CHAPTER-9
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Conclusion

As the world's population has reached seven billion, one of the most fundamental resources of human survival, clean water, is decreasing. The rising demands for drinking water often cannot be met by surface water supplies. This has led to increased dependence on groundwater resources in many parts of the world. The recent increased groundwater utilization has caused new health issues, mainly due to the presence of various geogenic toxic inorganic pollutants such as arsenic and fluoride. The case of arsenic in groundwater in southern Asia has become a classic example of the risks of groundwater contamination, the human health consequences of failing to monitor groundwater quality, and the failure of governmental organizations at all levels to protect the public from water quality problems.

The present study highlighted the detailed groundwater quality of Nalbari district, Assam. The water sources selected for the study have been in use for a long time for meeting the drinking and other purposes in this region. WHO and Bureau of Indian Standards (BIS), has recommended the quality standards for drinking water and these have been used for finding the suitability of ground water. pH in the study area is seen to be within permissible limit. The high turbidity of the tube well water may be due to the presence of high iron concentration. DO is generally seen to be low throughout the study area. Electrical conductivity is found to be within permissible limit and there exist very strong correlation between EC and TDS. In all the seasons the concentration of Ca, Mg, Na and K is found to be within permissible limit. Calcium is the dominant element in the study area. All the anions HCO₃⁻, Cl⁻, F⁻, NO₃⁻, SO₄²⁻, PO₄³⁻ were within permissible limit for all the seasons. Bicarbonate is the dominant anion of the study area. The dissolved organic matter may be an active source for bicarbonate in groundwater. Iron and manganese are seen to be high in the study area. The iron content was found to be high in all the water samples and it is seen that all the households of the study area had a sand filter arrangement. The degree of microbiological contamination was low in most of the tubewell water. It is earlier
reported that tubewell water is generally less affected by bacterial contamination and hence preferred over surface water for drinking purpose. The hydrochemical facies reveals Ca-Mg-HCO₃ type of water in the study area. Gibbs plot indicates that the ion chemistry in the region is mainly controlled by source rock dominance.

Groundwater arsenic contamination continues to be a major challenge confronting humanity due to its widespread health threats. Arsenic contamination of groundwater in diverse environments is common and widespread with reported studies from different parts of the world. It has been estimated that parts of all the states and countries surveyed in the Ganges Brahmaputra Meghna floodplain(GBM), which has an area of approximately 500,000 km² and an approximate population of 500 million, are at a risk from groundwater arsenic contamination. Assam which lies in the GBM plains has also reported of high arsenic concentration in some of the district. The groundwater table in the study area is rather shallow and the investigated tubewells were within 50 meters depth. The arsenic concentration in the study area ranged between 1.2 μg/L to 211 μg/L. It is seen 13 samples (26%) of the groundwater samples exceeds 50 μg/L during both the seasons. Again 24 samples (i.e 48 %) during post monsoon 2008 and 35 samples (i.e 70 %) during the pre monsoon exceeds the WHO guideline of 10 μg/L. It is suggested that reductive dissociation of Fe-oxyhydrates might be the dominant process in leaching out of arsenic into groundwater in the study area.

Fluoride is found more frequently in different source of water, with higher fluoride concentration found in groundwater due to presence of fluoride bearing minerals. The F⁻ concentration is Nalbari district ranges between 0.1 mg/L to 1.4 mg/L. None of the samples exceeds the WHO guideline of 1.5 mg/L. Most of the samples are seen to be deficient in fluoride content.

The suitability of the groundwater for drinking purpose was determined with the aid of Water Quality Index (WQI). It is observed that 16% of the samples are of excellent category, 54% are good, 16 % are poor and 14% are very poor. The study revealed that the groundwater of a few locations are unfit for drinking due to high arsenic concentration. Long term consumption of such water without prior treatment may have risk of skin lesions and other symptoms of arsenic related diseases in the study area. The condition of the water for irrigation purpose was determined by using
various factors. USSL salinity diagram reveals that the water was appropriate to be used for irrigation purposes.

Shallow aquifers in Nalbari district are reported to be contaminated with arsenic above the WHO permissible limit of 10 μg/L. The district is endowed with reasonable amount of surface and groundwater. Plentiful surface water resource of Pagladia river can be a potent alternative water source for the region. Another source of water in Assam is rainwater, which is available in adequate quantity in the monsoon. Dug wells and deep tube wells are also reported to be free from arsenic contamination and can be used for drinking water purpose after treatment for bacteriological contamination.

Social survey data reveals that arsenic awareness is currently not widespread in the study area, particularly in the low arsenic risk region. There are also gaps in arsenic knowledge regarding the diseases caused by arsenic poisoning and mitigating measures available to prevent contamination. The viral and bacterial pathogen are made accountable for the disease burden. Majority of the respondents have not heard of arsenic. In the high risk area only half the population knew about arsenic poisoning but did not have any knowledge of the consequences of its consumption. Unlike Bangladesh where importance is given on public awareness, it is seen that in Assam, the local media, TV and radio were not very active in wide spreading the health effects of arsenic in a massive way. Till date no detailed medical survey of the population in the study area has been conducted and emphasis was never given on such medical surveys.

As it is impossible to remove arsenic by boiling or by the use of normal filters, the most challenging task before the water authorities is to provide arsenic free drinking water to the rural population. Good data and ongoing monitoring are the cornerstones of an effective effort to improve the water quality. Public awareness regarding arsenic health effects is a must to prevent the people from using tube wells with high concentrations of arsenic.