Microbiological contamination of pond water and associated drinking water risk in rural coastal areas of Bangladesh

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Outline

- Study area

- Drinking water stress in normal situation and after cyclone

- Study design and data collection

- Results and discussion

- Research scope for further development

INDEX MAP OF POLDER NO - 32
Upazila-Dacope. District-Khulna.

Source: Bangladesh Water Development Board (BWDB)

Jaliakhali Khal Closure (60m) at km14.70

Jaliakhali Khal Closure (30m) at km14.00
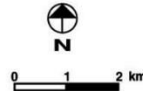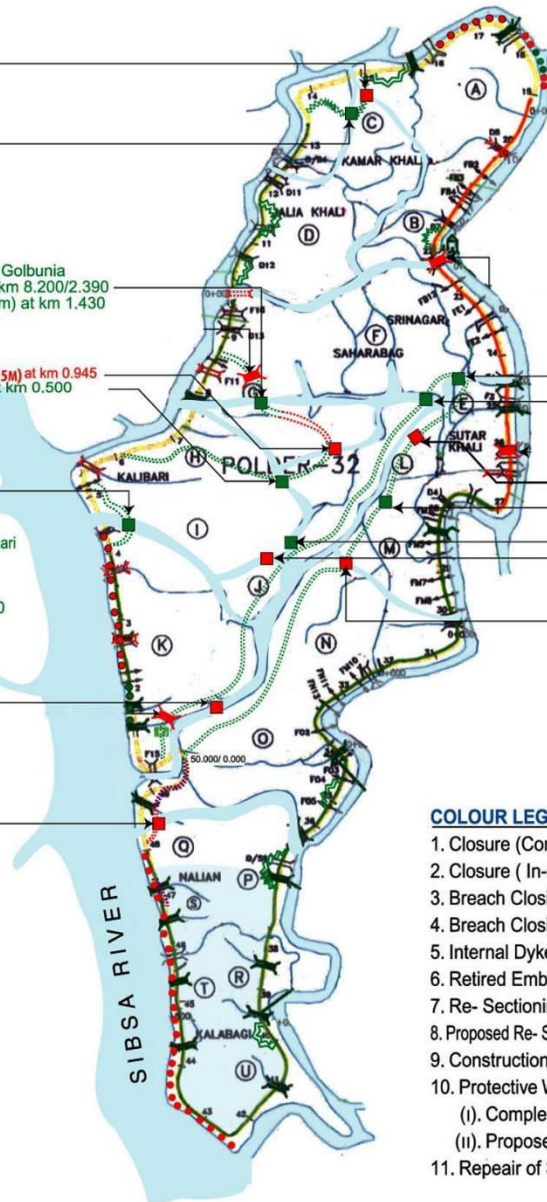
Retierd Embankment at Golbunia from km 7.800/1.230 to km 8.200/2.390 with Breach Closing (60m) at km 1.430

