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Assessment of Fluoride in Groundwater and Surface Water in Gorakhpur District, Uttar Pradesh, India

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Abstract: ***Fluorine is the most electronegative and most reactive halogen. Fluorine is 13th most common element on earth crust found in the form of fluoride. Concentration of fluoride below 1 mg/l are believed beneficial in the prevention of dental carries or tooth decay, but above 1.5mg/l, it increases the severity of the deadly diseases fluorosis, which is incurable in India.***
The whole study was conducted in Gorakhpur region to know about the concentration of fluoride, mainly in rural areas of the district.
We have collected 64 drinking water samples from 9 blocks of the district in which we took 6 number of ground water samples from each block so total 54 number of samples were collected from the groundwater source and 8 number of samples were taken from surface water source.
Out of 54 ground water samples, 36 numbers of samples were taken from India Mark-II hand pumps and rest 18 number of samples were taken from shallow depth hand pumps and tested to determine the concentration of fluoride.
From our assessment we came to know that in this region the concentration of fluoride in groundwater ranges between 0.004 to 1.42mg/l, minimum value is found in the surface water source and the maximum value is found from the ground water source.The samples collected from both ground water and as well as surface water were taken from potable sources i.e. they are used for drinking purposes in daily routine.
After the testing and analyzing the samples it is come to know that surface water has quite lower levels fluoride compare to ground water. The conclusion of this work is to give information about the concentration of fluoride in groundwater and surface water of the district.
Keywords: Fluoride concentration, Groundwater, Surface water

I. INTRODUCTION

Higher concentration of fluoride is found around in 25 countries and India is one of them. In India 230 district of 20 states are facing high fluoride levels. In which Andhra Pradesh, Gujarat, Rajasthan are severely affected states. Punjab, Haryana, Madhya Pradesh and Maharashtra are moderately affected states and Tamil Nadu, West Bengal, Assam, Bihar and Uttar Pradesh are mildly affected states. In Uttar Pradesh approximately 50% of the population is affected with fluorosis either by bone fluorosis or dental fluorosis. Fluoride is beneficial for human teeth and bones if it is present up to a certain limit but excessive consumption of fluoride through drinking water, food products causes dental ,skeletal and non-skeletal fluorosis.

Due to some minerals like fluorite, apatite, muscovite, hornblende, tremolite, topaz, etc. fluoride is found in ground water. For the assessment of fluoride concentration 64 samples were collected from 9 blocks of Gorakhpur district and they are Chargawan, Bhathat, Shahjanwa, Jangal kaudia, Khorabar, Sardar Nagar, Brahmpur, Uruwa, and Gola. In all these 9 blocks there Are 4 blocks which are Chargawan, Shahjanwa,Sardar Nagar and Brahmpur in which 100% samples having fluoride concentration below 1mg/l. According to the study, concentration of fluoride in groundwater ranges between 0.018 to 1.42mg/l.Minimum concentration is found in Jangal Kaudia and maximum concentration is found in Uruwa. On the other hand concentration in surface water were found very less. It ranges between 0.004 to 0.397mg/l, Minimum concentration is found in Ghaghara River and maximum concentration is found in Rohini River.

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II. STUDY AREA

Gorakhpur a city in Purvanchal region of Uttar Pradesh in India along the banks of Rapti river,a tributary of Ghaghra river.(Latitude 26°13'N & 27°29'N and Longitude 83°05'E &83°56'E). The total area covered by the district is approx 3448 km^2. The average annual temperature goes up to 26 °C (79 °F), climate here can be considered as Humid Subtropical Climate.

