DISCUSSION PAPER, APRIL 2018

Resilient options for improving drinking water security in coastal Bangladesh

Findings from a selected polder in Khulna district

While 98% of the population in Bangladesh has access to a technologically improved water source, only 39% is estimated to have 'safely managed' drinking water services, when water quality is taken into account (World Bank, 2018). The problem is more acute in the southwest coastal region, with complex hydrogeological conditions and adverse water quality resulting in high spatial variability in drinking water coverage. Research findings from a selected polder show substantially low coverage of safe drinking water, despite exponential growth of privately installed tubewells in the past decades. In hard to reach and hydrogeologically difficult areas, households trade-off between quality, distance and affordability in deciding their water source. The country has set its priorities for the Sustainable Development Goals (SDGs), with a strong focus on sustainable and climate resilient water supply systems and increased coverage via introduction and expansion of appropriate, affordable options. Achieving these targets entail analysis of the range of alternative options to determine the combination of interventions required to provide safe drinking water for all in particular contexts.

Methodology

Between December 2017 and February 2018, REACH conducted a household survey, a water audit, six focus group discussions, and 12 key informant interviews to collect empirical evidence on different aspects of safe and sustainable drinking water services in Polder 29, covering parts of Dumuria and Batiaghata Upazilas of Khulna district.

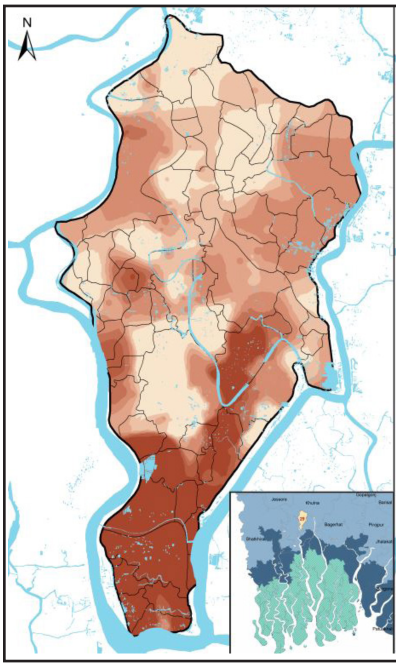

Figure 1: Households' concerns about drinking water services (the darker colour on the polder map indicates higher levels of reported environmental concerns)

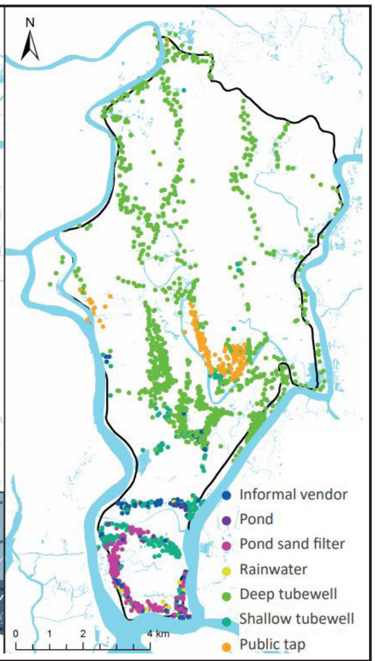

Figure 2: Main sources of drinking water used in the past one year

The survey was administered to 2103 households and collected data on various indicators of multidimensional poverty and water security risks. The water audit covered all the tubewells (total - 2805) in 35 mouzas, and included questions on location, installation date, depth, functionality, ownership, and usage patterns of tubewells, together with water quality measurements in all tubewells. In addition, data from existing borelogs was used to map the hydro-geological profile of the polder.

Key Findings

1. **Tubewells are the dominant sources, with alternative options used in hydrogeologically difficult areas.**

   About 72% of households, mostly in the northern mouzas, use tubewells as their primary source of drinking water. Concerns for drinking water services are high in the southern mouzas (Fig 1), where people resort to pond sand filters (PSFs), rainwater harvesting or vended water supplies (Fig 2). In terms of thickness, there are good first (shallow) and second aquifers; however, the latter becomes very thin in the south. Complex hydrogeology results in high variation in salinity within shorter distances. In general, salinity is lower (within drinking water standard) in the north, but gradually increases in the south (Fig 3).