Golbunia Breach Closing (115M) at km 0.945
Breach Closing (45m) at km 0.500

Retierd Embankment at Gunari from km 4.700/ 0.000 to km 5.100/0.460 with Breach Closing (60m) at km 4.900/ 0.200
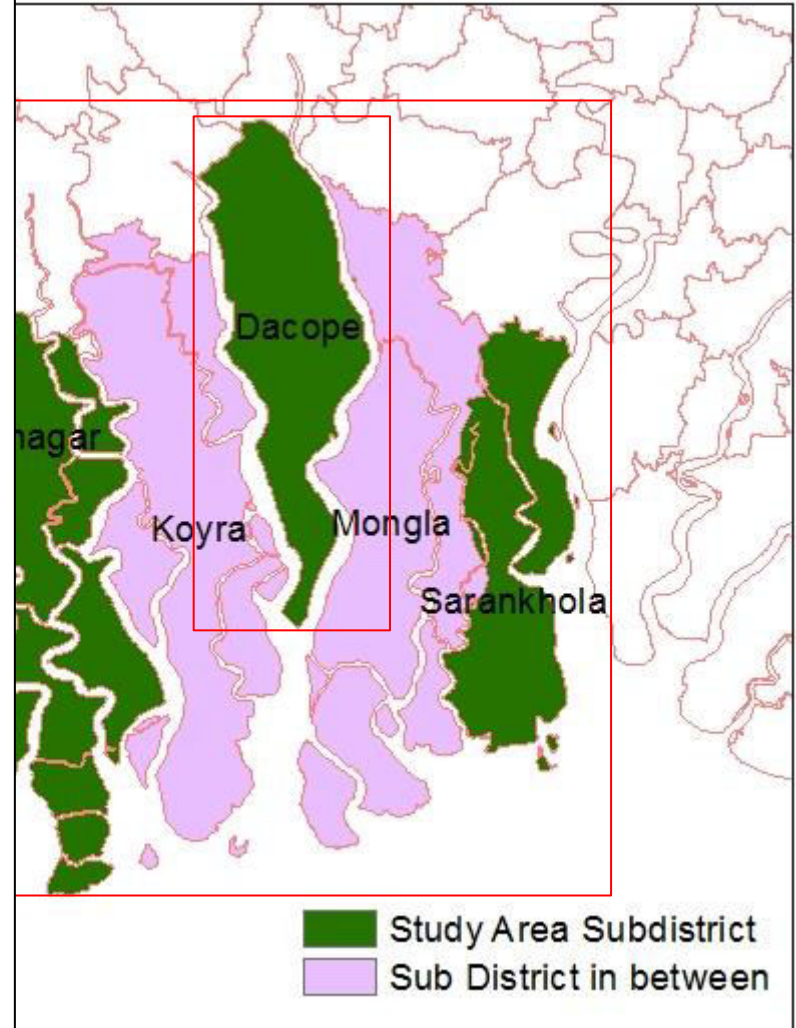
Nalian River Closure

Nalian Khal Closure (80m) at km. 48.465

Pachur Donia Bareach Closing (50M)

Breach Closing (55M) at Pachur Doani

Mazafuto Breah (60 M)
Dhalikhali Breach (55m)
Oramukhi Breach Closing (45m) at km
Oramukhi Breach Closing (120 M)

Breach Closing (70m) at Kaowratoli

N
0   1   2 km

COLOUR LEGEND :
1. Closure (Complete)
2. Closure (In-Complete)
3. Breach Closing (Complete)
4. Breach Closing (In-Complete)
5. Internal Dyke Construction
6. Retired Embankment
7. Re- Sectioning of Embkt.(Comp)
8. Proposed Re- Sectioning of Embkt.
9. Construction of Regulator
10. Protective Work
    (I). Complected
    (II). Proposed
11. Repeair of Sluice

Study Area Subdistrict
Sub District in between

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Drinking water problem aspects in normal situation

Spatially varied availability of sources and related seasonality aspects

Water fetching : Time consuming and Labor intensive

Drinking water problem aspects after cyclone

Damaged embankment, Contaminated sources and Refuge in cyclone shelters

Courtesy: Bangladesh Water Development Board

Courtesy: Dr. Bishawjit Mallick

Water relief, Embankment reconstruction, Restoration of contaminated sources

Courtesy: Bangladesh Water Development Board

Study design and data collection

1. Previous scientific studies did consider four critical factors all together to get a comprehensive scenario of the problem :

    → Contamination at source

    → Contamination at the point of use

    → Causes of contamination and remedial measures

    → Significance of the contamination to affect the

       communities drinking water management

2. As study area, we have selected nine mauzas (revenue collection unit in Bangladesh) from the three coastal sub districts Sharankhola, Dacope and Shyamnagar.

3. We have collected **62 water samples.**
    → 32 samples from ponds situated in 8 mauzas
    → 30 samples directly from households pitchers

Source: Field Survey, 2012

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Study design and data collection (continuation)

4. We have tested the samples in the **four parameters**
   - ➔ Total coliform (TC)
   - ➔ Total bacterial count (TBC)
   - ➔ *Escherichia coli* (*E.coli*)
   - ➔ *Vibrio cholera*

5. For each of the 62 samples, additional information regarding the location, maintenance and relevant physical surroundings have been collected through GPS, and a quantitative questionnaire