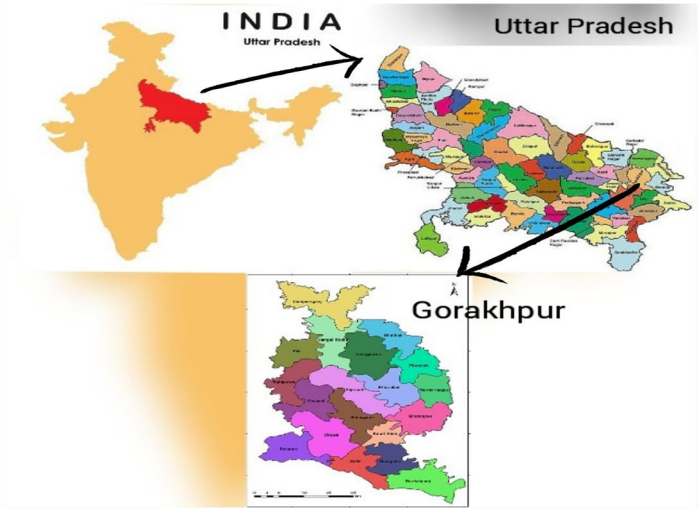


Fig. Study Area

There are 19 blocks in Gorakhpur from which we covered about 9 blocks , we took approx six samples from different locations of each block, namely- 1) Chargawan- Basharatpur,Ramjanki Nagar,Rapti Nagar, BRD College,ITI Chargawan, Fatima By-Pass, 2) Bhathat- Ataraulia, Bhathat Sadar, Chakia(Bela Road), Kharkhandi Mohalla, Pokhar Bhinda, Samstpur (Muria), 3) Sahjanwa- Luchui, Jura Kodri, Narwali(Bishunpura), Telawra, Manjharia, GIDA ,4) Jangal Kaudia- Railway Crossing, Bariarpur(Shishu Mandir), Deehghat, Mehdariya, Rampur, Ramjanki Mandir (Dohariya) ,5) Khorabar- Jangal Sikri, Rampur Nauka Tola, Azad Market, Gaur Harijan Tola, Nanda Nagar, Mohaddipur, 6) Sardar Nagar- Devkali, Saraiya,Telhnapar,Mahua Bujrg, Sonbarsa Bazar, Azad Chak. 7) Brahmpur- Primary Health Centre,Ragho Patti Padri,Star Brick Factory,Nayi Bazar,Piplahiya,Jungal Rasoolpur NO.2,8) Uruwa- Uruwa Bazar,Lohra Meera,Amorha,Mahui Bujurg, Barpuruwa,Konee Bujurg,9) Gola- Lamatiya (Nevada) Abrus, Atarara, Gola Bazar, Madria,Tehsil Gola.

III. SAMPLE COLLECTION AND ANALYSIS

Total 62 number of samples were collected from the 9 blocks of Gorakhpur district and analysed. 6 groundwater samples were collected from each block. Rest 8 number of surface water samples were collected from 4 rivers. Around 67% ground water samples were collected from India Mark-II hand pumps and rest 33% were taken from shallow depth hand pumps. Average distance between location of ground water samples were 2 to 3 km. Most of the groundwater samples were collected from village areas and hand pumps were the major source of samples. All 62 samples were tested within two days after collection. 250 to 500 ml of water samples were collected in high density polyethylene bottles (HDPE). All bottles were washed with distilled water before sampling.



Fig. Sample in HDPE bottle

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IV. MATERIAL AND METHODS

Fluoride and fluorine are different chemical compounds but fluoride is chemically related to fluorine. When fluorine amalgamates with minerals in rock or soil then salts are deployed and then fluoride are forged from these salts. All the samples were tested at room temperature in the laboratory.



Fig. Ion meter

For the testing of samples, Ion Selective Electrode Method was opted because main advantage of this method is, real time ion monitoring. Meaning of real time ion monitoring is monitoring the change of activity of ion with time.

V. PROCEDURE

Take 50 mL of each fluoride standard at 1 ppm and 10 ppm. Now calibrate the device with 50 mL of TISAB solution.Into a 150 mL polypropylene beaker, transfer 50 to 100 mL of sample. As indicated in the preceding paragraph, TISAB should be included. Rinse the electrode well, then blot dry before inserting it into the sample. After that, fully stir the mixture and record the steady reading on the metre. Every 1 or 2 hours, recalibrate the ion metre. A sample technique for measuring a large number of samples is direct measurement. By adding TISAB to all solutions, the temperature of the sample should be kept constant. A recognised addition technique is frequently used to verify direct measurement findings. A substance of known concentration is added to a sample solution in the known addition technique. The original sample concentration is calculated from the difference in electrode potential before and after the addition.

VI. RESULTS AND DISCUSSION

Total 62 samples were collected from groundwater sources as well as from surface water sources and tested and results are discussed below.

1) Fig. 1 is showing that 63% of the samples having fluoride concentration below 0.5 mg/l, 24% of samples having fluoride concentration 0.5 to 1 mg\l and 13% of the samples having fluoride concentration 1 to 1.5 mg/l. There no samples which have fluoride concentration greater than 1.5 mg\l.

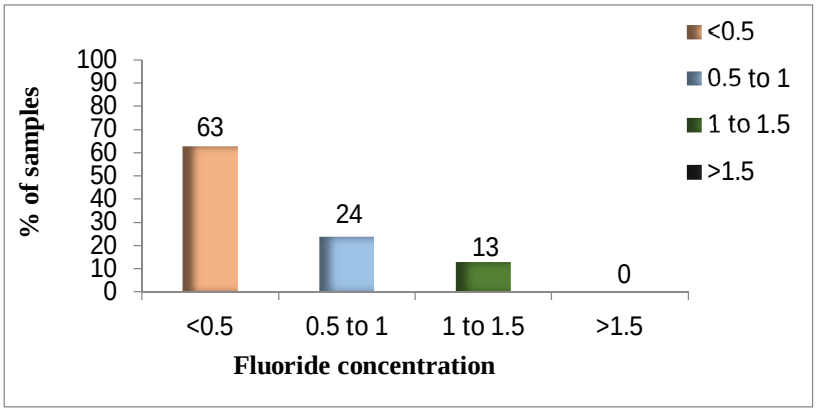


Fig. 1. Fluoride concentration of total samples

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2) Fig. 2 shows the minimum, maximum and average concentration of the groundwater samples of all blocks.