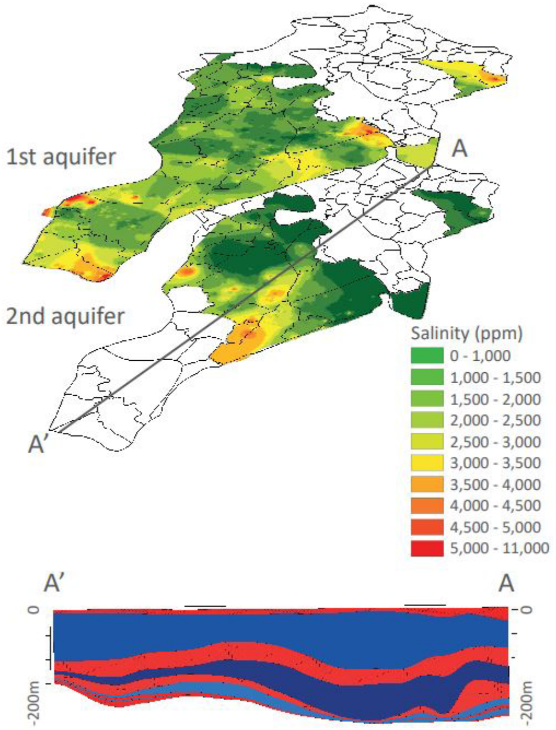

Figure 3: Salinity levels and aquifer stratigraphy

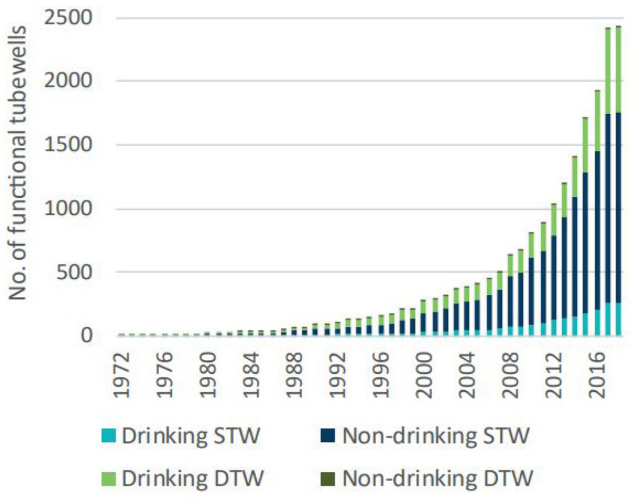

Figure 4: Growth of tubewells in past 5 decades

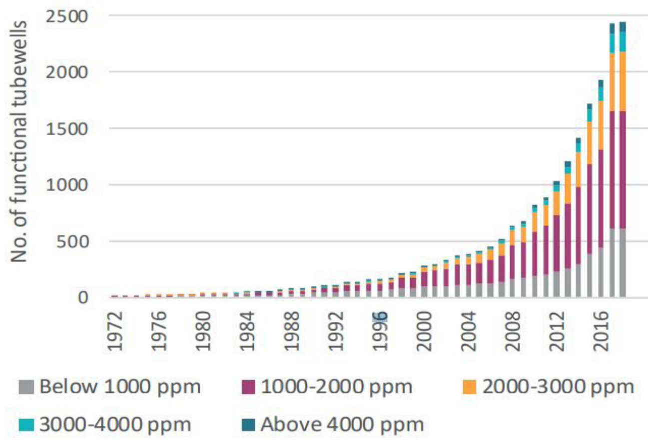

Figure 5: Salinity levels in all functional tubewells

2. **Future susceptibility of aquifers**

   Salinity in the shallow aquifer is influenced by lateral seawater intrusion and river salinity, more so by the latter, while the former is the dominant process in the second aquifer. A future with increased sea level and higher river salinity is likely to see more areas salinised in the shallow aquifer, thus posing greater challenge to drinking water security.

3. **Tubewells have quadrupled in 10 years**

   Tubewells have grown exponentially, reflecting an increase by four times from 2007 to 2017 (Fig 4), with 77% of these being privately funded and 81% being privately maintained. Population in the surveyed mouzas increased by about 4% in the same period, with some mouzas experiencing rise and some mouzas experiencing decline in population. This indicates people's increasing preference for private tubewells for drinking and other uses of water.

4. **Deep tubewells (DTWs) have been increasingly preferred for drinking water**

   The growth of tubewells has been substantially greater for shallow tubewells (STWs), comprising about 75% of total tubewells. Due to high salinity and iron levels, only 35% of the functional tubewells are used for drinking water purpose, of which DTWs have the major share (65% of all drinking tubewells). Increase in STWs in high salinity areas shows household preference for private waterpoints for domestic uses. In contrast, DTWs are preferred for drinking water because of their better quality.

5. **Safe drinking water coverage and accessibility are low**

   Although tubewells grew in large numbers, households are at greater risks than what these numbers suggest. About 20% of STWs and 60% of DTWs are safe for drinking (salinity within the acceptable limit of 1000 ppm), with many people drinking saline water in higher ranges (Fig 5). Relatively high coverage becomes substantially low, especially in the hydrogeologically difficult southern part of the polder, when salinity constraints are considered (Figs 6 and 7). Many people from the southern mouzas travel long distances to fetch water, highlighting an acute level of drinking water insecurity.

