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BREIF DETAILS OF GROUND AND SURFACE WATER QUALITY IN NORTH EASTERN REGION OF INDIA

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ABSTRACT
The rising salinity of groundwater used for water supply and irrigation is a major problem. Indiscriminate use of fertilizers in certain areas has resulted in very high concentrations of some of the chemical constituents in groundwater. North East region of India is highly diverse with hilly terrain and has abundant natural resources like forest, water, tea, oil and gas, coal, limestone Uranium etc. The region is witnessing significant fast rate of development of hydropower and industries. Therefore, change in the pattern of utilization of resources in this ecologically sensitive region and changes in lifestyles, culture, farming activities etc. are exerting pressure on the ecosystem. Activities like road building, urbanization, industry and hydel power projects form part of major developmental agenda of the NE region. The data presented in this paper show that groundwater quality in states of NE region has been affected by geogenic contamination from constituents like As, F, and Fe, and the concentration in many areas is beyond the permissible limits. The monitoring results indicate that lakes, tanks and ponds in the NE have reduced water quality. The water conservation and related management issues of the region and the legislative provisions that address the issues of water management, conservation and control of pollution are discussed.

Key words : Ground Water, Arsenic, Industries, Pollution.

INTRODUCTION

Water, the important element the survival on mother earth, has become one of the upcoming ecological issues our ecosystems are confronting nowadays. Concerns regarding the accessibility of water, quality, and quantity are the three main vital pillars that affect the standard of life on the planet as a whole. The assessment of the world's reservoirs of water might alert us to impending issues. Global communities of nature face challenges due to water crises, as water issues are included in the agenda twenty-one goals of the United Nations Environmental Programme.

The National Commission for Incorporated Water Growing has shown that a person's share of water varies from around a wavelength of cubic meters per person per year in basins like Sabarmati River catchment area to exceptionally large quantities in Brahmaputra region catchments, with a national average of about two thousand cubic meters per person per year. India's water sheds and bodies are highly unevenly split within the basins. It is anticipated that India will fall into one of the nation's experiencing a water deficit before 2035.

Groundwater is becoming an important source of water supply in many regions since there has been a tremendous increase in the demand for fresh water due to growth in population. The rapid growth of urban areas has adversely affected the groundwater quality due to over exploitation of resources and improper waste disposal practices. The rising salinity of ground water used for water supply and irrigation is a major problem. Therefore it is absolutely necessary to ascertain the potability of water before it is used for human consumption. Functioning of the ecosystem depends on water which is essential for life. Millions of people around the world face water shortage. The United Nations General Assembly declared the years 2005 to 2015 as the International Decade for Action 'Water for Life' to promote efforts to fulfil international commitments of the Millennium Development Goals which aim at reducing by half the proportion of people without access to safe drinking water and to stop unsustainable exploitation of water resources. The water for life decade coordinated by 'UN-WATER' was launched on 22nd March 2005. The World Summit 2002 in Johannesburg also adopted for developing integrated water resource management and water efficiency plans by 2005 and to halve the proportion of people who do not have access to basic sanitation by 2015, thus providing access to the poor people and ensuring the participation of women. The themes of 'Water for Life' Decade aimed to address the issues of scarcity, access to sanitation and health, water and gender, capacity- building, financing, valuation, Integrated Water Resources Management, trans-boundary water issues, environment and biodiversity, disaster prevention, food and agriculture, pollution and energy . World Water Day is celebrated each year on 22nd March emphasizing on worldwide need for increased integration and cooperation to ensure sustainable, efficient and equitable management of water resources.

Water, being a natural resource plays an important role in the socio- economic development processes and therefore, sustainable development and management of water is needed for meeting the requirement of energy, drinking water, and irrigation etc. The surface and ground water pollution, lowering of ground water table and depletion of discharge in water springs, siltation in lakes, reservoirs and ponds, salinization of croplands, etc are the commonly noticed problems.

Table-1
Water Resources at a Glance in India

S. No.	Parameters	Quantity(Cu.Km)
1.	Annual Precipitation Volume (Including snow fall)	4000
2.	Average Annual Potential flow in Rivers	1869
3.	Per Capita Water Availability (1997)	1967
4.	Estimated Utilizable Water Resources	1122
	(i) Surface Water Resources	690Cu.Km.
	(ii) Ground Water Resources	432Cu.Km.