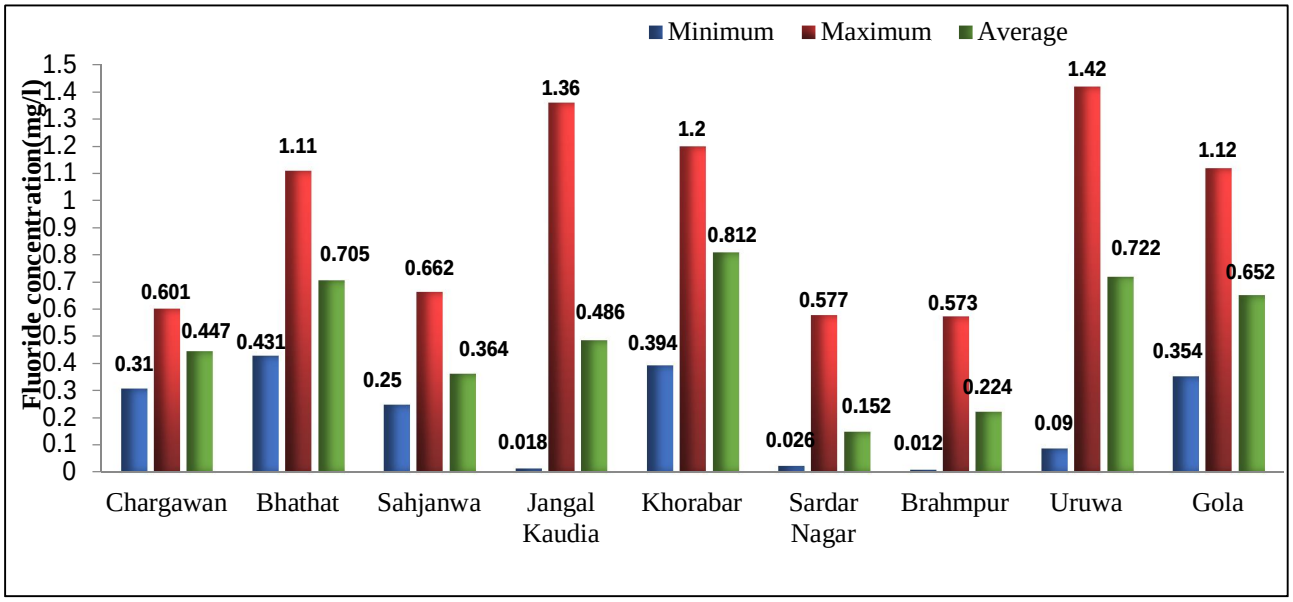


Fig. 2. Min-Max-Avg fluoride concentration in groundwater samples of each block

3) Fig.3. shows the concentration of fluoride in groundwater samples of each block.

