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# ARSENIC IN DRINKING WATER AND DISEASE PATTERNS IN THE BRAHMAPUTRA VALLEY WITH SPECIAL REFERENCE TO KAMRUP DISTRICT, ASSAM, INDIA

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## ABSTRACT :

*Arsenic contamination in drinking water has emerged as a critical public health issue in the Brahmaputra Valley of Assam, India, with Kamrup District being particularly affected. The presence of arsenic in groundwater, primarily due to natural geogenic sources, has led to widespread exposure among local populations, causing both acute and chronic health problems. Chronic exposure to arsenic is associated with skin lesions, pigmentation changes, keratosis, cardiovascular diseases, and various forms of cancer, including skin, lung, and bladder cancers. This paper examines the spatial distribution of arsenic contamination in Kamrup District, identifies the key sources and pathways of exposure, and analyzes the disease patterns observed in the affected population. The study draws on field surveys, laboratory analyses, epidemiological data, and literature reviews to provide a comprehensive understanding of the arsenic crisis in the region. It also highlights mitigation strategies, including water quality monitoring, public awareness campaigns, adoption of arsenic removal technologies, and policy interventions aimed at ensuring safe drinking water. The findings underscore the urgent need for a multi-pronged approach involving government agencies, research institutions, and local communities to address the health impacts of arsenic exposure and improve water management practices..*

**Keywords:** *Arsenic contamination, drinking water, Kamrup District, Brahmaputra Valley, groundwater, health impacts, disease patterns, mitigation strategies, India, public health.*

## I.Introduction:

The Brahmaputra Valley, encompassing the Kamrup District of Assam, is characterized by its fertile plains and extensive river systems. However, the region faces a growing challenge of arsenic contamination in groundwater, primarily due to natural geological processes. Long-term consumption of arsenic-laden water has been linked to various health disorders, including skin lesions, cancers, and cardiovascular diseases. This paper aims to explore the extent of arsenic contamination in Kamrup District and its associated health impacts.

## II. Objectives of the Study:

1. To assess the extent and spatial distribution of arsenic contamination in drinking water sources in Kamrup District, Assam, and identify the primary geogenic and anthropogenic factors contributing to groundwater arsenic levels.

2. To examine the health impacts and disease patterns associated with chronic arsenic exposure among the local population, with a focus on skin lesions, cancers, and cardiovascular disorders, in order to inform effective mitigation and public health interventions.

## III.Methodology:

The study on arsenic contamination in drinking water and associated disease patterns in Kamrup District, Assam, was conducted using a combination of field surveys, laboratory analysis, and secondary data review. The methodology is outlined below:

**1. Study Area Selection**

Kamrup District was chosen as the study area due to its proximity to the Brahmaputra River, known variations in groundwater quality, and reports of arsenic-related health issues. Specific villages and localities within the district were selected based on accessibility, historical reports of arsenic contamination, and population density.

**Data Collection**

Primary Data:

Water Sampling: Groundwater samples were collected from hand pumps, tube wells, and community water sources in selected villages. Samples were collected in pre-cleaned polyethylene bottles, preserved with nitric acid, and stored at 4°C to prevent chemical changes.

Field Surveys and Interviews: Structured questionnaires and interviews were conducted with local residents to gather information on drinking water sources, duration of exposure, and observed health problems. Focus group discussions helped identify prevalent disease patterns and community awareness about arsenic contamination.

**Secondary Data:**

Historical records of arsenic levels from government and research reports were analyzed.

