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Safe drinking water status in the state of Bihar, India: Challenges ahead

D.S. Mishra, India

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Water is a precious resource gifted by nature for the human well being. But its contamination whether chemical or fecal is a challenge for the water supply agencies in providing safe drinking water especially to the rural community. It is a known fact that safe drinking water is essential for healthy living yet millions of people on the earth are deprived of it. Deterioration of ground water quality in recent years due to various human as well as geogenic activities is a threat to humanity especially in rural areas in plains as it is the only available water source within their reach. The governments are struggling to provide adequate safe water to all rural habitations. Depletion of water table in many areas resulting in emergence of chemical impurities like Arsenic and Fluoride in water is making it unsafe whereas water in high water table zone are bacteriologically unsafe. Bihar one of the largest states of Indian Republic with high groundwater potential is facing a serious water quality problem .This paper is a case study and attempts to identify the steps to improve the rural health through safe water supply

Introduction

Safe Drinking Water Supply remains a cause of concern for the governments and the water supply agencies through out the world but this task is more challenging in developing and under developed countries especially in rural area. The concept of 24x7 water supply is being adopted for ensuring safe water in many countries where as the rural population in developing countries are struggling for a bare minimum required quantity of safe drinking water for their survival.

In India groundwater is playing a pivotal role in fulfilling the demands of domestic, industrial and agriculture sectors. The rural drinking water supply is mainly dependent on groundwater.

During last few decades emphasis was on coverage of rural habitations in terms of water supply. In terms of physical progress, the achievements have been remarkable and almost all the habitations have been now covered. Now sustainability of the source and the system along with poor quality of water have been emerged as a great threat in providing safe and regular supply to all habitations. Unfortunately poor environmental sanitation and unsafe drinking water has been the major health problem. Water and sanitation related infections and diseases of the alimentary tract constitute 60% to 80% of the illness. Many of them such as diarrhea, dysentery, typhoid fever, intestinal helminthiasis, jaundice, cholera are endemic in rural areas.

It is estimated that in India alone, 1.5 million children below 5 years die from diarrhoeal disease every year. Despite advancement in the medical sciences morbidity and mortality due to water and excreta related communicable diseases continue to remain a heavy burden for the governments.

Bihar: A brief profile

Bihar is the third largest state of Republic India having population over 86 million. 89% of its population resides in rural area. The brief profile of Bihar state is given in Table 1.

Table 1.

Latitude	21°-58'-10" ~ 27°-31'-15" N
Longitude	82°-19'-50" ~ 88°-17'-40" E
Total area	94,163.00 sq. kms
Height above sea-level	173 feet
Avg. number of rainy days	52.5 days in a year
Districts	38
CD blocks	534
Panchayats	8,471
Number of revenue villages	45103
Number of habitations	105303
Urban agglomerations	9
Towns	130
Key statistics	
Population(2001)	82,878,796
Population density(persons per Sq Km)	880
Literacy	47.53%
Infant mortality rate	67
Maternal mortality rate	452

Sources: Directorate of Economics and Statistics, GoB 2003;Census of India 2001.

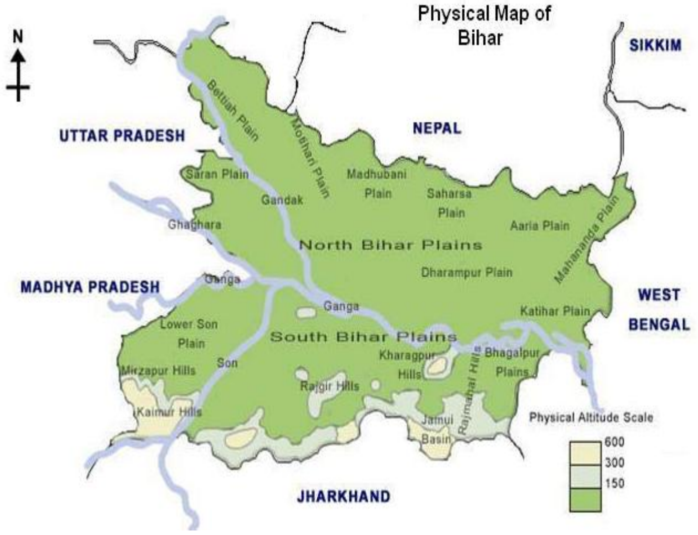

Figure 1. Physical map of Bihar

Geology

Geologically, Bihar represents the extreme northern front of Indian subcontinent.These includes (i) the belt of Himalayan foothills in the northern fringe of Paschim Champaran (ii) the vast Ganga Plains, (iii) the Vindhyan (Kaimur) Plateau extending into Rohtas region, (iv) the sporadic and small Gondwana basin outliers in Banka district, (v) the Satpura Range extending into large part of the area North of Chotanagpur Plateau, (vi) the parts of Bihar Mica belt in Nawada, Jamul and Banka districts and (vii) the Granite Gneissic complex of Chotanagpur plateau. Nearly two third of Bihar is under cover of Ganga basin compossed of alluvium and masks the nature of basement rocks.