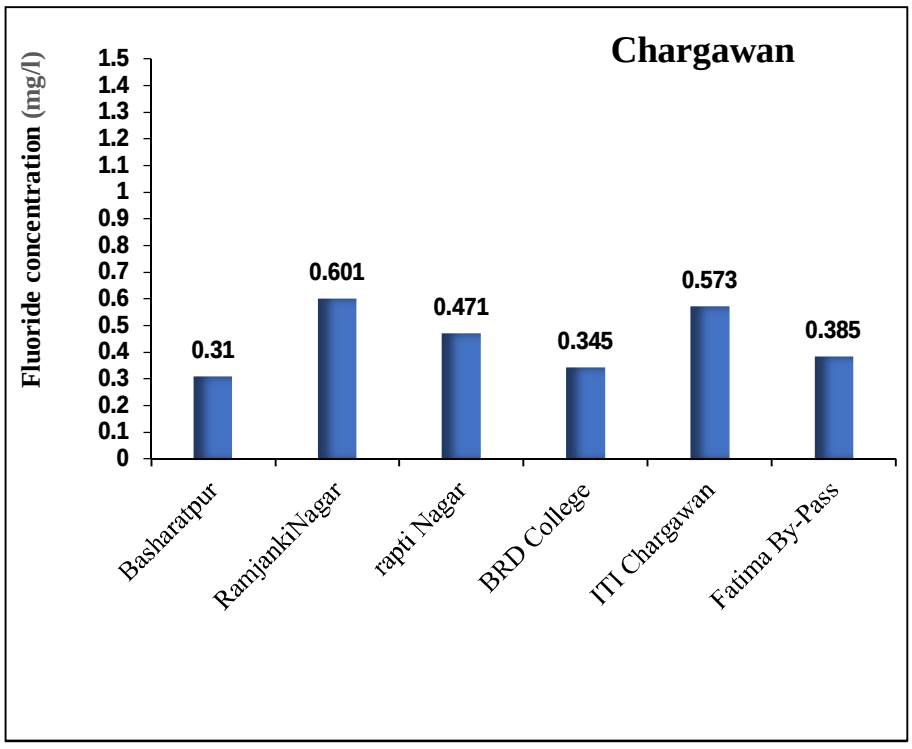


Fig.3.1. Fluoride concentration in Chargawan

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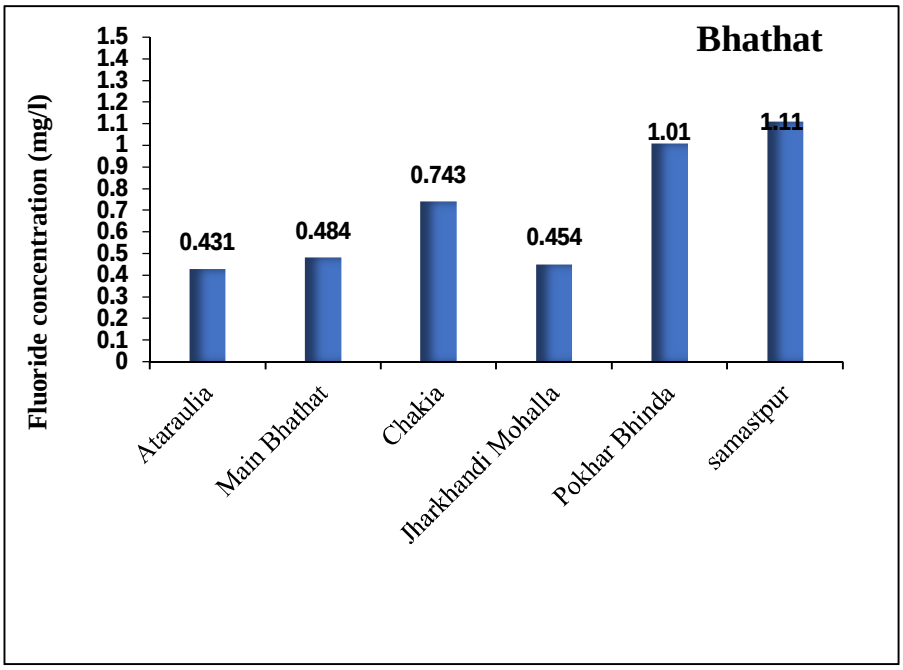


