RESEARCH ARTICLE

IMPACT ON HEALTH OF EXCESS FLUORIDE INGROUND WATER NEAR JHANSI U.P. INDIA

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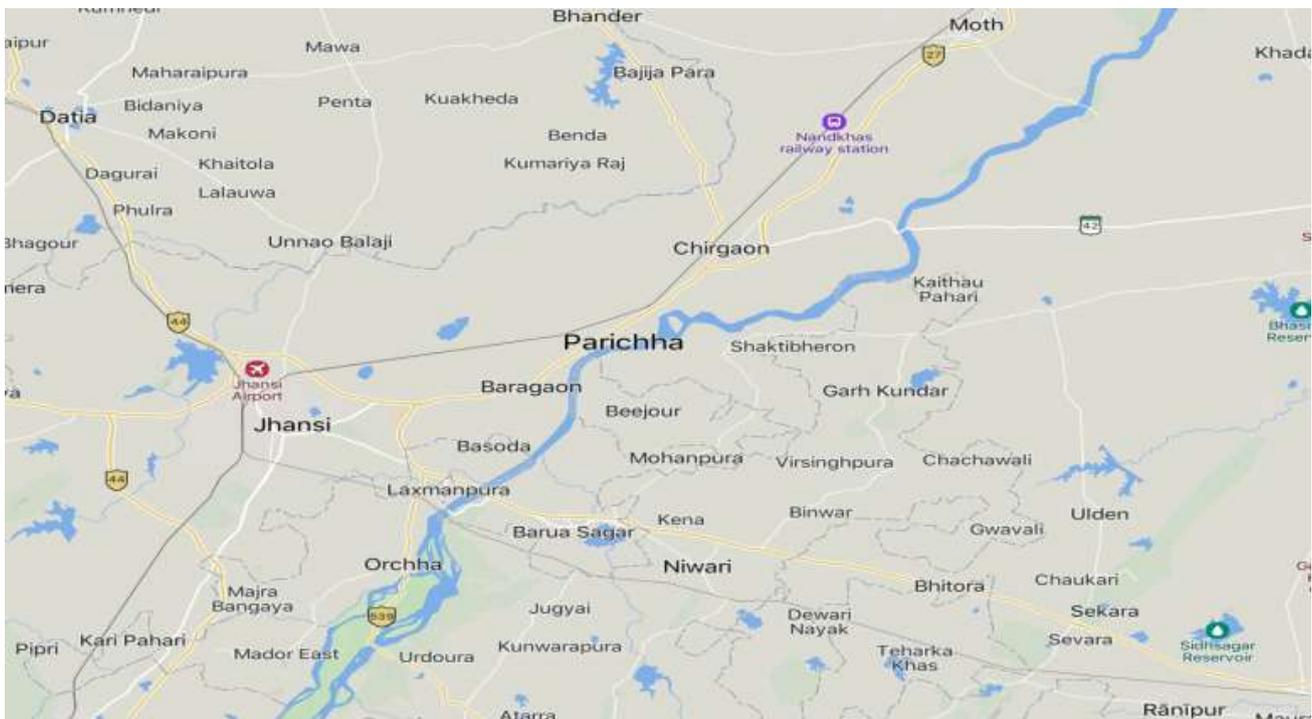| ARTICLE INFO	ABSTRACT
	Water is very important for our life. And it is abundantly available in nature. For the investigation we have collected four sample near Parichha thermal plant. Water samples are collecting in February, May, August, NovemberMonth. During physiochemical analysis fluoride have found in very excess amount in groundwater sample collected from resources of drinking water near Parichha thermal plant. While fluoride levels can vary greatly, some fluorides are found naturally in soil, air, and water. Fluoride is present in almost all water. Foods derived from certain plants and animals have also fluoride, Fluorides enter the body and pass through the digestive system before entering the bloodstream. They are carried by blood and tend to gather in calcium-rich tissues like teeth and bones. Our society is now at serious risk from fluoride contamination on a worldwide basis. The water source's fluorination is mostly due to volcanic activity, fluoride-rich soil, and human activity. The World Health Organization recommends 1.5 mg/L of fluoride for drinking water to prevent dental mottling and skeletal fluorosis because of the negative health effects, which include dental discolouration and skeletal fluorosis. "In addition to skeletal and dental fluorosis, excessive fluoride in water can cause osteoarthritis, arthritis, fatigue, joint problems, muscle damage, and chronic illnesses. In extreme situations, it can damage a living thing & #39; s heart, veins, kidney, liver, sensory organs, and neurological system, as this research discusses.