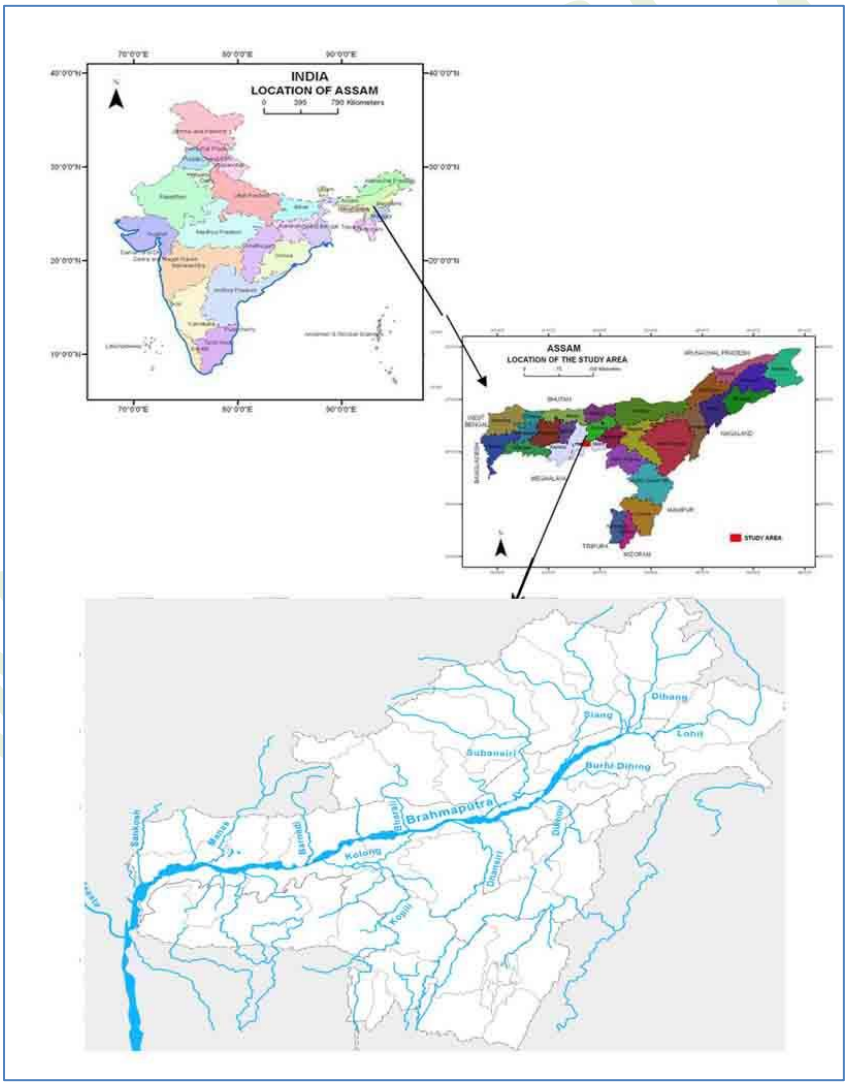
Health records from local healthcare centers and hospitals were reviewed to document cases of arsenic-induced diseases, including skin lesions, cancers, and cardiovascular disorders.

**Laboratory Analysis:**

Water samples were analyzed using Atomic Absorption Spectrophotometry (AAS) to determine arsenic concentration in micrograms per liter (µg/L). Quality control procedures, including standard reference materials and duplicate samples, were followed to ensure accuracy.

**Data Analysis:**

Spatial Analysis: Geographic Information System (GIS) software was used to map arsenic contamination levels and identify high-risk zones within Kamrup District.Statistical Analysis: Correlation analysis was performed to examine the relationship between arsenic concentration and the prevalence of disease patterns. Descriptive statistics summarized demographic profiles, exposure duration, and health outcomes.



