Briefing note: January 2023

Cost estimates for safe drinking water in schools and healthcare centres in Khulna District, Bangladesh

Summary

In rural Bangladesh, the responsibility for managing drinking water infrastructure and water safety is allocated to individual schools and healthcare centres. In response to uneven service delivery performance and increasing climate and environmental risks, the Government of Bangladesh has published its first National Operation and Maintenance Guidelines for Water and Sanitation. The guidelines recognise the role of professional service delivery models working at scale to ensure safe, reliable, and affordable drinking water services for all public schools in a defined service area. We estimated the annual costs of professional water services for 1,700 primary and secondary schools and 300 healthcare centres[1] in Khulna district, based on observed data from a pilot in 171 schools and 33 healthcare centres in eight unions. The estimated cost is Tk 33.5 million[2] (c. USD 350,000) per year for a district population of over 320,000 students and thousands of daily patient visits, equating to less than USD 1 per person per year.

1. State of drinking water services in schools in Khulna district

In Bangladesh, capital expenditure in water supply infrastructure in schools is centrally financed through the Ministry of Primary and Mass Education (MoPME) and the Ministry of Education (MoE). Since 2005, the Primary Education Development Programme (PEDP) provides a pooled fund to install or upgrade drinking water facilities in schools. Installation is led by the Department of Public Health and Engineering (DPHE), with the choice of the water supply technology dependent on the availability and quality of groundwater.

1 The number of healthcare centres is based on data published by the Facility Registry of the Ministry of Health and Family Welfare, and includes community clinics, union health centres, union health sub-centres, and upazila health complexes.

2 USD 1 = Tk 100

Figure 1: State of drinking water services in schools in Khulna District.

320,000
Pupils

1700+
Primary & secondary schools

Total waterpoints

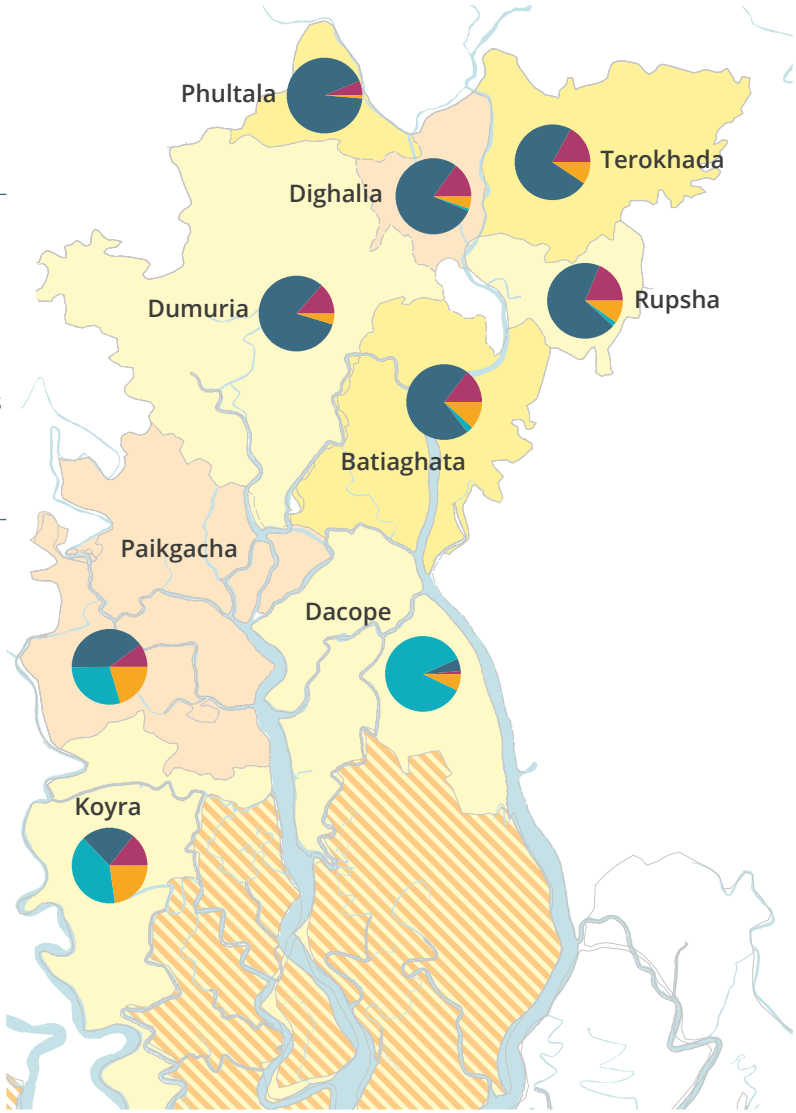
1000 tubewells
4 out of 5 functional
3 out of 5 used for drinking
330 rainwater harvesting systems
17 piped connections
15 reverse osmosis plants