INTRODUCTION

The physiological processes of people, animals, and plants all depend on water. The local geological history, which includes the rocks and hidden ore deposits close to the water assembly sites, as well as other factors like the effort of fundamental elements and contaminants by lentic and lotic waters and alternative aquifers, determine the nature and quality of surface and ground water, all of which vary greatly.[1] The complexity of interactions between water and soluble minerals, sparingly soluble minerals, and salts, both natural and man-made, makes it difficult to understand the quality of water [2]. When fluoride (F) levels in drinking water go below the 1.5 ppm maximum allowable limit, it becomes hazardous. In addition to humans [3,4], a variety of domestic animal species [5,6] also develop osteo-dental fluorosis because of prolonged exposure to fluoridated drinking water or ground. bio-indicators of frequent fluor toxicosis caused by fluoridated water in recent years.[7,8]. Because of the high levels of fluoride in drinking water, hydro fluorosis is common in several Indian states [9,10]. Contradictory information regarding the nation's drinking water supply and quality is presented in several reports [11]. The most significant geogenic source of fluoride enrichment in water is weathering of these fluorine-rich minerals. Water also contains fluoride. This covers things like mining, using insecticides, and using brick kilns [12]. Too much fluoride causes dental fluorosis, and at

even greater doses, it can cause skeletal fluorosis. As a result, several national and international organizations have established standard acceptable levels of fluoride in drinking water. The WHO and the Bureau of Indian Standards (BIS) have established a 1.5 mg/L allowable limit for fluoride in drinking water [13,14]. Approximately 30% of the world's freshwater supplies are groundwater, which is essential for industry, agriculture, and drinking water. India, which is home to 17% of the world's population yet only has 4% of the world's freshwater, is severely water-scarce [15]. India uses more than a quarter of the world's groundwater, but overuse has resulted in problems like pollution, depletion, and saltwater intrusion [16,17]. Currently at 1486 m3, per capita water availability is predicted to fall below 1140 m3 by 2050, making the situation worse. This problem is made even more acute by climate change, since increased irrigation demands are expected to quadruple groundwater depletion rates by 2041–2080 [18,19,20]. One of the main worldwide problems is fluoride pollution of groundwater. An estimated 200 million individuals worldwide, or a significant portion of the population in 25 countries, suffer from fluorosis, which has been linked to fluoride poisoning of groundwater, particularly in India [21,22]. Consuming fluoride-rich groundwater increases the risk of fluoride exposure in all nations. The most electronegative element, fluoride, is found in the groundwater system as fluoride ions (F−) and is frequently linked to natural processes that release it [23,24,25]. Fluoride is essential for the development of teeth and bones; while its presence guarantees