6. A quantitative survey for 824 households have provided us information regarding the communitiy's drinking water management
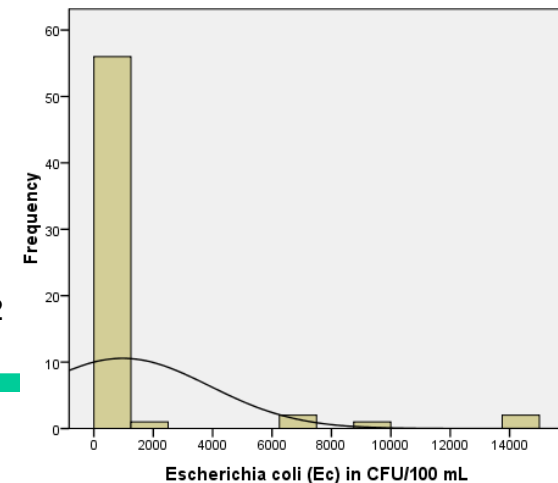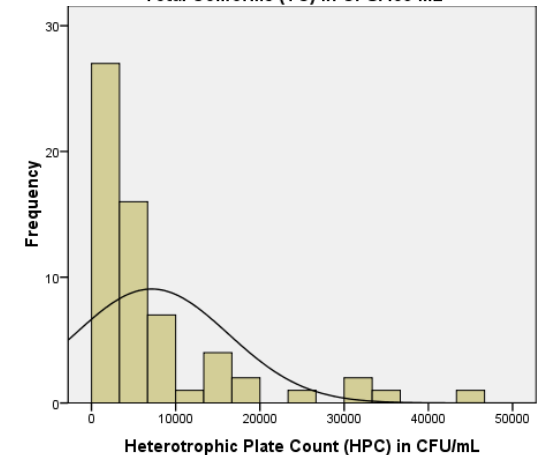
Source: Field Survey, 2012

Results- Contamination scenario

1. The recorded maximum concentration of

→ TC HPC, and Ec in the source-samples is 8300 CFU/100ml, 45000 CFU/ml and 14000 CFU/100ml respectively.

→ The WHO standard for these three parameters is 0, less than 500 CFU/ml and 0 in that order.

2. The point of use (household samples) concentrations are comparatively lower in the cases of alum $[KAl(SO_4)_2 \cdot 12H_2O]$ use

3. Presence of *Vibrio cholera* has been identified in about 42% samples.

Source: Field Survey, 2012

Total Coliforms (TC) in CFU/100 mL

Heterotrophic Plate Count (HPC) in CFU/mL

Escherichia coli (Ec) in CFU/100 mL
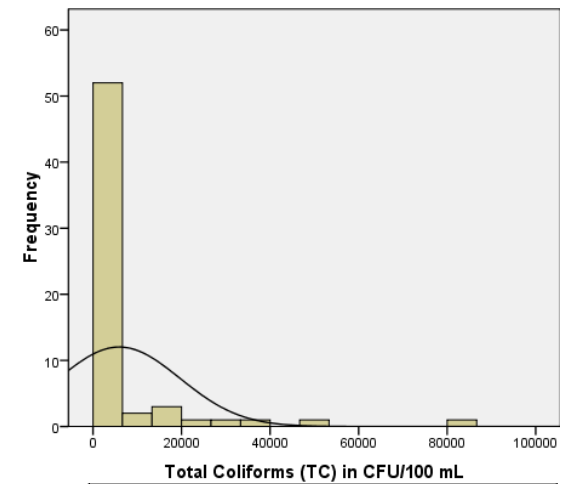
Results- Factors affecting the contamination rate

F1: Presence and functionality of a PSF installed beside the pond

F6: Contamination by previous cyclone surge

F2: Presence of toilet within 10 m buffer

F5: Height of the pond bank from the adjacent land

F3: Multipurpose use of the pond specially for bathing and cleaning

F4: The use of alum [$KAl(SO_4)_2 \cdot 12H_2O$] for water purification at households

Source: Field Survey, 2012

Research scope- Rural water supply network

→ Experimentally established by GIZ in SW-Coastal Bangladesh

→ Water flow direction:
   Pond ► PSF ► Overhead Tank ► Supply Point

→ 5 chambered PSF. 3 filled with sand, brick chips, alum and coal chips

→ Solar energy runs the pump to let water in PSF and to pump the treated water in overhead tank