Fig.3.2. Fluoride concentration in Bhathat

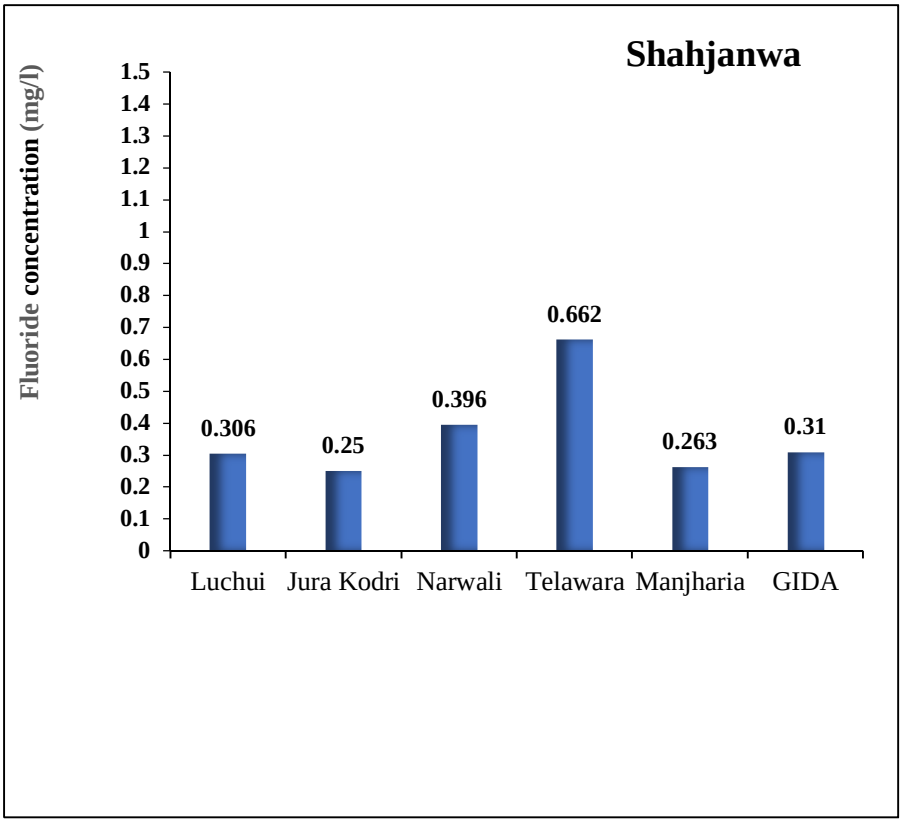


Fig.3.3 Fluoride concentration in Sahjanwa

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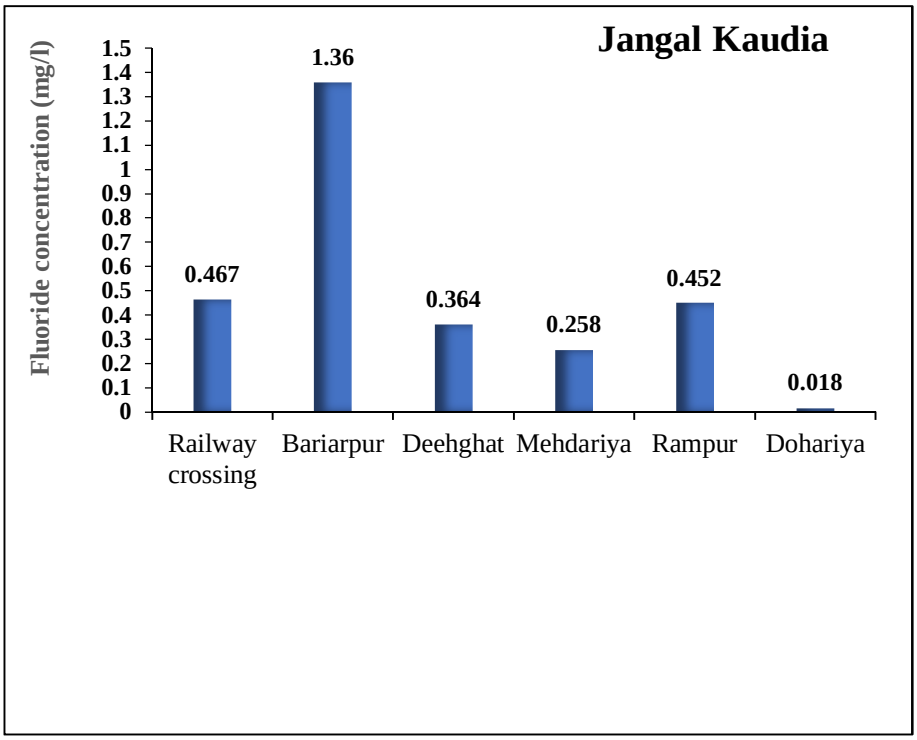


