To pay or not to pay for safe water?

Insights from arsenic-affected communities in West Bengal, India

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About 60 million people worldwide are exposed to arsenic-contaminated groundwater.

One sustainable solution: produce and sell treated water to communities

- How many people will purchase water? And why?
- Are there other alternatives to groundwater that will compete?
- If people purchase water, will they be safe?

We don’t know:

Approach: survey areas where alternatives to groundwater are already available

- Field site in West Bengal, India.
  - 150 miles north of Kolkata.
  - Rural area
  - ~ 5 miles from medium-size city Berhampore
  - Villages: ~ 800 to 2500 households
Groundwater problems in survey area

Shallow groundwater (50-200 feet deep)

1. Arsenic
   - According to testing by Public Health Engineering Department in 2002-2006:
     - All wells >10 ppb As
     - ~ 80% wells > 50 ppb
   - Confirmed by my measurements (30 wells)
   - But: very few arsenicosis patients

2. Iron

3. Microbes
   - Very few latrines
   - When present, often located near water sources
Alternatives available in survey area

1. Purchased water (jars from village treatment plant)

2. Domestic filters (from self-made to off-the-shelf)

3. Government tubewells (deeper)
Method: household survey (409 households)

- Detailed questions about household water behaviors: all sources of water + frequency of use

- “Measure” 13 factors that can potentially affect the use of alternatives to groundwater:
  - Socioeconomic status
  - Income stability
  - Arsenic risk perception
  - Dissatisfaction with iron
  - Risk perception of gastric illness
  - Presence of children <5
  - Aspirations
  - Participation in women group
  - Peer behavior
  - External advice
  - Doctor advice
  - Exposure to purchased water
  - Perception of purchased water
Wide range of household water behaviors

**USE OF ALTERNATIVES**
(N = 409)

- None
- Domestic filter
- Government tubewell
- Other
- Purchased water

**USE OF PURCHASED WATER**
(N = 101)

- Exclusively (or concurrently with other alternative)
- Concurrently with tubewell
- Only some household members
- Rarely
1. What are the predictors / drivers for the use of alternatives?
2. How do people choose between alternatives?
3. Purchased water: what predicts the degree of adoption?
4. How durable is the use of purchased water?
Logistic regressions: predictors / drivers for using alternatives

\[
\text{logit} \left( P_{\text{use alternative}} \right) = \beta + \sum_{i=1}^{13} \alpha_i \times \text{Factor}_i
\]

- The use of alternatives is primarily predicted by **socioeconomic status** and **risk perception of gastric illness**
- **Arsenic risk perception** is secondary, both in weight and significance
- **Dissatisfaction with iron** comes third

<table>
<thead>
<tr>
<th>Predictor</th>
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<tbody>
<tr>
<td>Socioeconomic status</td>
<td>1.2***</td>
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<tr>
<td>Income stability</td>
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<td>Exposure to purchased water</td>
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<td>Women group</td>
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<td>Peer behavior</td>
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<td>External advice</td>
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<td>Doctor advice</td>
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<tr>
<td>Risk perception of gastric illness</td>
<td>0.8***</td>
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<td>Dissatisfaction with iron</td>
<td>0.4*</td>
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<td>Arsenic risk perception</td>
<td>0.5**</td>
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<tr>
<td>Children &lt; 5</td>
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<tr>
<td>Aspirations</td>
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<tr>
<td>Perception of purchased water</td>
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## Research Question 1

### Logistic regressions: predictors / drivers for using alternatives

<table>
<thead>
<tr>
<th>Predictor</th>
<th>ALL</th>
<th>POOR</th>
<th>RICH</th>
<th>FILTER</th>
<th>PURCH. WATER</th>
<th>GVT TW</th>
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<tr>
<td>Socioeconomic status</td>
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<td>Risk perception of gastric illness</td>
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<td>1.0***</td>
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<td>Dissatisfaction with iron</td>
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*Statistical significance indicated: **p < 0.01, *p < 0.05, ***p < 0.001*
Logistic regressions: choosing between alternatives

- Filters compete with purchased water at all socioeconomic levels
- Compared to water purchasers, filter users:
  - dislike purchased water
  - participate less in women’s groups
  - may have higher dissatisfaction with iron

USE OF ALTERNATIVES

<table>
<thead>
<tr>
<th>Socioeconomic status</th>
<th>POOR</th>
<th>MEDIUM</th>
<th>RICH</th>
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</thead>
<tbody>
<tr>
<td>Perception of purchased water</td>
<td><img src="image1.png" alt="Graph" /></td>
<td><img src="image2.png" alt="Graph" /></td>
<td><img src="image3.png" alt="Graph" /></td>
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<tr>
<td>Participation in women’s group</td>
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<td><img src="image5.png" alt="Graph" /></td>
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Transition from one level of behavior change to the next

USE OF PURCHASED WATER
(N = 101)

1. Rarely
2. Only some household members
3. Concurrently with tubewell
4. Exclusively (or concurrently with other alternative)

HYPOTHESES

- Socioeconomic status
- Income stability
- External advice
- Perception of purchased water

? (Not enough data)
The use of purchased water is not always durable

Village 1:

12% of households surveyed used to purchase water

Compared to households who are still purchasing water, they had:

- Lower risk perception of gastric illness
- Less doctor advice
- Worse perception of purchased water
- A domestic filter

Village 2:

Public taps available (government-treated surface water)

- Prior to tap water: 20% of households (N=92) purchased water
- Now: only 2%, and only as a back-up
<table>
<thead>
<tr>
<th>WATER PROVIDER</th>
<th>DEVELOPMENT WORKER</th>
<th>PUBLIC HEALTH PERSON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can I sustain a business?</td>
<td>How can I promote behavior change?</td>
<td>Are people safe?</td>
</tr>
<tr>
<td>A significant number of households will purchase water (model: ~ 20%)</td>
<td>The main predictor (outside wealth) of the use of alternatives is risk perception of gastric illness (salient issue), not arsenic awareness.</td>
<td>Purchased water is never used for cooking</td>
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<td>Government-provided taps may outcompete you</td>
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<td>Behavior change is progressive (use ≠ exclusive use)</td>
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<td>Domestic filters in fact compete with purchased water.</td>
<td>EQUITY: use (and degree of use) of alternatives increases with socioeconomic status, except for government tubewells</td>
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<td>Alternatives are not compared on the basis of their arsenic removal merits</td>
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