

Groundwater Contamination and Fluorosis: A Comprehensive Analysis

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Abstract : Groundwater contamination with fluoride has emerged as a global concern affecting millions of people, leading to the widespread occurrence of fluorosis. It affects bones and teeth, leading to dental and skeletal fluorosis. This study presents a comprehensive analysis of the relationship between groundwater contamination and fluorosis. It delves into the causes of fluoride contamination in groundwater, its spatial distribution, and adverse health impacts of fluorosis on affected communities. Fluoride contamination in groundwater can be attributed to both natural and anthropogenic sources. Geogenic sources involve the dissolution of fluoride-rich minerals present in the aquifer materials. On the other hand, anthropogenic activities such as industrial discharges, agricultural practices, and improper disposal of fluoride-containing waste contribute to the contamination of groundwater. The spatial distribution of fluoride contamination varies widely across different regions and geological formations. High fluoride levels are commonly observed in areas with fluorine-rich geological deposits. Additionally, agricultural and industrial centres often exhibit elevated fluoride concentrations due to anthropogenic contributions. Excessive fluoride ingestion during tooth development leads to dental fluorosis, characterized by enamel defects, discoloration, and dental caries. The severity of dental fluorosis varies based on fluoride exposure levels during tooth development. Long-term consumption of fluoride-contaminated water causes skeletal fluorosis, resulting in bone and joint pain, decreased joint mobility, and skeletal deformities. In severe cases, skeletal fluorosis can lead to disability and reduced quality of life. Various defluoridation techniques such as activated alumina, bone char, and reverse osmosis have been employed to reduce fluoride concentrations in drinking water. These methods effectively remove fluoride, but their implementation requires careful consideration of cost, maintenance, and sustainability. Diversifying water sources, such as rainwater harvesting and surface water supply, can reduce the reliance on fluoride-contaminated groundwater, especially in regions with high fluoride concentrations. Groundwater contamination with fluoride remains a significant public health challenge, leading to the widespread occurrence of fluorosis globally. This scientific report emphasizes the importance of understanding the relationship between groundwater contamination and fluorosis. Implementing effective mitigation strategies and preventive measures is crucial to combat fluorosis and ensure sustainable access to safe drinking water for communities worldwide. Collaborative efforts between government agencies, local communities, and scientific researchers are essential to address this issue and safeguard the health of vulnerable populations. Additionally, the report explores various mitigation strategies and preventive measures to address the issue and offers recommendations for sustainable management of groundwater resources to combat fluorosis effectively.

Keywords : fluorosis, fluoride contamination, groundwater contamination, groundwater resources

Conference Title : ICGIGISGT 2023 : International Conference on Groundwater Investigations, Groundwater Information Systems and Geophysical Techniques

Conference Location : Dubai, United Arab Emirates

Conference Dates : December 25-26, 2023