Fig.3.4. Fluoride concentration in Jangal Kaudia

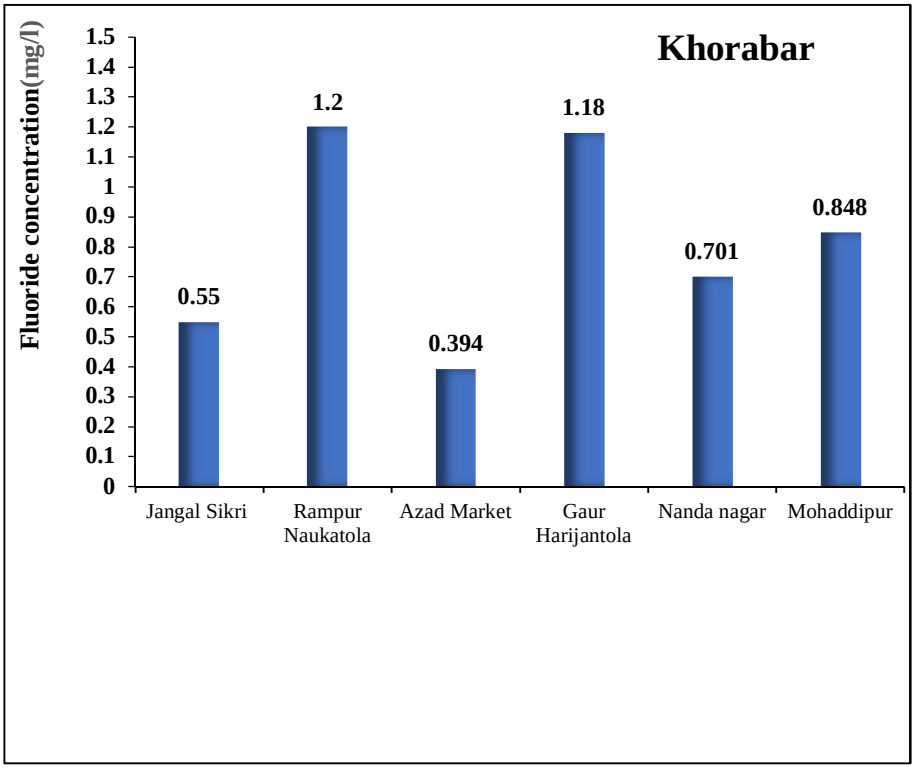


Fig.3.5. Fluoride concentration in Khorabar

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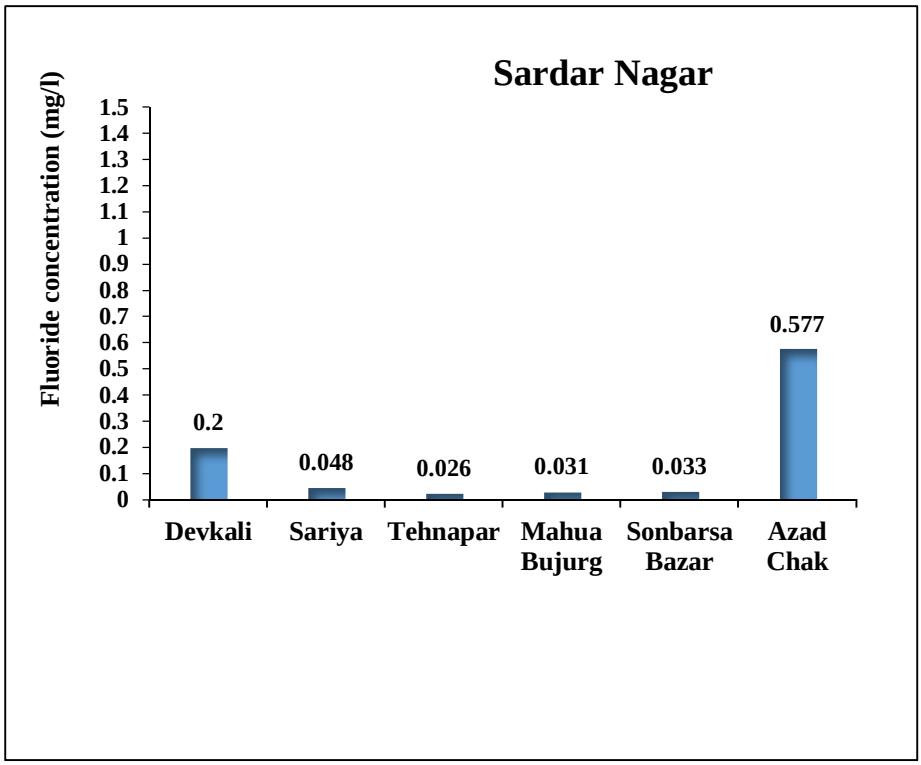