6. **Small piped water schemes improved access in areas within 1-2km of suitable aquifers**

   Three piped water schemes (two solar- and one electricity-operated) were installed in 2014, with capital costs largely borne by international donors. The solar-powered systems (B in Fig 7), appropriate for larger aquifers (with layers> 60 feet), delivered water free of cost up to 12 hours a day. Those served by the electricity powered system (A in Fig 7) paid monthly user tariffs of Tk. 30 (USD 0.4) per household for an hour of water supply per day. Proper community-based management ensured effective service delivery.

7. **Regular management of PSFs is vital for sustainability**

   PSFs, funded by international donors, act as low-cost alternatives in the short-term (D in Fig 7). Sustainability depends on regular cleaning and replacement of sand beds, and protection of source ponds from contamination. However, management largely lies with private pond owners with occasional support from volunteering users.

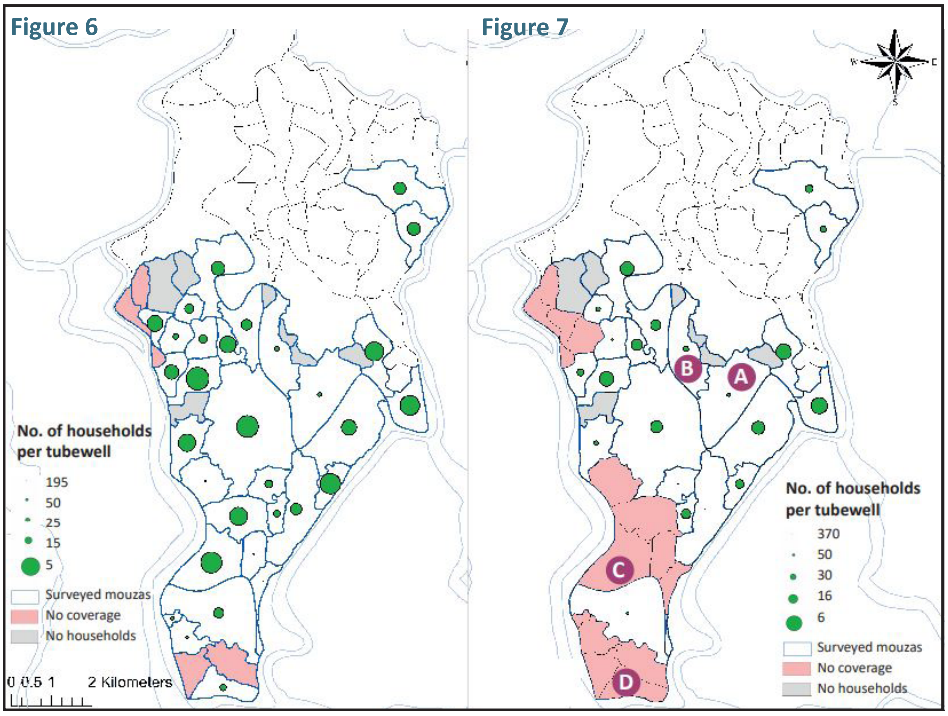

Figure 6 (left): Tubewell coverage for basic drinking water service

Figure 7 (right): Tubewell coverage for safe drinking water service (within salinity threshold)

8. **Formal vending system struggled with cost recovery**

   A formal vending system, managed by the Union Parishad, supplied water for three years (2015-17) to 350 households. Upazila Parishad funded capital costs for the pumphouse, while an international donor provided the delivery truck.

   Households received water in 20-litre containers six days a week for Tk. 50 per month (USD 0.7/m^3). Tariffs were insufficient to meet O&M costs, and service ceased operation following an accident that damaged the truck.

9. **Informal vendors are working towards meeting demands in high salinity areas**

   About two out of five households in high salinity areas (C,D in Fig 7) reported purchasing water from informal vendors, with wealthier ones using it for significantly longer durations (>6 months) than poorer ones. Prices ranged from USD 8 - 12 per m^3, depending on source and distance. Households' decisions to purchase water depended on income flows, seasonality, sickness and physical ability to fetch water.

10. **Gendered and wealth inequalities in water security**

    Women are the main water collectors in 70% of the households. Substantial proportion of households require greater than 30 minutes and in some cases several hours to collect water, especially in the southern saline prone, hydrogeologically difficult areas, and the major burden rests on women's shoulders (Fig 10). Trade-offs between quality, distance and affordability determine the choice of options between saline shallow tube-wells, PSFs or vended water systems.