In various policies and programmes, concerns have been shown to conserve our water resources, in addition to preservation of our natural environment and alleviation of poverty and hunger. Water quality is becoming an important as well as emerging vital issue in India. Unequal distribution over varied regions results in water scarcity and unsuitability with respect to water quality (CPCB 2008a). Table 1 provides the water scenario at a glance in India (Upadhyay and Rao, 2007). Apart from the moderate to severe water shortage in India due to urbanization and industrialization (CPCB, 2010), the country is facing the issue of depleting water quality. The National River and Lake conservation plans, creation of Central Ground Water Authority and programmes for inter linking of rivers in the country are a few programmes towards integrated water resource management. River Valley projects are being taken as multipurpose reservoir project and the stored water is utilized for power generation, development of irrigation and water supply networks to town and cities (Upadhyay, 2004; Saio et al., 2017). North East (NE) region of India comprises of hills and plains on both sides of the river Brahmaputra and the Himalayan range around it.

Table-2
Drinking water standards for Arsenic(As), Fluoride(F), and Iron(Fe) stipulated by different agencies

Constituent	Drinking Water Standard				
	BIS2012 (mg/L)		WHO, 2011 (mg/L)	USEPA (mg/L)	EU guideline (mg/L)
	Acceptable Limit	Permissible Limit			
Arsenic	0.01	0.05	0.01	0.01	0.01
Fluoride	1.0	1.5	1.5	4.0	1.5
Iron	0.3	No relaxation		0.3	0.2

With abundant natural resources like forest, water, tea, oil and gas, coal, limestone and Uranium etc., the region is highly diverse and is witnessing significantly fast rate of development of hydropower projects and industries. The region is surrounded by the international boundaries of four countries and is ecologically sensitive; therefore, change in the pattern of resource utilization and changes in lifestyles, culture, farming activities etc. will exert pressure on the ecosystem. The states of the northeast region are privileged by the provisions of Schedule VI of the constitution of India and have different property laws. The culture, ethnicity and traditions of the people have inbuilt system for protection and management of ecosystem, as they follow certain natural strategies and principles to protect the ecosystem. The developmental activities like road building, urbanization, development of industries (mining, oil and gas exploration, power etc.) and hydel power projects form part of major developmental agenda for NE region. North East India has varied topography and climatic conditions which vary from tropical to temperate and alpine depending upon elevation. Flood plain areas have very different water regime, storage and utilization practices compared to hilly regions. Several areas in the NE are suffering from water scarcity and pollution including water depletion and contamination. The present paper highlights the water conservation and management related issues of the region and the legislative provisions that address the issues of water management and conservation and control of pollution.

Table3
Number of Environmental Clearances (EC) given to Drilling and Petrochemical projects in the North East States

Sl. No.	District (Project)	No. of EC
ARUNACHALPRADESH (Exploratory Drilling)		
1	Changlang	3
2	Ningru	2
3	Lohit	1
ASSAM (Exploratory Drilling)		
1	Golaghat	9
2	Jorhat	5
3	Sivasagar	10
4	Karimganj	1
5	Cachar	9
6	Hailakandi	1
7	Dibrugarh	7
8	KarbiAnglong	1
9	Sonitpur	1
10	Tinsukia	14
11	Duliajan	1
12	DimaHasao	1
13	Nagaon	1
14	Dhemaji	1

15	Morigaon	1
ASSAM (Refinery and Petrochemical)		
1	Digboi Refinery (Tinsukia)	6
2	Numaligarh Refinery (Golaghat)	9
3	Bongaigaon Refinery	8
4	Guwahati Refinery (Kamrup)	4
5	Lepetkata + Assam Petrochemical (Dibrugarh)	2+1=3
TRIPURA (Gas exploration and Production)		
1	Khowai	1
2	South Tripura	4
3	West Tripura	8
4	North District	3
MANIPUR (Refinery)		
	West Imphal	2
MIZORAM (Exploratory Drilling)		
1	Aizawl, Lunglei, Mamit, Sechhip	1
2	Kolasib	1
1	NAGALAND (Mining)	1

Groundwater Quality: Groundwater plays an important role in supply of drinking water throughout the world. Although only 0.9% of the total water supply on the earth comes from the groundwater, it is the preferred source of drinking water and acts as the main supplier of drinking water in rural areas and supplementary supplier in urban areas in India (CGWB, 2014). Groundwater contributes to both drinking water (80%) and agricultural needs (50%) in rural areas. More than half of the total irrigated areas and around 70-80% of the total irrigated areas in India are dependent on ground water (Dains and Pawar, 1987). Groundwater is a critical resource for the socioeconomic development of the country, catering to domestic, irrigation and industrial sector. In recent years, concerns have aroused due to depleting resources (dried wells and lowering of water levels in the aquifers) along with deteriorating groundwater quality impacting the rural water demand and supplements in urban areas (CGWB, 2014). Ground water quality is dependent on the varied geological formation, hydrogeological condition, climatological and topographic settings, type and depth of soils and rock-water interaction. In addition, impact due to anthropogenic activities, such as, industries, urban sewage and waste landfills, mining, atmospheric contribution and composition of surface water bodies also influence the groundwater quality (CGWB, 2010). Groundwater becomes non-potable when the ingredients present in water exceed the prescribed desirable limits. In India, most widely used standard for drinking water quality is the Bureau of Indian Standard: IS 10500-2012.