Water resources

Bihar is blessed with abundant surface and ground water resources that are sufficient to cater to demands for various end uses. The state receives average rainfall of 1250-1350 m but 87% of this precipitation is limited to three monsoon months. Water table in the state varies from as low as 5M in the North Eastern region to 20M in the Southern districts. Bihar lies in the transitional climate zone between humid West Bengal in the east and sub humid Uttarpradesh in the west.Recurrent floods are a serious problem in Bihar.These can render about 9.4 lakh ha water logged and affect as much as quarter of the population in some years.

Hydrology

Hydrogeologically, the various litho-units of the State can be grouped as unconsolidated / Alluvial formation; semi-consolidated formations and consolidated/fissured formations. The main alluvial tract covers entire north Bihar and a sizeable area south of the Ganga River. These alluvial formations constitute prolific aquifers where the tubewell can yield between 120-247m3/hr. The potentiality of these aquifer decreases due south in the marginal tract. Auto flow conditions occur in the sub-Tarai region of Madhubani, Sitamarhi and West Champaran districts. In the hard rock areas of South Bihar, borewells located near lineaments/fractures can yield between 10-50 m3/hr.

Groundwater exploration/sources findings

Table 2.	
Dynamic resources	
Annual replenishable ground water resource	29.19 BCM
Net annual ground water availability	27.42 BCM
Annual ground water draft	10.77 BCM
Stage of ground water development	39 %
Developmental nonitoring	
Over exploited	NIL
Critical	NIL
Semi-critical	NIL

Water supply status

It is the responsibility of the State Government to provide safe drinking water to its people . Till last decade coverage of habitations was the priority of the government. Safe water and other related issues like sanitation and hygiene have been not taken care of. The rural population of the state is served by public as well as private hand pumps (India Mark III and shallow well handpumps).The nos of Govt handpumps in the state is more than 800000 in addition to over 700 rural piped water supply schemes. The contribution of private handpumps in water supply is also significant as they are quite high in numbers. The accessibility of drinking water is easy due to groundwater availability at low depth. In terms of quantity , the average population served per source is 110 against the Government of India norms of 250 persons per source. A study by STEM (2000-2001) reported that shallow handpumps constituted by 87 percent of the total stock, while deep tubewells constitute 12 percent.

The major problem in the sector is to ensure adequate, safe and uninterrupted availability of water and adequate sanitation facilities. Due lack of knowledge and low affordability, the private water sources are mostly shallow in nature hence there is high risk of fecal contamination. Lack of adequate sanitation facilities and hygiene practices makes the situation more critical. The sanitation coverage in rural areas is only 14%, hence the task of providing safe drinking water becomes more challenging. The recurrent floods poses significant challenges to rural water supply and sanitation service delivery in large parts of the state. This not only interrupts service delivery during the floods but also causes damage to RWSS infrastructures and has heavy health implications during and after the recession of floods.

Sustainability of sources and the water supply system is also a key issue in maintaining regular supply of drinking water. The aging of the water supply assets, their timely replacement and regular maintenance of the water supply assets, minimising the down time of the water supply system are the major area to be addressed.

Water quality status

Even after being rich in water reserves, the summer is water stressed in the southern part of the state and during rainy season floods in the northern Bihar drinking water becomes unsafe due to fecal contamination causing increase in incidents of diseases like diarrhea, dysentery, typhoid fever, intestinal helminthiasis, jaundice, cholera etc. The emergence of chemical contamination in the ground water also posing challenges in providing safe drinking water.

The state Government recent findings of the water quality mapping of the whole state (226145 samples were tested during November 2007- February 2008 , covering all the 38 districts) indicates that the drinking water sources in rural areas are not safe in most of the area and the health of the rural population is at risk. Out of the 38 districts, water sources of 1750 habitations of 80 blocks in 13 districts situated along the river Ganges are partially affected by arsenic contamination(As >50 ppb) whereas the drinking water sources of 6373 habitations of 22 districts are affected with excess Fluoride (>1.5 ppm) and presence of excess iron in groundwater is in majority of the districts. Apart from chemical impurities fecal contamination of water is prevalent in many water sources. (Envirotech Report 2008). It was found in Arsenis affected areas that the water of open wells are safer in respect of Arsenic. The Deep tubewells (Depth > 125M) are yielding Arsenic free water whereas in fluoride affected areas the fluoride content is increasing with depth.

Mitigation measures

In Arsenic affected area, sanitary dug wells are being constructed for immediate short term measures, Multi village piped water supply schemes using surface water is being implemented in few districts. Deep tubewells are also adopted as one of the alternate options.

In Fluoride affected area domestic fluoride removal filters are being distributed as a short term measures. As long term measure community water supply schemes with solar powered motor and pumps and adsorption based treatment units are being constructed. Apart from that the contaminated water sources are marked red to make people aware of the quality problem in the water source.