5%
Schools have no water sources

15%
Schools have no drinking water sources

Water sources in schools

- No drinking water sources
- Tubewells
- Rainwater harvesting
- Others



The REACH programme conducted a survey of 1700 schools and madrasas[3] in Khulna district to identify the main sources of drinking water in schools as tubewells (55%) and rainwater harvesting (20%), respectively. Less than 3% of schools depended on alternative sources like reverse osmosis plants, piped water, and pond sand filters. 15% of schools had no source of drinking water on premises and 7% purchased vended water (Figure 1). Rainwater harvesting systems varied in terms of storage capacity, with those above 10,000 litres being installed in high salinity areas through donor-funded projects.

The type of technology affects the complexities and costs of operation and maintenance, the responsibilities for which are borne by the individual school administrators. With limited funds, training, time and autonomy, school administrators lack capacity to ensure timely repair and maintenance, with no provision of monitoring water quality post installation.

3 Includes all primary and secondary schools under government, integrated, private and NGO ownership in Khulna district, excluding Khulna City Corporation.

2. Piloting a professional water service delivery model for rural schools and healthcare centres

The SafePani model is testing how to reallocate service delivery responsibilities from individual schools to a professional water service provider operating within an exclusive service area. Since 2021, the SafePani model has been piloted in eight unions of Khulna district covering 294 drinking waterpoints across 171 schools and 33 healthcare facilities.

The pilot phase was launched with the formation of a National Steering Committee and a District Working Group chaired by the Additional Secretary of the Local Government Division and the Deputy Commissioner of Khulna district, respectively. The SafePani model comprises three main packages of work.

a. Rehabilitation and maintenance of all water supply infrastructure, with any reported breakdowns being repaired within 48 hours;

b. Water safety assessment involving sanitary inspection, baseline tests for arsenic, manganese and chloride, and seasonal tests for *E. coli*, and prompt disinfection of sources upon detection of faecal contamination; and

c. Development and maintenance of a data storage platform highlighting key performance metrics related to water quality, service reliability, volumetric use, and costs.

3. Estimating costs for upscaling the SafePani model to district level

The activities and costs incurred during the SafePani pilot phase provided an indication of the costs of upscaling the professional water service delivery for all schools in Khulna district. We disaggregated these costs into three components: service hubs, maintenance services, and water safety (Figure 2), and calculated the set-up and annual recurring costs for each of the components.

The estimated 5-year costs for 1700 schools and 300 healthcare centres in Khulna district (excluding Khulna City Corporation) amount to approximately Tk 154 million (USD 1.5 million) (Table 1 and 2, Figure 3). We recognise that a number of items have been excluded in this cost estimate which can be addressed in future analysis.

Figure 2: Cost components to estimate the costs for professional water service delivery for schools in Khulna district.

	1. Service hubs	2. Maintenance services	3. Water safety
Set-up costs	Office, vehicles, data management	Minor rehabilitation	Field laboratory for microbial analysis
Annual recurring costs	Office rent, staff salary	Maintenance (spare parts), technician, fuel, disinfection	Chemical & microbial tests (consumables), lab staff, fuel costs
Excluded costs	Company licence, taxes & permits	CAPEX & major rehabilitation	District laboratory for chemical analysis

a. Service hubs

We identified the need for six service hubs, of which one will be designated as the 'District Headquarters' and five will act as 'Local Service Hubs' responsible for service delivery within one or more surrounding upazilas. All six service hubs will host a microbiology laboratory for testing *E. coli* and three full-time staff as Hub Manager, Mechanic, and Lab Technician, while the District Headquarters will also have seven additional staff as Programme Coordinator, Government Liaison Officer, Performance Manager, Water Quality Manager, Senior and Junior Engineers and Administrative Officer.