Other international guidelines are: 1) World Health organizations (WHO) Guidelines 2011) European Union (EU) guidelines and 3) U.S. Environmental Protections Agency (USEPA) Guidelines. The permissible limits for the three contaminants which have significantly affected the water quality of NE region are given in Table 2. These contaminants will be discussed in the present review article.

Contamination of Groundwater in the NE Region: People of NE mainly depend on natural springs, rivers, ponds and dug wells for their freshwater requirement. With many springs becoming seasonal, most of the domestic water requirement is being fulfilled from groundwater through shallow and deep tube wells (Bordoloi, 2012). The contamination of groundwater with Arsenic (As), Fluoride (F), Iron (Fe) and Nitrate deeply affects the overall domestic water requirement of the NE people.

Arsenic Contamination in North East India : High As concentration is found in groundwater in the unconsolidated aquifers along the alluvial and deltaic plains of southern, south-eastern and eastern region of Asia with the problem being aggravated since the densely populated area is dependent on the shallow aquifer as their source of drinking water (CGWB, 2014) and approximately 40 million people are within the risk zone of As contamination (Acharya, 2005;, Saha, 2009). After the first groundwater contamination was detected in 1983 (west Bengal), several states including Assam and Manipur (Brahmaputra and Imphal river flood plain)

have been detected with As concentration of 50-986 µg/L (Das et al., 2015). In another study, As content was detected in water samples collected from 137 hand pumped Tube wells from different parts of Assam with a maximum concentration of 490 µg /L (Chakraborti et al., 2004).

Industries in North East India and their implication on Arsenic Concentration: With the economic progress being closely linked to energy demand, the need for oil and gas will also grow considerably. As per the Vision 2030 report, it is proposed to increase oil and gas production in NE India. The exploration activities, expansion of piped natural gas (PNG) network, and LPG distribution system reaching even the remote areas are on the increase (Vision, 2030). Table 3 provides the details of the exploration and drilling projects and oil refineries in the NE states. Some exploration projects overlap with districts that have high As concentrations. Similar is the case for Manipur and Tripura, (Table 3). Arsenic and other trace elements are found in oil and other fossil fuels, with their concentration depending on the source (Cozzarelli, et al., 2016). Analysis of 23 crude oil samples have shown arsenic concentration in the range 10 and 37 µg/L (Stigter et al., 2000). Though reports suggest that in petroleum hydrocarbons, As is not a major contaminant; perturbation to the existing naturally occurring As geochemistry by induction of biodegradable organic carbon including petroleum hydrocarbons may result in mobilization of naturally occurring As, and increase in ambient As level (Brown et al., 2010). Soluble hydrocarbons may stimulate biological activity, resulting in the degradation of dissolved hydrocarbon. According to Brown et al.(2010), Arsenic will regress to its pre-existing geochemistry with concentration that is above or below the maximum contaminant level once the petroleum hydrocarbon is attenuated. Given the fact that the exploration drilling projects in NE India are in the areas that have high As concentration, proper management with due consideration for the specific site As geochemistry is required in all exploration and oil refinery projects.

Fluoride (F) Contamination in North East India: Globally 65% of endemic fluorosis is caused by fluoride contaminated drinking water (Felsenfeld and Robert 1991). In India, more than 40 million are impacted by dental fluorosis (Karthikeyan et al., 2005). Subarayan et al (2012) reported that 50% groundwater resources in India is contaminated with fluoride. Various factors such as temperature, pH, precipitating ions and colloids, solubility of fluorine bearing minerals, anion exchange capacity of aquifer minerals, contact time between water and geological formations, along with the size and type of geological formations traversed by water affect the fluoride dynamics (Apambire et al., 1997). Concentration higher than 1.5 mg/L has been observed to cause serious health problems such as stiffness of the back and difficulty in performing natural movements at higher concentrations (such as 5.0-10.0 mg/L) (CGWB, 2010).. Groundwater analysis of 75 samples from 32 villages and 8 towns of Karbi- Anglong and Nagaon districts of Assam revealed fluoride levels above 1.0 mg/L in 43 samples (Chakravarti et al., 2000). Hasne et al (2019) reported high concentration (1.63 g/L to 3.25 mg/L) of F in 4 out of 8 studied blocks with no uniformity in F concentrations in the water samples. The authors also concluded that high F concentration was due to the F-rich minerals in the zone. Occurrence of dental fluorosis (31%) and skeletal fluorosis (1.7%) among 2063 people from 8 villages in Karbi - Anglong district has been reported by Chakravarti et al (2000). Hasne et al. (2019) reported high non- carcinogenic risk from elevated F contaminated drinking water in both adult and children.