Extensive IEC activities and awareness programmes are being organized at District, block and Panchayat level all over the state to educate the rural masses. The grass root workers are being given training to use FTKs(Field test Kits) for testing the water quality of water source. Each Panchayats are given FTKs for testing of chemical and bacteriological impurities.

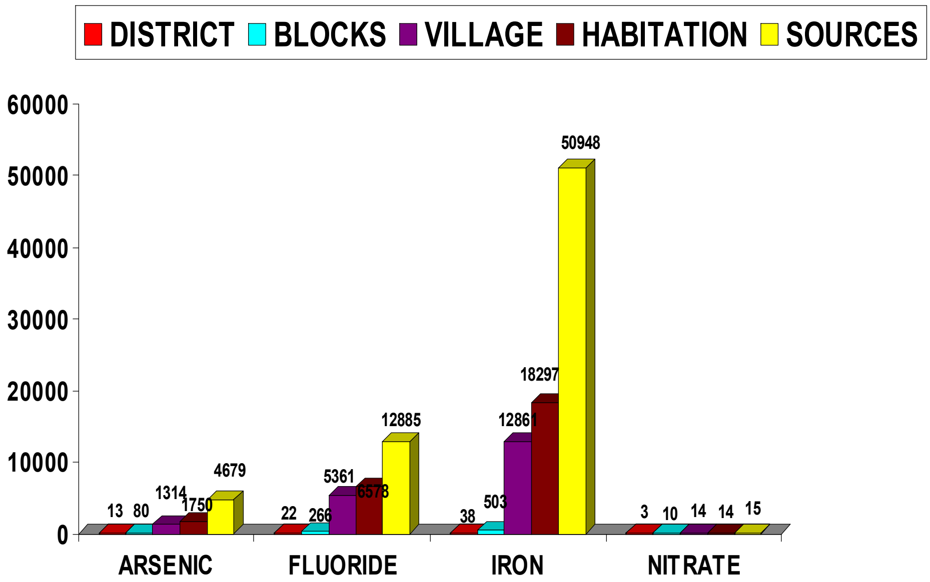

Figure 2. Status of chemical contamination in water sources

Source: Water quality survey 2007-08

Conclusions and recommendations

The arsenic and Fluoride contamination of groundwater along with poor sanitation facilities in the state of Bihar has become a major challenge in water supply in rural and urban areas. Particularly the risk is high in rural areas because the affected aquifer (<70 m below ground) is the main supplier of drinking water mainly through hand pumps.

The arsenic contamination is confined within Younger Alluvial Belt along the river Ganga. The affected areas are flood prone, geochemically representing reducing environment resulting in mobilization of arsenic in groundwater. The Pleistocene aquifers are free from arsenic contamination. Though lot of water quality data is being generated, there is lack of sufficient health data and their correlation with contamination.

Presently the safe limit is being considered as 50 ppb. If the international guideline of 10 ppb is adopted the affected areas and the population at risk will be many times.

The arsenic affected wells in particular and the contaminated aquifer in general, to be avoided. Arsenic free deep aquifer, which has sufficient potentiality, can be tapped for community water supply. But care should be taken for leakage of contaminated water from shallow aquifer downwards due to faulty design/construction of the wells. Surface water may be the long-term sustainable source for the villages along the River Ganga. Detailed health data is an essential input for understanding the scale of the problem, which is lacking. Research work is needed impact on arsenic fixation and its magnification through food chain. Arsenic treatment based solution may not be viable because of several constraints such as difficulty in operation, safe disposal of sludge and maintenance of the system. At last efficient water management is required for preventing further deterioration of water quality and its sustainable use.

As magnitude of the problem is large , following activities may help in improving the safe water delivery mechanism and reduction of health problems:

- Improved sanitation and hugeine practices through advocacy, mass awareness compaign and adeqauate attention to institutionalized hygene education promotion.
- A water quality database should be developed to document all water quality data collected with GIS mapping.
- Strengthening of the water testing Laboratories and their capacity.
- A concurrent monitoring system needs to be developed. The private sources are also to be monitored.
- Effective communication and social mobilization is to be done extensively in the affected area.

- The district, block and grass root health functionaries (in particular those from affected areas) need to be sensitized. Frequent health camps in the area will be helpful in awareness generation.
- The effective execution of the implementation of the activities involves regular monitoring and evaluation.
- Research and development activity is required to be given priority to develop user friendly, cost effective, area specific technological options.
- Overall it requires to develop a region specific total water management system considering all water demands from all sectors with drinking water as a priority.

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Contact details

Daya Shanker Mishra
Director (Water Quality), Public Health Engineering Department, Govt of Bihar, Visvesvaraya Bhawan, Bailey, Road, Patna-800014, India.
Residence: 201, Sona Apartment, Sheikhpura, Patna- 800014, India.
Tel: 91612 2295601 , 919431619284
Email: dayashanker_mishra@yahoo.com