The set-up costs for these service hubs are Tk 4.9 million, include the cost of setting up the office, purchasing motorcycles for staff and IT equipment, and developing a data management system. The latter involves creating a baseline dataset of the state of water supply infrastructure in all schools and healthcare centres. Once the database is established, the performance manager based at the District Headquarters will update it regularly to record repair and maintenance activities, response times, costs incurred and results of water quality tests. A mobile App, linked to the database, will also be designed to allow waterpoint managers to report issues.

The annual recurring costs, estimated to be Tk 7.3 million per year, include the salaries of the Programme Coordinator, Government Liaison Officer, Performance Manager, and Administrative Officer, office rent, car hire and other miscellaneous costs. The costs of setting up and running the laboratories, including salaries of the water quality manager and the lab technicians and the consumables, are incorporated under the water safety component, while the salaries for the engineer and the mechanics are calculated under the infrastructure maintenance component. The fuel costs for the motorcycles are split equally between maintenance and water safety components.

b. Maintenance services

We estimated the set-up costs for repairing and renovating existing water supply infrastructure and the annual recurring costs for breakdown and routine maintenance by four main technology types – tubewells, rainwater harvesting, piped water systems and reverse osmosis plant.

Figure 3: Estimated set-up and annual recurring costs for professional water service delivery for schools in Khulna district.

	1. Service hubs	2. Maintenance services	3. Water safety
Set-up costs **Tk 26.3 million** **(USD 263,000)**	Tk 4.9 million	Tk 11.8 million	Tk 9.6 million
Annual recurring costs **Tk 25.6 million** **(USD 256,000)**	Tk 7.3 million	Tk 13.1 million	Tk 5.1 million

The set-up costs, amounting to Tk 11.8 million, is based on the percentage of waterpoints needing rehabilitation and the average rehabilitation costs for each technology. To estimate these set-up costs, we used the existing number of waterpoints in schools[4] and healthcare centres,[5] that is, 1160 tubewells, 417 rainwater harvesting systems, 22 reverse osmosis plants and 17 piped water connections (Table 1). We do not include the capital expenditures for installation of new waterpoints in the 15% schools and healthcare centres that do not have any drinking water sources, as these costs will be part of the mandate and budget of the DPHE.

The annual recurring expenses, amounting to Tk 13.1 million per year, include the cost of spare parts, the salaries for the engineer and mechanics and half of the total fuel costs. The spare parts or materials costs are estimated from the predicted frequency of repair or maintenance events and the costs for each event. To estimate these annual recurring maintenance costs, we added the numbers of existing waterpoints to the number of new waterpoints assumed to be installed in the schools and healthcare centres without drinking water sources. We assumed the new waterpoints to include 78 tubewells, 165 rainwater harvesting systems, and 101 reverse osmosis plants, with latter two being relatively higher owing to higher groundwater salinity in areas without drinking water sources (Table 1).

c. Water safety

Ensuring the water safety at schools involves regular monitoring of selected chemical and microbial parameters, promptly disinfecting sources with faecal contamination, and conducting sanitary inspection of waterpoints. We assumed that all drinking water sources, except rainwater harvesting systems, will be tested for arsenic, manganese, and chloride once every five years, while *E. coli* tests will be done twice a year in the first year and then once every two years. For rainwater harvesting systems, only the *E. coli* will be tested, as rainwater is unlikely to have chemical contamination.