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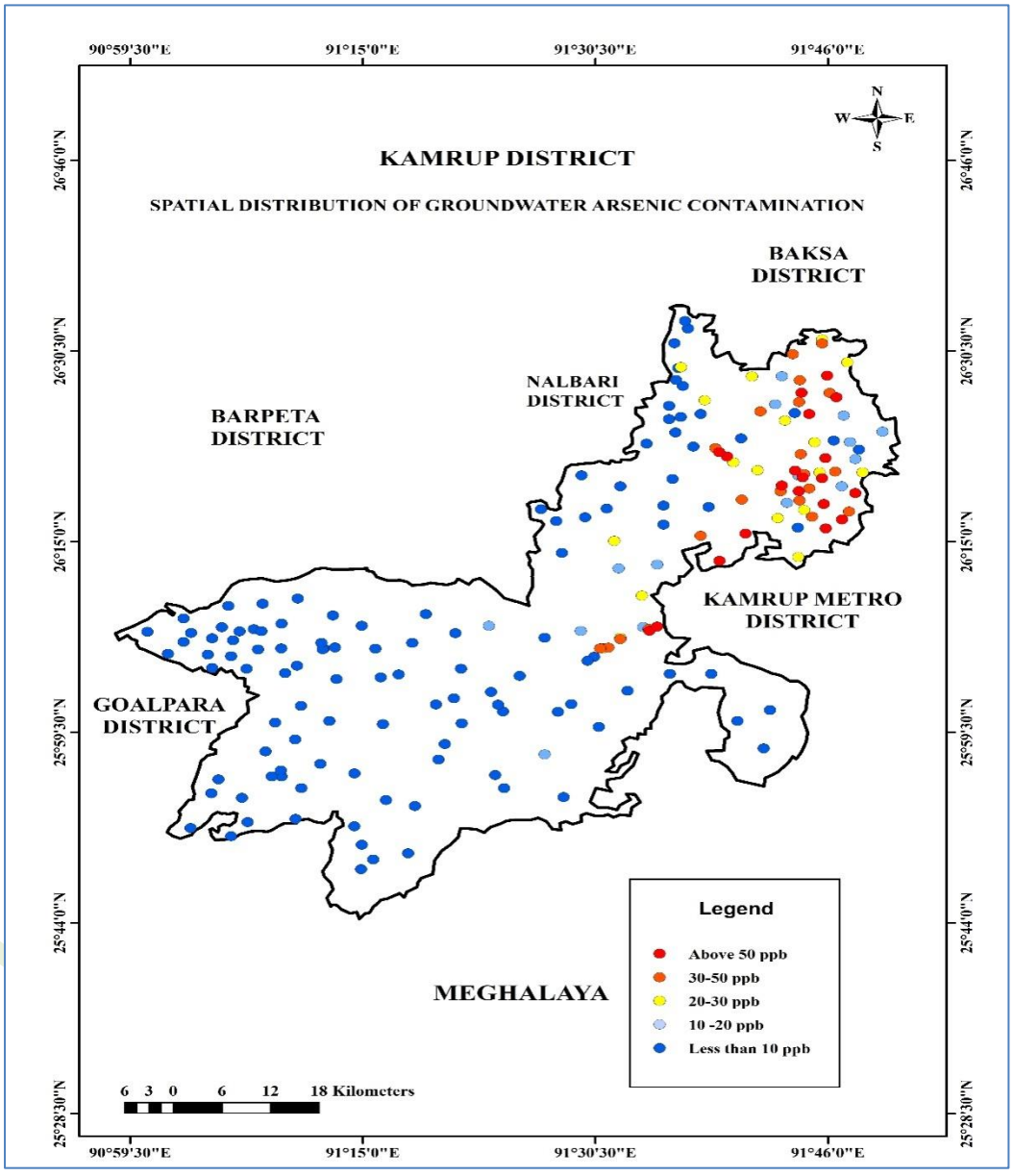
## IV. Resultss and Discussion:

### Spatial distribution pattern of Groundwater arsenic contamination in Kamrup district of Assam

Following figure will show level of arsenic in different tube well samples

3.




**Spatial distribution of groundwater arsenic contamination in Kamrup District**

## Level of groundwater arsenic contamination

Groundwater arsenic contamination in Kamrup district of Assam has been studied with the help of tube well water samples. Water samples for different tube wells have been collected and tested in Tezpur University laboratory to know the value of arsenic contamination in groundwater.

**Table 1: Level of Groundwater arsenic contamination in different tube wells**

| Serial | Arsenic in ppb | Number of | Per cent of |
|---|---|---|---|
| 1 | Less than 10 | 116 | 61.05 |
| 2 | 10-20 | 15 | 7.89 |
| 3 | 20-30 | 18 | 9.47 |
| 4 | 30-50 | 21 | 11.06 |
| 5 | Above 50 | 20 | 10.53 |
| Total | | 190 | 100 |

**Source: Primary survey, 2024**

Groundwater arsenic contamination in Kamrup district has been mapped by considering the WHO standard. Number of tube wells above WHO maximum permissible limit i.e. 10 ppb is counted and the percentage value of arsenic contaminated wells to the total sampled tube wells are calculated and classified into five classes. Table depict that about 61.05 per cent of the total sample tube well points are safe and less than 10 ppb. About 38.5 per cent sample tube well points are contaminated with arsenic more than WHO limit. Out of the total sample tube well points 7.84 per cent tube well point have arsenic contamination between 10 to 20 ppb. About 9.47 per cent tube well points have arsenic contamination between 2o to 30 ppb. Another 11.06 per cent tube well sample points have arsenic between 30 to 50 ppb. Almost 10.53 per cent tube well has been identified with arsenic concentration above Bauru of Indian Standard (BIS) limit i.e. 50 ppb. The level of arsenic concentration varies in magnitude to great extent.