strength, too much of it can have major negative effects on health. The human body can absorb fluoride from both geogenic and anthropogenic sources, with geogenic sources being more common in India [15,21]. Geogenic sources include evaporative enrichment, leaching, weathering, ion exchange, rock-water interactions, and the dissolution of fluoride-containing minerals [24,25]. Fluoride levels in groundwater are raised by anthropogenic sources, such as phosphate fertilizers, coal combustion, and industrial operations. Additional potentially dangerous ions present in fertilizer products are nitrate and sulphate. By preventing dental cavities, building tooth enamel, and establishing bone minerals, fluoride maintains teeth healthy. When fluoride levels in drinking water fall below 0.5 mg/L, cavities, reduced bone mineralization, and a lack of dental enamel development might result. The geology of the Bundelkhand gneissic complex in Jhansi district is typified by granite rock, which means that fluoride poisoning of groundwater results from the weathering of granite rocks. The main contaminant in this area is fluoride, which poses serious health concerns to people. To assess the health effects of these contaminants across various exposure pathways, the USEPA (2014) [26] used the human health risk assessment (HRA) model.Utilizing statistical methods such as regression analysis and interpolation, geographic information systems (GIS) were utilized to forecast the levels of contaminants at unsampled sites. To produce spatially explicit risk maps, these approaches rely on tried-and-true methods [27, 28, 29, 30, 31, 32, 33]. The study successfully illustrated the spatial breadth of health concerns by combining the anticipated pollutant distribution with data from the human census [34,35,36,37]. These vibrant risk maps identify hotspots, supporting focused mitigation and management techniques to enhance the region's groundwater quality.

Research Area

from toxic substances (IPCS 2004). The widely used HRA model from the USEPA (2014) provides a framework for evaluating how pollutants affect human health. To draw attention to the dangers that environmental contaminants pose to human health, researchers from all over the world have used these policies and guidelines [39,40,41,42,43,44,45,46,47]. The Bundelkhand region is confronted with the worldwide problem of groundwater contamination by nitrate and fluoride, as well as severe water scarcity [29, 30, 31, 48, 49, 50]. The hydrogeochemical evolution of the groundwater samples is examined in this study, with particular attention to fluoride and nitrate contaminants. A human health risk assessment was conducted using the USEPA approach, and various statistical techniques have been employed to interpret the spatial inter-correlation of hydrogeochemical parameters. Insufficient spatial and temporal assessments of groundwater contamination by fluoride and nitrate, especially in light of agricultural and industrial activities, are among the research gaps on the Marginal Ganga Alluvial Plain.

RESEARCH AND METHODOLOGY

Parichha: The Jhansi-Kanpur Highway (via Kalpi) runs 25 kilo meters from Jhansi to the town of Parichha. Located on the banks of the River Betwa, this charming town is well-known for the Parichha Dam and Reservoir. Although the Reservoir is a well-liked destination for water sports, the Dam is a charming location with a stunning view of the area. Parichha Thermal power Station is found at Parichha in Jhansi. The control plant is claimed and worked by Uttar Pradesh Rajya Vidyut Utpadan Nigam which may be a state undertaking.

Arc GIS has an extension module called "geostatistical analyst" that has been used for cross-validation, exploratory data analysis, the semi variogram model, and determining the distribution pattern of groundwater contaminant concentrations. Kriging is a statistically based prediction tool that describes the stochastic theory for assessing how geographic data behaves spatially [38]. Indicator kriging (IK) is used to determine the likelihood of contaminants, while ordinary kriging (OK) is used to create the spatial distribution of water quality and contaminants in the study area. Human health is "at risk" due to sub-lethal factors that exist locally and/or regionally. By using risk assessment, exposure evaluation, and hazard characterization, HRA assesses the population's possible exposure to and negative impacts

METHODOLOGY

Sampling of water: The water samples were collected from the hand pump and tap water in and around parichha and parichha thermal plant areas. After filtration and preservation with acidification with HNO3 the water samples were stored in plastic bottles of polyethylene (250 mL), finally analysed to determine the following heavy metals contents: Cd, Pb, Mn, Fe, Si and Cu and nitrates, fluorides. Electrical conductivity (EC) and pH values were measured in the field using a portable conductivity and pH meter. Water samples were collected two mining area and two residential area near mines in parichha Jhansi (U. P). during (February-November 2024)

Methodology used to be measurement of physical-chemical parameter: following table no.1shows methods used to analyse physical-chemical parameter of water samples.

