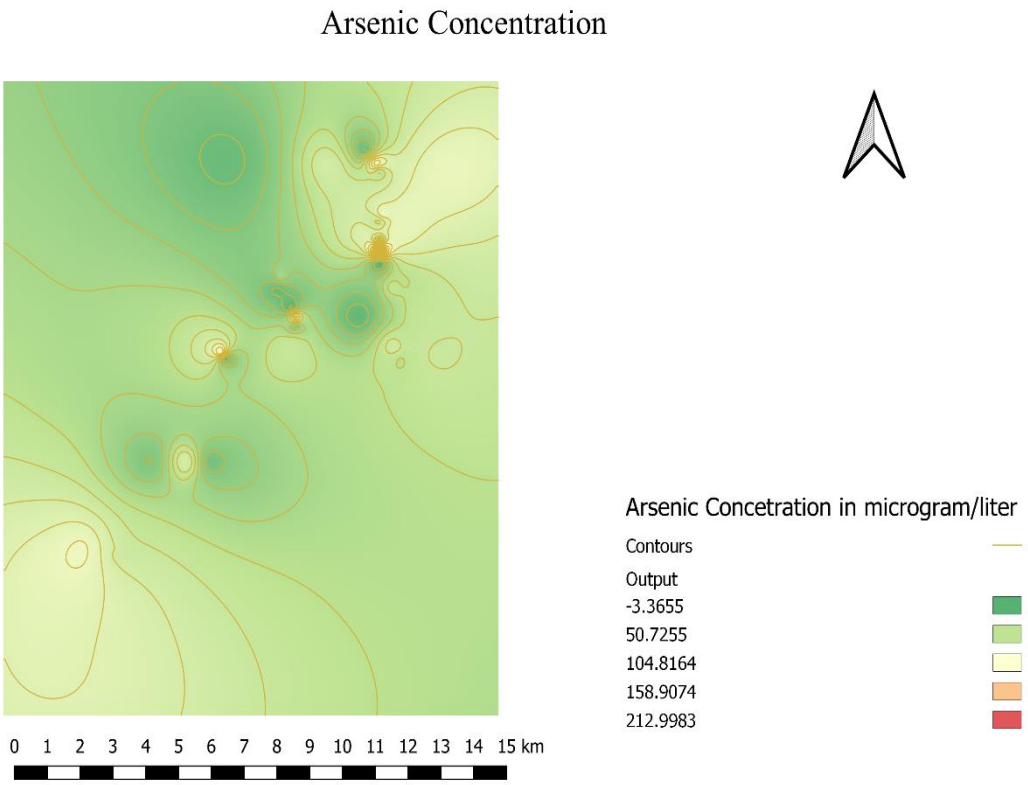

Fig. 4: Contour map of Arsenic concentration of Ranchi city after analysis using QGIS

IV. CONCLUSION

This research paper successfully produced the Arsenic concentration map using multivariate interpolation methos using QGIS. This result is very helpful in installation of new borewell which has Arsenic concentration below desired level to supply drinking and domestic water use. This result can be used for the new policy for the public and aware the people. QGIS is very helpful in preparation of this map and it has the capability to analyze these types of data. It is necessary to investigate the source of pollution. This result would be helpful in future research.

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