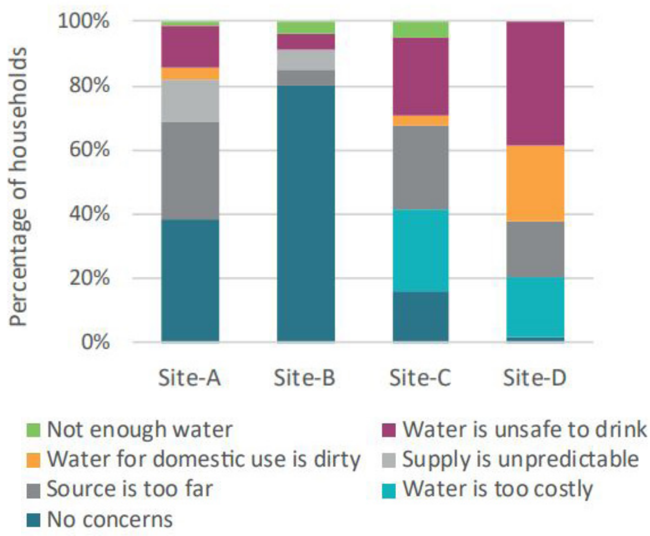

Figure 8: Concerns regarding water reported by households in selected sites (marked in Fig 7)

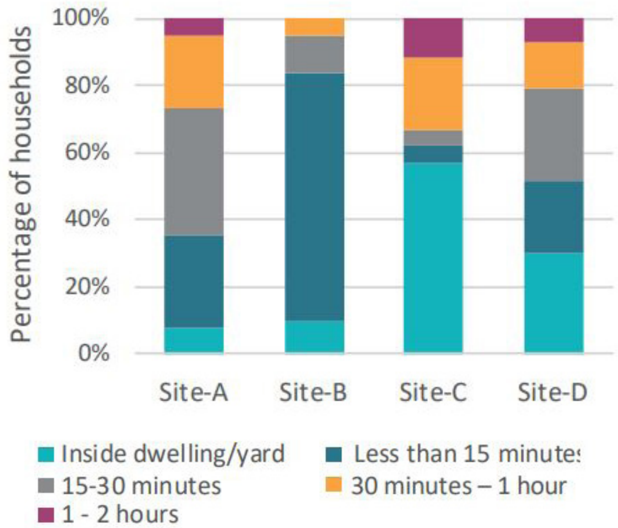

Figure 9: Time taken to collect water from reported main sources in selected sites (marked in Fig 7)

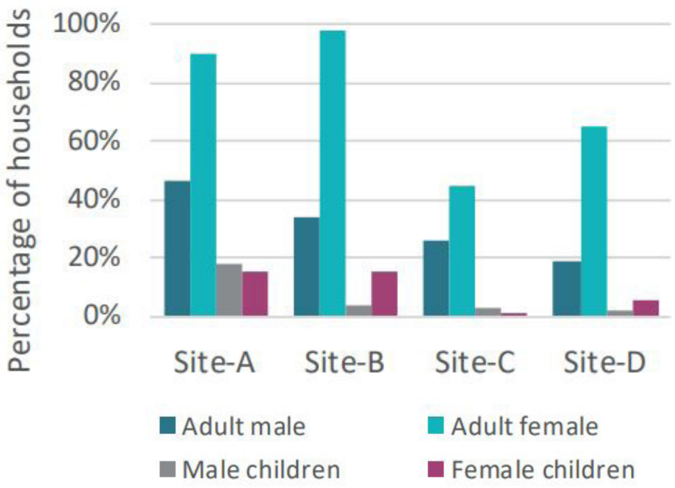

Figure 10: Persons responsible for water collection in selected sites (marked in Fig 7)

Policy Implications

1. Demand for privately owned groundwater sources continues to multiply despite water quality constraints. This has implications for public investment across monitoring of water points.
2. Mere drinking water coverage by water points does not ensure supply of safe water, suggesting greater SDG challenges. This may be aggravated in the future by climate change or anthropogenic influences.
3. Hydrogeologic and salinity mapping suggests possibilities for expanding piped systems in few areas. However, larger systems will require formal institutions for management, with salaried employees having designated roles and responsibilities. Extension of existing piped networks, without required modifications in system capacity, is likely to jeopardise sustainability.
4. Demand and willingness-to-pay for safe water continue to increase. However, poor households cannot afford to pay high prices charged by informal vendors. In the short-term, formalised water delivery systems, managed by the local government and priced to recover O&M costs, can improve access in high salinity areas.
5. Information on affordability and equity of access is limited. Ongoing interdisciplinary research, involving biophysical monitoring and water diary methods, seek to advance methodological approaches and provide empirical evidence for monitoring progress on SDGs.

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