RESULT AND DISCUSSION

All physiochemical parameters are detected in aggregable amount according to WHO standard except total Hardness and fluoride. Total hardness of water can be removed by boiling of water before drinking use. Butexcess amount of fluoride found in water sample is problematic for health and environment, showing Table no.2,3 and figure1 and 2.

intake of fluoride from other sources. In our sample we have got excess amount of fluoride according to WHO Recommendation. This excess amount of fluoride is harmful for Health. Intense exposure to high concentrations of the most prominent dissolvable fluoride compounds can cause toxic effects by acting as an interferometer with calcium and triggering the action of proteolytic and glycolytic proteins. Ingested fluoride reacts with gastric corrosive to produce hydrofluoric corrosive in the stomach. appears quickly and includes symptoms like heaving, excessive spitting, nausea, and stomach pain. There may also be muscle fits and seizures. Respiratory loss of motion may be a plausible cause of death. Serious respiratory tract irritation, including asthma-like symptoms and pneumonic oedema, are the severe effects of inhaling hydrogen fluoride.

Table 1. parameters and methods/Instruments to be used during analysis of physical-chemical analysis of water

S. No.	Parameters	Method/ Instruments
1.	pH	pH-meter
2.	EC (mmhos/cm)	Electronic Conductivity Meter
3.	Turbidity	Nephelometric method
4.	(TS)	Oven, Desiccators
5.	TDS (Total Dissolved Solids) (mg/l)	Oven, Filtration
6.	TSS (Total Suspended Solids) mg/l	Oven, Gravimetric Method
7.	Total Alkalinity (mg/l)	Titration
8.	Ca-Hardness (mg/l)	Titration
9.	Mg-Hardness (mg/l)	Titration
10.	Total hardness (mg/l)	Titration
11.	D.O.	Titration (Iodometry)
12.	Nitrates	Reverse osmosis
13.	Chloride (mg/l)	Titration
14.	Fluorides (mg/l)	Ion exchange method
15.	Iron (mg/l)	Iron treatment method

Table 2. Range of physical-chemical parameters and their comparison with World Health organization (1996) standard for drinking water (WHO, 1996[20])

S. N	parameters	Average detective value in water sample	Acc to WHO
1.	colour	6unit (Dusty)	5unit
2	taste	salty	…..
3.	pH	7.2	…..
4	EC (mmhos/cm)	428(mmhos/cm)	…..
5.	Turbidity (NTU)		<1(NTU)
6	Total solids(mg/l)	510(mg/l)	540(mg/l)
7	Total dissolved solid (TDS) ppm	310(mg/l)	500(mg/l)
8	Total suspended solid (TSS) ppm	230(mg/l)	500(mg/l)
9	Total Alkalinity (mg/l)	1.62-2.99(mg/l)	500(mg/l)
10	Ca-Hardness(mg/l)	86-32(mg/l)	40(mg/l)
11	Mg-Hardness(mg/l)	40-58(mg/l)	120-180(mg/l)
12	Total Hardness(mg/l)	220(mg/l)	120-180 (mg/l)
13	DO	6.7-8.4(mg/l)	13-14(mg/l)
14	Nitrates	48mg/l	50mg/l
15	Chlorides(mg/l)	71-42(mg/l)	250(mg/l
16	Fluoride(mg/l)	0.8-1.4(mg/l)	1.0(mg/l)
17	Iron(mg/l)	0.12-1.0(mg/l)	0.1(mg/l)

Fluoride Conc in February, May, August, November-2024

Research Area	concentration of fluoride			
A1	0.7	0.8	0.9	0.6
A2	0.8	0.9	0.9	0.7
A3	0.9	0.9	0.9	0.8
A4	1.1	1.2	1.2	1.3
Month	February	May	August	November

World Health Organization (WHO) fluoride guideline values- The guideline value for fluoride in drinking-water is 1.5 mg/L, based on increasing risk of dental fluorosis at higher concentrations and that progressively higher levels lead to increasing risks of skeletal fluorosis. This value is higher than that recommended for artificial fluoridation of water supplies for prevention of dental caries, which is usually 0.5–1.0 mg/L. WHO recommends that, in setting a standard, Member States should consider drinking-water consumption and the