Solar Panel

Overhead Tank

Pond

Pump house

PSF Chambers
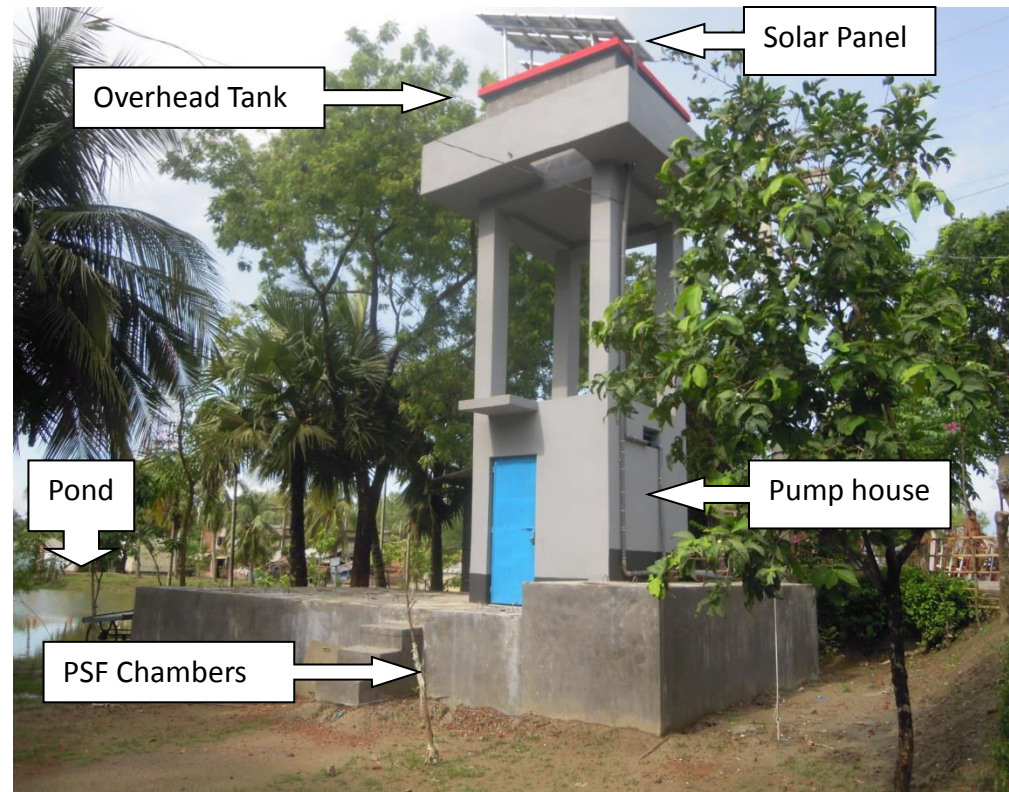
Thank you very much for your attention !

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Karlsruhe Institute of Technology**