Fig.3.6.Fluoride concentration inSardar Nagar

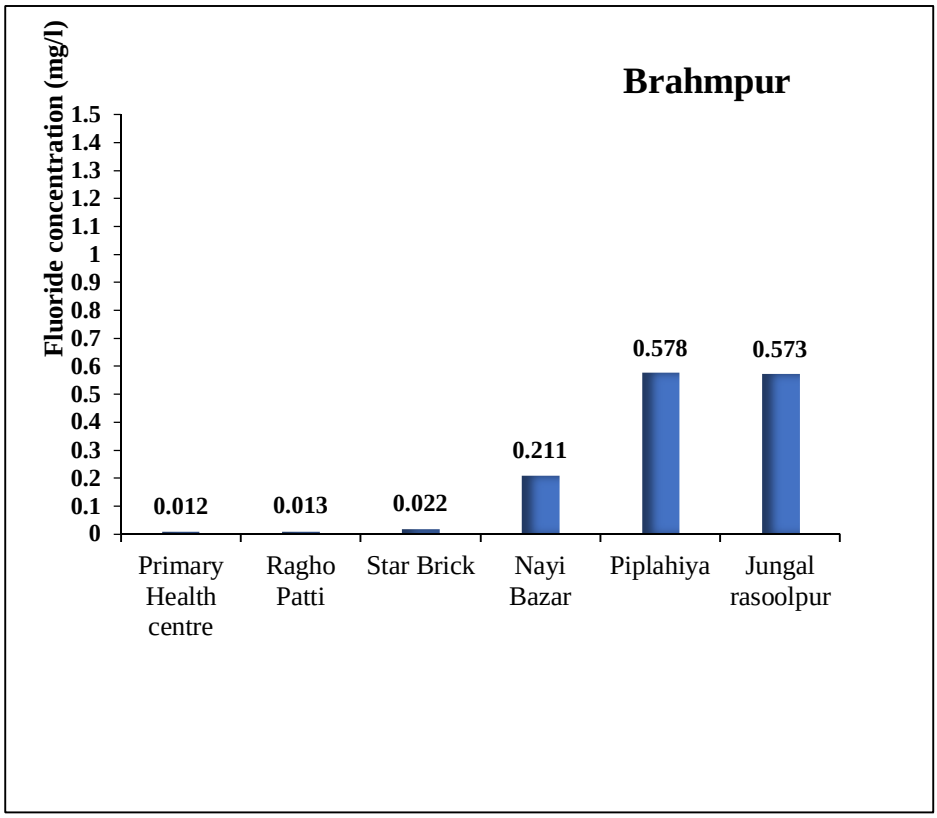


Fig.3.7. fluoride concentration in Brahmpur

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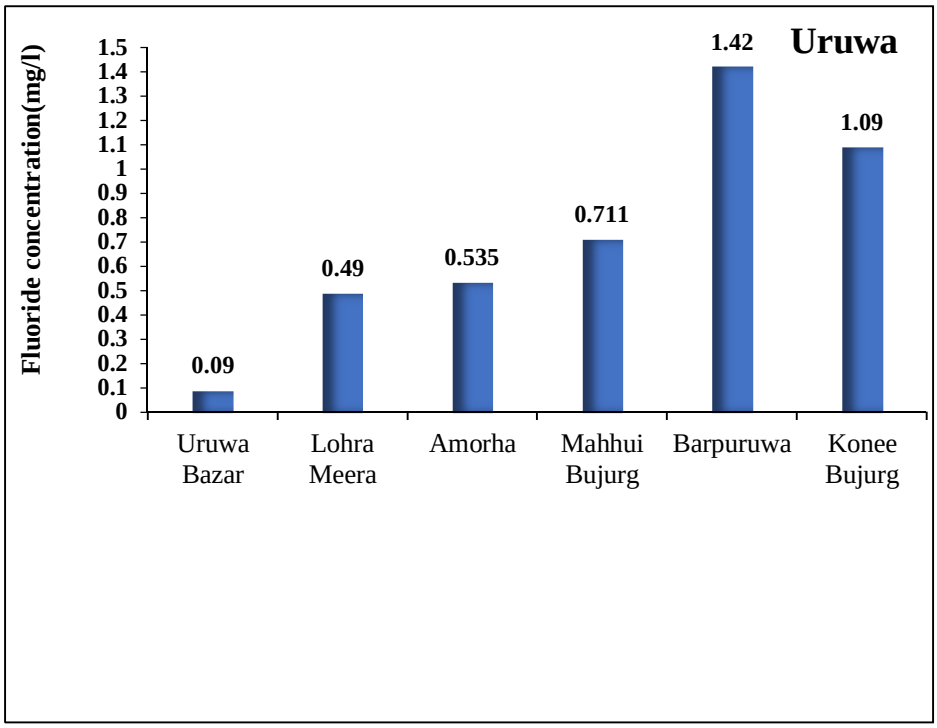


