CHAPTER 8
Chapter 8

Alternative drinking water source

8.1 Alternative drinking water source: A necessity

Water plays a major role in laying the foundation for economic growth, not only by increasing the assurance of supply, but also by improving water quality and therefore human health (Phillips et al., 2006). There is a direct link between the provision of clean water, adequate sanitation and improved health (Gleick, 1996). Achieving water and sanitation millennium goals in developing countries is crucial for sustainable development (Korfali and Jurdi, 2009). In developing countries, over one-third of deaths are caused by the consumption of contaminated water (Palamuleni, 2002), and 60% of all infant mortality is linked to infectious and parasitic diseases, which are mostly water related (Hinrichsen et al., 1997).

In Nalbari district where 97.59% (http: Nalbari district profile) of the population dwell in villages, safe drinking water is a high priority issue for safeguarding the health and well being of the people of this region. Pro-poor engineering techniques to deliver water will yield obvious and significant net-benefit to the poorest of the people (FAO, 2004). Shallow aquifers of holocene plains in Nalbari district are reported to be contaminated with arsenic above the WHO permissible limit of 10 ppb. The district is endowed with reasonable amount of surface and groundwater. Despite this scenario the non-usability status of the surface water has made the district water stressed. In order to obtain microorganism free safe drinking water, the government had installed a huge number of shallow tube wells in the region. Surface water was inadvertently replaced by As-contaminated groundwater, which has exposed the people to skin, bladder and liver cancer. The area also experiences an average annual rainfall of 1752 mm, but only 20% of it contributes to groundwater storage and the rest go away as run off. This chapter tries to highlight the strategies for overcoming drinking water related challenges in this highly disadvantaged district of Assam by
effective water resource management practices and exploration of alternative drinking water source.

It is necessary, therefore, to have a clear understanding of the risks associated with different options and to provide a quantitative estimate of the likely health burden arising from these risks. Further, it is necessary to establish how these risks may be managed.

8.1.1 Surface water source

The surface water treatment plants play a key role for the assessment of water quality from the bacteriological point of view. The success of such treatment plants depends on identification, selection of raw water intake points and per capita water consumption daily (Chetia et al., 2010 b). The Pagladia sub basin is the major basin of the region and it has a number of important tributaries like Mutunga, Dimla, Nona and Chaulkhoa. The Pagladiya river system originates in the Bhutan hills and enters the Nalbari district of Assam near Chowki. The river flows in a north southern direction upto Bijalighat and then it flows in a south westerly direction upto its confluence near Lowpara village. The total length of the river is 196.80 km out of which it flows for a length of 19 km in the hilly tracts of Bhutan territory and for the rest 177.8 km, it flows through the Nalbari district of Assam. The surface water resource of Pagladiya basin has been estimated as annual average of 1133.65 million cubic metric meters (Water resource Dept). This enormous quantity is sufficient to meet the irrigation requirement of the sub-basin. The Pagladiya dam project envisages construction of a 26.20 meters high and 23 km long weir in the upper reaches of the Pagladiya river for controlling flood, providing irrigation and hydropower generation for the region (Water Resource Dept, Assam). River Bed Filtration (RBF) was found to be a viable alternative to direct surface water abstraction for providing safe drinking water to many riparian communities situated along the Ganga River and its tributaries (Sandhu et al., 2010; Ray, 2005). The conditions required for RBF is also ubiquitous in the present study area. RBF systems provides a significant barrier to microorganisms has also been observed (Weiss et al., 2003; Gollnitz et al., 2003; Tufenkji et al., 2002; Wang, 2002; Irmscher and Teermann, 2002; Medema et al., 2000).

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8.1.2 Groundwater Potential

Out of a total area of 2257 km² (225700 hectares) about 147813 hectares area is cultivable land. This accounts for 65.49% of the total area which is utilized for agricultural purposes. The area under irrigation is only 10342 hectares which constitute only 6.9% of the total agricultural land.

8.1.2 (a) Drawbacks of groundwater irrigation

Nalbari has no comprehensive and functional watershed management system for rainwater harvesting which could be used for irrigation. Thus groundwater is widely regarded as the main source for agriculture irrigation and its use is increasing day by day to meet increasing food demands. In Nalbari district, rice (paddy) is the main crop cultivated. Studies from Bangladesh shows that irrigation with As-polluted groundwater particularly affects rice (Brammer and Rovenscroft, 2009). Meharg and Rahman (2003) found rice grain contents ranging between 0.058 and 1.835 mg/kg arsenic in 13 different rice varieties tested in Bangladesh. Duxbury and Zavala (2005) reported mean concentrations of 0.032–0.046 mg/kg arsenic for aromatic rice from Bangladesh, Bhutan, India and Pakistan. A soil irrigated with 1000 mm of water containing 100 ppb (parts per billion) arsenic receives 1 kg/ha arsenic per annum. The limited evidence at present suggests that the safe limit of soil arsenic for rice lies somewhere in the range 25–50 mg/kg (Saha and Ali, 2006; Duxbury and Panaullah, 2007). Arsenic accumulation is most serious in soils used for transplanted rice (paddy) cultivation, where the topsoil is puddle to hold water on the surface. That is partly because of the large amounts of water used to irrigate rice — of the order of 1000 mm per crop — and partly because, under the anaerobic conditions in flooded paddy fields, the As is mainly present as As (III), the form that is most readily available to plant roots (Xu et al., 2008; Brammer and Rovenscroft, 2009). Arsenic taken up from soils by rice accumulates in different proportions in different plant parts in the order roots > stem > leaf > grain (Abedin et al., 2002). Different vegetables and food crops in West Bengal, India and Bangladesh are reported to accumulated arsenic (Williams et al., 2006; Roychowdhury et al., 2002). Estimation of As accumulation in the rice and other crops of this study area is beyond the scope.
of this study and can be a priority target for later investigators. However, it is highly recommended that the abundant surface water source be explored for irrigation purpose.