Regulation on Management of Groundwater: Ground water (GW) is the most precious and essential component of water resource for sustenance of life. Recent pace of development as well as need of the people, especially of the urban population has threatened the availability of the precious groundwater. Since GW is not an inexhaustible resource of fresh-water, a balance between discharge of GW and recharge must be maintained. Indiscriminate drilling of tube- wells and excessive drawl is lowering the water table. In the absence of substantial vegetation cover, rainfall is not arrested, as a result the precipitation rushes straight down to the rivers and eventually to the sea, without sufficiently recharging the ground-water. Deforestation and consequent decline in forest cover is also contributing to lowering of the water table in addition to anthropogenic harvesting of the resource. Central Ground Water Authority (CGWA) has been constituted by the Ministry of Environment & Forests with a specific mandate for regulation and control of GW management and development of the country (Upadhyay, 1998). CGWA shall also regulate indiscriminate boring and withdrawal of ground water in the country and issue necessary regulatory directions with a view to preserve and protect ground water under this Regulatory Act and notify an area or such areas where there is over exploitation, pollution, salinity, hazard

etc., The jurisdiction of the Authority shall be the whole of India. The Authority functions under the administrative control of the Ministry of Water Resources. The Central Ground Water Board / Authority takes up regular monitoring of ground water resources and awareness programmes on water management in the country. The CGWA is delegated with powers under Section 5 of the Environment (Protection) Act, 1986 for issuing directions and taking such measures in respect of all the matters referred to in sub-section (2) of Section 3 of the said Act.

CONCLUSION

The pollution of drinking water sources needs to be immediately tackled. Participation of local voluntary organizations, the district authorities and village panchayats will help CGWA to identify the problem areas and to take appropriate action for management of groundwater development. All development projects like industries, mining and housing in the NE region may be prohibited to harvest groundwater resources from critical areas. All industrial discharges must meet the prescribed norms. Zero effluent discharge from industries and surface water harvesting must be made mandatory in these areas. All concerned urban authorities should enforce Rain Water Harvesting and Recharge schemes for housing projects. The problem of GW depletion and pollution can be controlled with the help of the public and with strict enforcement of legal instruments. Severe penalty for defaulters and incentives for those who care and conserve the natural resources will be an effective approach. Long term plan for control and management of rainwater, surface water, and GW and appropriate measures to conserve soil moisture to increase water availability to crops is required to meet the demand of human population, agriculture and industries by using efficient technologies and the best practices.

REFERENCES

- Acharya, S.K. (2005). Arsenic trends in groundwater from Quaternary alluvium in Ganga plain and Bengal basin, Indian subcontinent: insights into influences of stratigraphy. Gondwana Research. 8, 55-66.
- Saio, V., Tynsong, H., Quazi, S.P., Upadhyay, V.P. and Aggarwal, S.K. 2017. Environmental Compliance in River Valley Projects of North East Indian Region. Pleione 11(2):455-461.
- CPCB 2019 b. Water quality of Medium and Minor Rivers 2019 (State wise). National water quality program (NWMP)
- Dutta, J. 2013. Fluroide, Arsenic and other heavy metals contamination of drinking water in the tea garden belt of Sonitpur district, Assam, India. International Journal of Chem Tech Research, 5(5) : 2614-2622.
- Hanse, Amar & Chabukdhara, Mayuri & Baruah, Sunitee & Boruah, Himangshu & Gupta, Sanjay. 2019. Fluoride contamination in groundwater and associated health risks in Karbi Anglong District, Assam, Northeast India. Environmental Monitoring and Assessment. 191. 10.1007/s10661-019-7970-6.
- Subarayan BG, Viswanathan Gopalan, Siva IS. 2012. Prevalence of fluorosis and identification of fluoride endemic areas in Manur block of Tirunelveli district, Tamil Nadu, South India. Appl Water Sci 2:235–243
- Upadhyay, V. P., Quazi, S. P., and Tynsong, H. 2018. Environmental management in cement and limestone mining projects industries of Meghalaya. Indian Mining and Engineering Journal 57(2):31-33
- Upadhyay, V.P., 2004. Environmental issues in large dams and hydro power. In: Proceedings of Conference on large dams and hydro power development. CBIP, New Delhi. pp. 81-88.
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