Fig.3.8. Fluoride concentratioin Uruwa

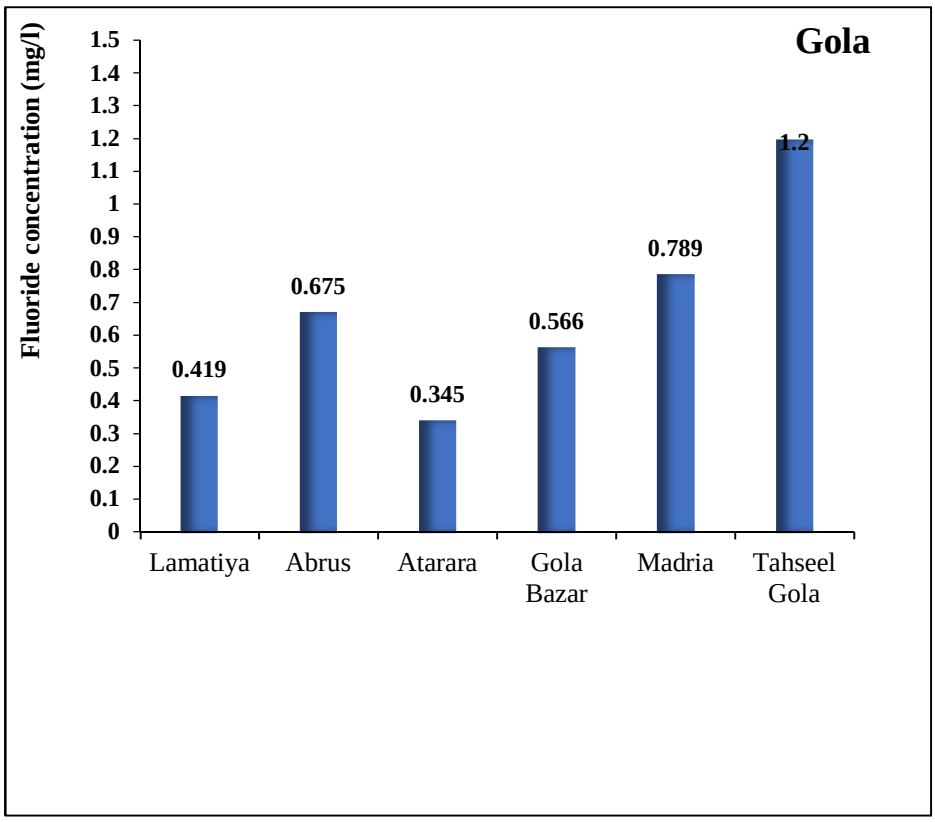


Fig.3.9. Fluoride concentration in Gola

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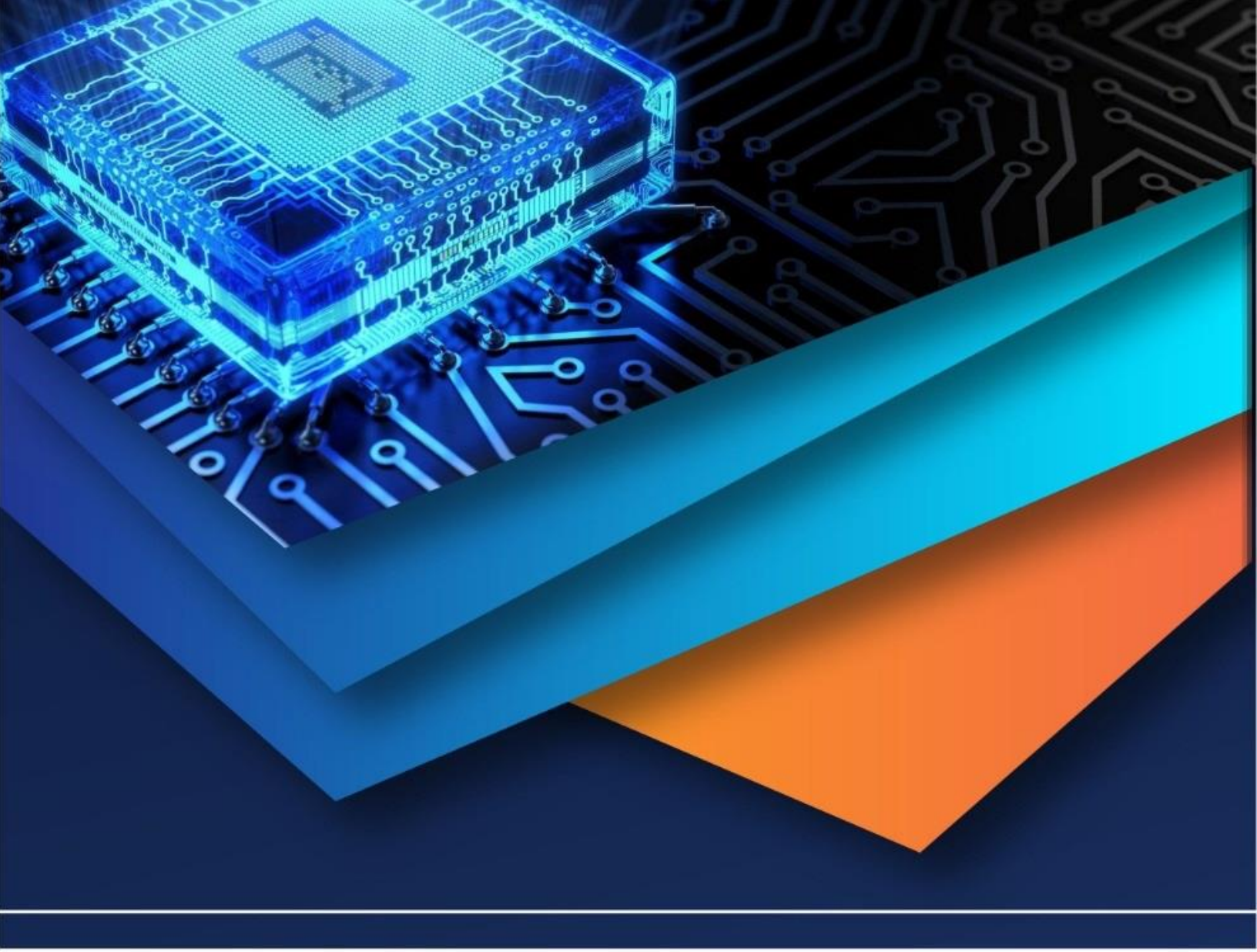
VII. CONCLUSION

The fluoride concentration is making the groundwater and as well as the surface water contaminated which is an enormous issue for present as well as the future. As soon as we acknowledge this issue and take a determined step towards this it would help us in indentifying the larger water crisis. We should firstly search and identify all the water sources which are contaminated and they should be sealed off as soon as possible. Along with that, people should be provided state drilled tube wells so that they must get safe drinking water. The affected areas should have huge campaigns and awareness should be made regarding the promotion of higher calcium and vitamin-c usage. The State should take the responsibility of providing these and arranging free of cost as most of the Indian in rural area cannot afford these. Artificial techniques like flooding of groundwater with surface water are one of the major reasons of fluoride concentration so the next step should be to reduce these artificial measures to balance the situation. And the ultimate step is the importance of drinking water on human health should be given attention. So that the affluent which may have been piled their bottled water which will be major concern could be avoided as the majority of Indians cannot afford it.

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