For every 10 samples collected, one duplicate sample and one field blank sample will also be tested to ensure accuracy of results. If *E. coli* is detected in any waterpoint, the source of contamination will be identified where relevant and remediation work will be done promptly. These sources will be retested to check that the contamination has been eradicated. The remediation costs are included in the water safety component, except for rainwater harvesting systems, for which the costs of tank cleaning and disinfection are incorporated under the maintenance services component.

The set-up costs include establishing a field laboratory for microbial testing within each of the six service hubs but excludes the laboratory set-up costs for chemical analysis as these will be done at a government (DPHE) district laboratory. The annual recurring costs include laboratory consumables, salaries of the water quality manager and lab technicians, and half of the total fuel costs.

4. Limitations

There are several limitations in these cost estimations, which can be addressed in future work.

- In the absence of district-wide data on water supply infrastructure for healthcare centres, we extrapolated from the eight SafePani unions and REACH school survey to decide on the existing types and numbers of waterpoints available.
- While estimating annual recurring costs, we assumed that new waterpoints will be installed by the government in schools and health care centres without any drinking water sources.
- Tubewells can be of different depths and pumping mechanisms, resulting in variations in rehabilitation and maintenance costs. The groundwater quality also affects breakdown frequency, especially in areas with iron contamination.

4 Based on survey data of all schools.

5 Extrapolated from data available from eight SafePani unions.

- Rainwater harvesting systems vary considerably in capacity, ranging from below 2,000 litres to above 30,000 litres, and installation year, resulting in variations in need for rehabilitation and maintenance costs.
- We excluded the rehabilitation costs for piped schemes, as these are community sources and the costs should not be counted as part of water service delivery for schools, and reverse osmosis plants, as the bulk of their costs are included under maintenance expenses.
- We excluded other technologies like pond sand filters and managed aquifer recharge as these are also community sources and the costs of rehabilitating the non-functional ones is often same as providing new ones.
- We did not estimate depreciation or inflation for equipment, or government taxes and permits for a professional service provider.

5. Next steps

The transition from a pilot in 8 unions to a contracted service delivery model at district level with 67 unions will require a number of steps. The cost analysis presented here provides an initial planning framework to develop a contract between the Local Government Division and a professional water service provider, outlining the technical and financial arrangements between all parties. This includes exploring potential contributions from public and donor funds, and performance metrics for a result-based funding model. The results and findings from SafePani can inform other districts in Bangladesh and contribute to the government's international leadership in delivery of Sustainable Development Goal Target 6.1.

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Appendix

Table 1: Numbers of different types of water supply infrastructure estimated for schools and healthcare centres in Khulna district

No. of institutions	No. of waterpoints	Tubewell (TW)	Rainwater harvesting (RWH)	Reverse Osmosis (RO)	Piped water systems (PWS)
1700 schools	Existing number of waterpoints (as of 2022)	1000	330	15	17
	Estimated number of waterpoints to be installed in the 15% schools without any drinking sources as of 2022	50	150	100	0
300 healthcare centres	Existing number of waterpoints (extrapolated from data in 8 SafePani unions)	160	87	7	0
	Estimated number of waterpoints to be installed (assuming 15% do not have any drinking water sources)	28	15	1	0
Total		**1238**	**582**	**123**	**17**

Table 2: Breakdown of set-up costs for professional water service delivery for 1700 schools and 300 healthcare centres in Khulna district.

Service hubs				
Item	**Description**	**Units**	**Unit cost (Tk)**	**Total (Tk)**
Motorcycles	3 motorcycles for District HQ;	13	150,000	1,950,000
	2 motorcycles for each local service hub - 1 for mechanic and 1 for WQ sampling			
Laptops and printers	12 laptops and 6 printers	12	60,000	720,000
	Includes 1 printer for each hub	6	10,000	60,000
Office	Furniture and miscellaneous items	6	30,000	180,000
Data management	Technical needs assessment survey, database, and mobile App development			2,000,000
Total				**4,910,000**