### 2.1 Extent of Contamination

A study by Chakrabarty (2011) assessed the heavy metal concentrations in drinking water sources across Kamrup District. While arsenic levels were found to be slightly elevated, they did not exceed the World Health Organization's (WHO) permissible limit of 10 µg/L. However, the presence of

other heavy metals like cadmium, manganese, and lead in significant concentrations raised concerns about the overall water quality.

Further investigations revealed that certain areas within Kamrup District, particularly those situated along the Brahmaputra River's floodplains, exhibited higher arsenic concentrations. These regions are more susceptible to arsenic leaching due to the dynamic nature of the river's sediment deposition and groundwater recharge processes.

### 2.2 Sources of Arsenic

The primary source of arsenic contamination in the Brahmaputra Valley is geogenic, stemming from the natural dissolution of arsenic-bearing minerals in the aquifers. The region's geology, characterized by the presence of ferrous-rich sediments, facilitates the mobilization of arsenic into groundwater sources. Additionally, anthropogenic activities, such as the over-extraction of groundwater for irrigation and industrial purposes, exacerbate the problem by reducing the dilution capacity of aquifers.

## 3. Health Implications of Arsenic Exposure

### 3.1 Acute and Chronic Effects

Long-term exposure to arsenic-contaminated water has been associated with a range of health issues. Acute effects include nausea, vomiting, and abdominal pain, while chronic exposure can lead to more severe conditions such as skin lesions, respiratory problems, and neurological disorders.

### 3.2 Carcinogenic Risks

Arsenic is classified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC). Prolonged ingestion of arsenic-contaminated water has been linked to an increased risk of skin, lung, and bladder cancers. In Kamrup District, several cases of arsenic-induced cancers have been reported, underscoring the urgent need for effective mitigation strategies.

### 3.3 Cardiovascular and Metabolic Disorders

Recent studies have indicated that arsenic exposure may also contribute to cardiovascular diseases, including ischemic heart disease, even at levels below the WHO's permissible limit. A study conducted by Columbia University highlighted the heightened risk of cardiovascular diseases in populations exposed to arsenic-contaminated drinking water in Assam.

### 4. Disease Patterns in Kamrup District

Epidemiological studies in Kamrup District have observed a higher prevalence of arsenic-related diseases compared to other regions. Skin lesions, characterized by pigmentation changes and keratosis, are among the most common manifestations. Additionally, there has been an uptick in cases of lung and bladder cancers, particularly in areas with elevated arsenic concentrations. The district's healthcare infrastructure, though improving, faces challenges in diagnosing and treating these conditions due to limited resources and awareness.

### 5. Mitigation Strategies

#### 5.1 Water Quality Monitoring

Regular monitoring of groundwater sources is essential to detect arsenic contamination early. Establishing a comprehensive database of water quality parameters can aid in identifying high-risk areas and implementing targeted interventions.

#### 5.2 Public Awareness Campaigns

Educating the local population about the risks of arsenic exposure and promoting the use of alternative water sources, such as rainwater harvesting and surface water treatment, can significantly reduce health risks.

#### 5.3 Technological Interventions

Implementing cost-effective arsenic removal technologies, such as activated alumina filters and reverse osmosis systems, can provide safe drinking water to affected communities. Collaborations with research institutions and NGOs can facilitate the dissemination of these technologies.

#### 5.4 Policy and Regulatory Measures

The government should enforce stringent regulations on groundwater extraction and promote sustainable water management practices. Incentivizing the adoption of arsenic-safe technologies and ensuring equitable access to clean water are crucial steps toward mitigating the crisis.

## V. Conclusion:

Arsenic contamination in drinking water poses a significant public health challenge in Kamrup District, Assam. While the concentrations in some areas are below the WHO's permissible limit, the

cumulative exposure over time has led to a discernible increase in arsenic-related diseases. A multifaceted approach involving rigorous monitoring, public education, technological interventions, and policy reforms is imperative to address this issue effectively. Protecting the health of the population requires a concerted effort from all stakeholders, including government agencies, research institutions, and local communities.

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