“Evaluation of microbial contamination in drinking water during chemical intervention of geogenic contaminant removal in India”

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Global WASH statistics...

- Over 780 million people do not have access to improved sources of drinking water and 2.5 billion lack improved sanitation (WHO, 2012)
- Socioeconomic development is clearly linked to access to safe drinking-water (WHO, 2011)
- Improving water, sanitation and hygiene has the potential to prevent at least 9.1% of the disease burden or 6.3% of all deaths worldwide (WHO, 2008).
- Of all deaths attributable to water, sanitation and hygiene, over 99.8% occur in developing countries, and 90% are of children (Nath et al, 2006).
Key points...

• Geogenic contaminants

• Need for evaluation of contaminant removal technologies

• Behavioural trends
Geogenic contaminants....

- Arsenic
  - 140 million people in 70 countries (UNICEF report, 2007)
  - Arsenicosis and other problems
  - WHO guidelines Arsenic 10 µg/L
- Iron
  - Aesthetic effects and physical effects
  - Significant discolouration and turbidity
  - USEPA Iron 0.3 mg/L
- Fluoride
- 200 million people from among 25 nations are affected (Ayoob and Gupta, 2007)
- Causes dental and skeletal fluorosis
- WHO Guidelines 1.5 mg/L
My Focus...

- Indian scenario: 25 million affected by fluoride in more than 15 states (Ramesh and Soorya, 2012)

- Study area
  - Village: Chichkotha
  - Location: 20°48’06”N, 78°58’30”E
  - Population: 124
  - Water source: Groundwater
    - Handpumps (2)
    - Wells (2)
  - Fluoride: ≥1.5 mg/L
Fluoride mitigation...

One of the primary goals of WHO and its member states is that “all people, whatever their stage of development and their social and economic conditions, have the right to have access to an adequate supply of safe drinking water” (WHO 2003)

- Household chemo-defluoridation unit
  - Point-of-use treatment technology
  - Slow Sand filtration
  - Coagulants - Calcium and phosphorus salts
  - 25-30 Lit capacity
  - 200-300 ml flow rate

Designed by NEERI Nagpur
Funded by Rajiv Gandhi Science and Technology Commission
Need for evaluation....

- Sustainability of the technology
- Scope of improvement
- Risk Substitution (Howard 2005)
- Public acceptance
How do we evaluate?

• Questionnaire based surveys
  • Demographic information
  • Socio-economic status
  • Water and hygiene practices
• Direct field observations
• Group Conversations with the villagers
• Water quality analysis
  • Fluoride
  • Thermotolerant coliforms
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Questions</th>
<th>Yes (%)</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Is the storage designed for dipping</td>
<td>95.8</td>
<td>4.2</td>
</tr>
<tr>
<td>2</td>
<td>Dipper with short/ no handle</td>
<td>92</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Lack lid on storage vessel</td>
<td>16</td>
<td>84</td>
</tr>
<tr>
<td>4</td>
<td>Inside of the vessel difficult to clean</td>
<td>8</td>
<td>92</td>
</tr>
<tr>
<td>5</td>
<td>Vessel accessible for children</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>Material of the storage vessel non-durable</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>Pour back excessive water into the vessel</td>
<td>4.2</td>
<td>95.8</td>
</tr>
<tr>
<td>8</td>
<td>Signs of dirt around the mouth/opening of vessel</td>
<td>52</td>
<td>48</td>
</tr>
<tr>
<td>9</td>
<td>Cloth tied around the tap</td>
<td>57.1</td>
<td>42.9</td>
</tr>
</tbody>
</table>
Water Quality results....

Faecal contamination level in the water samples

Thermotolerant coliform colonies on M-FC Agar
Correlation analysis...

Thermotolerant Coliforms (CFU/100ml) vs. Fluoride concentration (F- mg/L)

- Linear (FC)

\[ y = 43.941x - 1.6487 \]
\[ R^2 = 0.164 \]
Observed behavioural trends....

- Wife was not at home.
- Cloth tied around the opening of the tap.
- The powder is hygroscopic & therefore not using the unit. Instead they were using water from the nearby well.
- Using the treated water for drinking purpose. But, use well water for cooking.
- Sand was washed. Therefore not using the Chemo-defluoridation unit.
- The powder was exhausted.
Summary...

- Point-of-use treatment technology
  - User friendly
  - Low cost
  - Sustainable in the field
  - Should not compromise with risk substitution
  - Socially and culturally acceptable
Aknowledgement

• NEERI

• Rajiv Gandhi Science and Technology Commission

• The University of Oklahoma

• The villagers from Chichkotha village

• My family and friends…
Thank You!

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