Maintenance services				
Type of waterpoint	**Notes**	**Number of waterpoints**	**Rehabilitation costs per waterpoint (Tk)**	**Total rehabilitation costs (Tk)**
Tubewells (Handpump/ motorised)	30% needing rehabilitation (Repair/ construction of platform, drainage system with soak well, replacement of small and large parts)	1160*0.3 = 348	10,000	3,480,000
Rainwater Harvesting System	50% needing rehabilitation (Repair of tank, catchment area, taps and pipes)	417*0.5 = 209	40,000	8,340,000
Total				**11,820,000**

Water safety				
Item	**Description**	**Units**	**Unit cost (Tk)**	**Total (Tk)**
Laboratory set-up	Quanti Tray, Quanti Tray sealer, Incubator, Refrigerator, Reagent, Portable Multimeter and other items	6	1,400,000	8,400,000
Portable meters	Multimeters for measuring EC, pH, temp	6	200,000	1,200,000
Total				**9,600,000**

Table 3: Breakdown of annual recurring costs for professional water service delivery for 1700 schools and 300 healthcare centres in Khulna district.

Service hubs				
Item	**Units**	**Months**	**Unit cost (Tk)**	**Total (Tk)**
Car hire	1	12	50,000	600,000
Project coordinator	1	12	80,000	960,000
Government Liaison Officer	1	12	60,000	720,000
Performance manager	1	12	60,000	720,000
Admin/ finance officer	1	12	40,000	480,000
Hub manager	5	12	40,000	2,400,000
Office rent for Upazila hub	5	12	12,000	720,000
Office rent for District HQ	1	12	30,000	360,000
Other office costs (printing, mobile credit, internet)	6	12	5,000	360,000
Total				**7,320,000**

Maintenance services				
Type of waterpoint	**Notes**	**Number of waterpoints**	**Repair costs per waterpoint per year (Tk)**	**Total repair costs per year (Tk)**
Tubewells (Handpump/ motorised)	Small parts = Tk 500 per repair * 3 repair events per year = Tk 1500 per year Large parts = Tk 2500 per repair * 0.25 repair events per year (or once every 4 years) = Tk 625	1238	2,125	2,630,750
Rainwater Harvesting System	Tank cleaning and disinfection before start of rainy season	582	1,472	856,704
Reverse Osmosis plant	Replacing filter and dosing media	123	50,000	6,150,000
Piped water scheme	Annual OPEX estimated at 5% of CAPEX = Tk 500,000 Each school with a connection assumed to bear 1% of the total OPEX, i.e. Tk 5000	17	5,000	85,000
Sub-total for Spare parts				**9,722,454**

Item	**Units**	**Months**	**Unit cost (Tk)**	**Total (Tk)**
Engineer	2	12	60,000	1,440,000
Mechanic	6	12	20,000	1,440,000
Fuel cost for motorcycle (50% of total)	13*0.5 = 6.5	12	7,000	546,000
Sub-total for Staff and Transport				**3,426,000**
Grand total				**13,148,454**

Water safety				
Item	**Cost per sample**	**Number of waterpoints + 10% duplicates + 10% field blanks**	**Tests per year**	**Total (Tk)**
Chemical tests at DPHE lab (Once every five years)	1000	(1238 TWs + 582 RWH + 17 PWS)*1.2 = 2204	0.2	440,880
E.Coli training in Year 1 only (100 random samples per service hub)	500	600	0.2	60,000
E.Coli tests at SafePani lab (twice in Year 1; then once every two years)	500	(1238 TWs + 582 RWH + 17 PWS + 123 ROs)*1.2 = 2352	0.8	940,800
Disinfection post E.Coli detection (20% TWs)	300	1238 TWs * 0.2 = 248	0.8	59,424
Post-disinfection E.coli test (20% of TWs and 40% of RWH)	500	(1238 TWs * 0.2)+(582 RWH * 0.4) = 480	0.8	192,160
Sub-total for consumables				**1,693,264**
Item	**Units**	**Months**	**Unit cost (Tk)**	**Total (Tk)**
Water quality manager	1	12	60,000	720,000
Lab technician	6	12	30,000	2,160,000
Fuel cost for motorcycle (50% of total)	13*0.5 = 6.5	12	7,000	546,000
Sub-total for staff and transport				**3,426,000**
Grand total				**5,119,264**

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