8.1.2 (b) Deep Tube wells and Dug Wells

A number of DTW and STW had been installed by irrigation department for providing water to the command area which created an irrigation potential of 7125 hectares. Considering the total area under irrigation to be 10342 hectares the share of groundwater is estimated to be 69.54%. The Pleistocene aquifers in Bangladesh that are typically found at deeper levels have been found to be relatively free from arsenic contamination (Islam and Uddin, 2002). Assam is said to have similar geology like Bangladesh. Hence this water could be tapped for drinking purpose. The installation of DTW in the vicinity of high risk area is shown in Table 8.1. The average depth of this tube wells are 100 meters. These DWTs which are used for irrigation purpose could be immediately diverted for supplying safe drinking water to the people.

Table 8.1: Deep Tube Wells in the vicinity of high arsenic area

<table>
<thead>
<tr>
<th>Location</th>
<th>No of deep tube wells installed</th>
<th>In working condition</th>
<th>Not in working condition</th>
<th>Total DTW installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamata</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Belsor</td>
<td>9</td>
<td>3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Bongoan</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Solmara</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Tihu</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Mugkuchi</td>
<td>12</td>
<td>5</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Haripur</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>18</td>
<td>19</td>
<td></td>
</tr>
</tbody>
</table>

Water resource Engineering department, Govt. of Assam

Today Dug wells (DW) are also considered as sources of drinking water in arsenic contaminated regions. The water from dug well is believed to have low dissolved arsenic and iron even in locations where tube wells are contaminated (Ahmed et al., 2005). The main reason behind its low arsenic content is because of the oxidation of
DW water due to its exposure to air in the well and agitation during water withdrawal which may cause precipitation of dissolved arsenic and iron. The presence of air and aerated water in the dug well can oxidize the soils around DWs and infiltration of water into wells through this oxidized soil can reduce the concentration of arsenic in well water (Ahmed, 2002). This dug well water can be used for drinking after treatment for bacteriological contamination.

8.1.3 Rainwater harvesting

Rain Water Harvesting (RWH) is becoming very popular in the rural areas all around the globe (Hurtung, 2007). Another source of water in Assam is rainwater, which is available in adequate quantity in the monsoon. The average yearly rainfall in Nalbari district is around 1744.7 mm, which is a source of water for the replenishment of both surface and groundwater sources.

The collection of rainwater for domestic use is a further probable source of water for arsenic mitigation. Some studies report that rainwater from rooftops generally meets the international guidelines of drinking water (Zhu et al., 2004) while other studies
reports that chemical and/or microbial contaminants are often present in concentration exceeding international guidelines of drinking water (Abbott et al., 2006; Vasudevan and Pathak, 2000). The sources of contamination of rooftop RWH tanks include; dust from the soil, leaves from trees, insect repellent, chemical deposits, and bird droppings. The first run off from the roof should be discarded to prevent entry of impurities from the roof. Adequate training should be given on maintenance of the water quality. Another risk associated with long storage of rainwater is the growth of algae and breeding of dengue mosquito inside the storage tank. When nutrients are present in the water, algae grows in the tank quickly with the help of sunlight. Therefore, in addition to regular maintenance of the RWH system, the tank should be kept closed and wire mesh should be provided at the inlet and outlet of the tank. RWH is easy to maintain and there is less possibility of contamination if the owner pays a little attention. This method has shown satisfactory results in Bangladesh. However one major drawback of rainwater is its lack of taste. The mineral salts in natural ground and surface waters sometimes impart pleasing taste to water. The absence of mineral content may affect the acceptability of the water for drinking purpose.

8.1.4 Sanitation programme in Nalbari district

In Assam, maintenance of cleanliness and personal hygiene is an age-old practice and Total Environmental Sanitation is also a part and parcel of rural lifestyle of some of the communities. In rural areas, open defecation is not a normal practice. However, a major section of the community uses a “Kacha Latrine” for defecation which is constructed by digging an earthen pit and fitting an arrangement into the pit to be used for defecation with a temporary superstructure above it. For treating the bacterial contaminant in water, calcium hypochlorite or sodium hypochlorite which are extensively used in USA can be used in the study area. Boiling of drinking water before consumption can also go a long way in prevention of water borne diseases. The above practices can go a long way in safeguarding the population against the risk of arsenic related health problems.