Research approach- Data

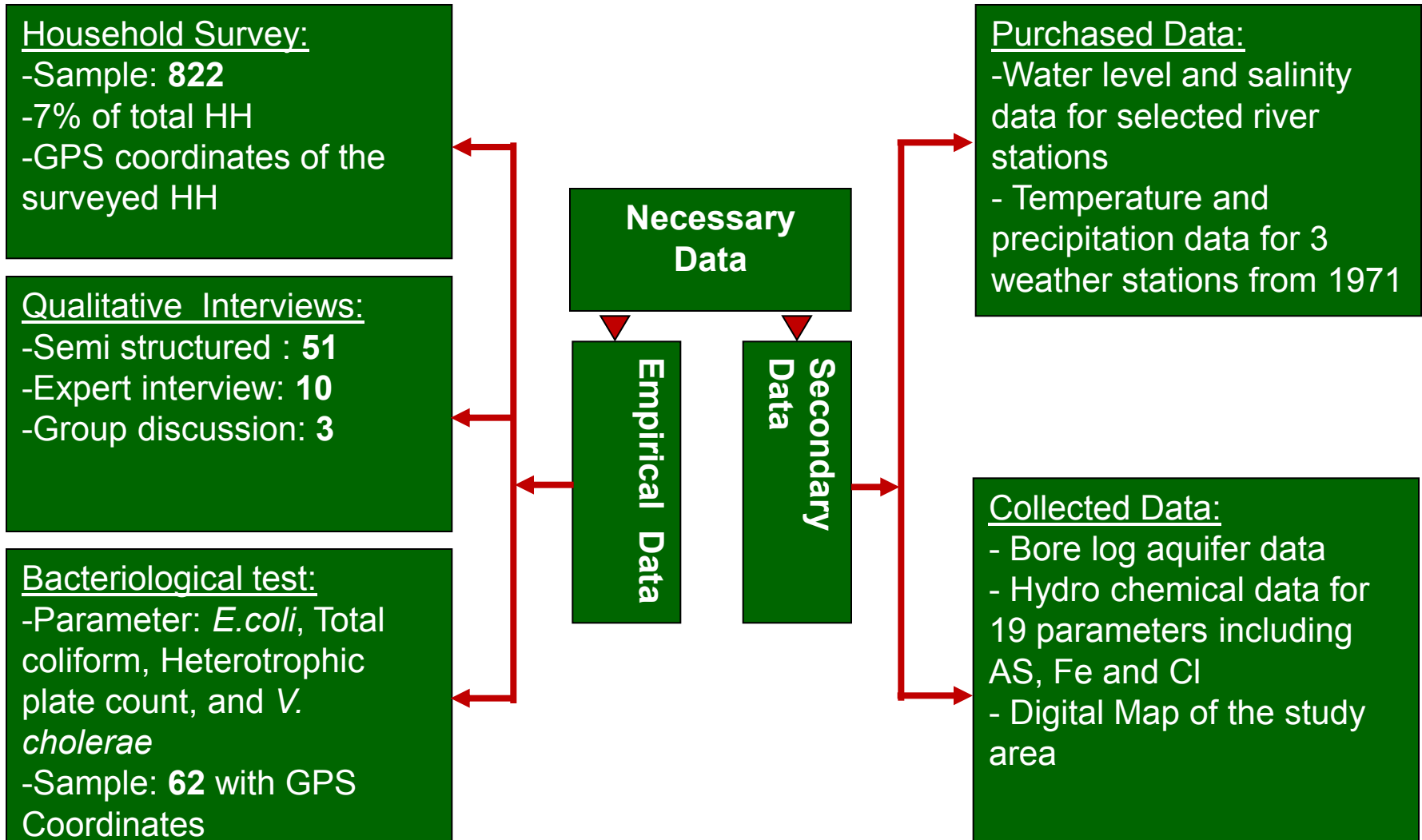**Household Survey:**
-Sample: **822**
-7% of total HH
-GPS coordinates of the surveyed HH

Qualitative Interviews:
-Semi structured : **51**
-Expert interview: **10**
-Group discussion: **3**

Bacteriological test:
-Parameter: *E.coli*, Total coliform, Heterotrophic plate count, and *V. cholerae*
-Sample: **62** with GPS Coordinates

Necessary Data

Empirical Data

Secondary Data

Purchased Data:
-Water level and salinity data for selected river stations
- Temperature and precipitation data for 3 weather stations from 1971

Collected Data:
- Bore log aquifer data
- Hydro chemical data for 19 parameters including AS, Fe and Cl
- Digital Map of the study area

Study Area at a glance

District	Sub district	Mauza*
Satkhira	Shyamnagar	Kupat
		Gabura
		Biralakshmi
Khulna	Dacope	Sutarkhali
		Dacope
		Maukhali
Bagerhat	Sharankhola	Sonatala
		Royenda
		Morellabad

*Mauza: The smallest spatial unit for revenue collection; Have officially deliniated boundaries as well as official statistics (BBS, 2001)

- Pond and Rainwater
- Tube well, Pond and Rainwater
- Only Tube well

Source: BBS, 2001

Parameter	Information
Area (Km²)	99.94
Population	59946
Number of HH	12054