Contact between the skin and the eyes can cause serious burns or injuries. It can be lethal by ingestion, inhalation, or skin presentation. Repeated or extended inhalation exposure to aluminium fluoride, mainly in word-related circumstances, can cause asthma.12 The main cause of fluorosis is prolonged exposure to high fluoride concentrations through ingestion or inhalation: Finish fluorosis can develop in children because it is brought on by consuming large amounts of fluoride during the period when teeth are developing. The

appearance of white areas within the finish distinguishes it as a wonderful issue in this frame. Table 3 shows concentration of fluoride in drinking water sample of research area.
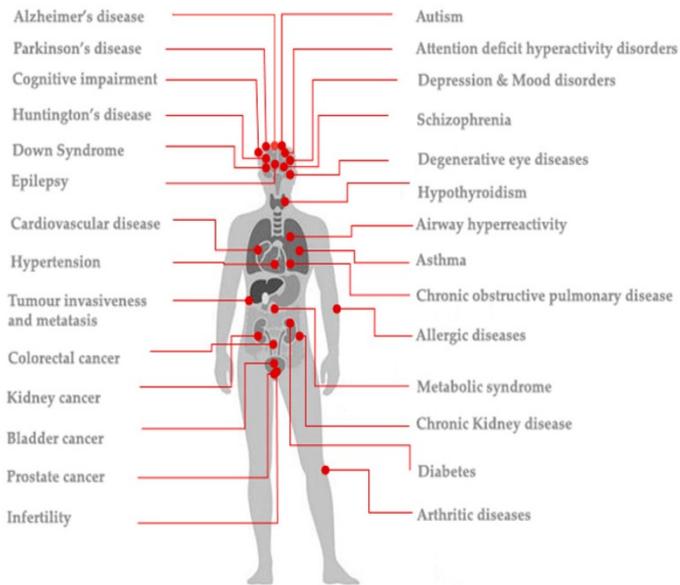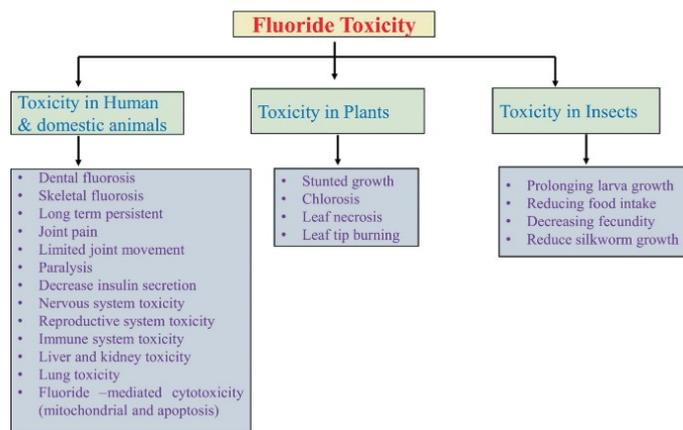

Figure 1. Shows adverse effect on human health

Figure 2. Shows fluoride toxicity on environment.

CONCLUSION

We have found excess amount of fluoride in drinking water sample of parichha, Jhansi (U. P).The fluoride-contaminated water isinfluencing lakhs of individuals, and broad administration methods arerequired of the hour. Application of surface water and water are ecofriendly procedures; be that as it may, they are not feasible. Endeavours ought to bemade to supply financial andproficient defluorination methods. Although a few methods exist, they have their claim deficiencies. Toaddress the confinements of defluorination methods, hybridization oftwo or more methods is essential, subsequently making the fluorideevacuation prepare more successful. Most of the information within the writing doesnot include the administration of post-treatment fluoride-bearing slimetransfer and the recuperation or reuse of went through materials and analysing. whether the defluorinated water is fit to drink. This opens a modernspace of issues that needs a quick address. In this way, futureinvestigate ought to centre on the common sense of the proposed strategy in a point-by-point way towards fluorosis relief.

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