“Appropriate technologies” for drinking water supply in developing countries.

Caetano C. Dorea
Look what 22000 litres of water has done for me!
Infectious diseases

Caused by:

• Bacteria;

• Viruses;

• Protozoa.
Water-related disease

- Related to water or impurities in the water;
- Person to person;
- Animal to person;
- Does not include illnesses caused by chemical contaminants.
Faecal-oral route

“Hardware”:
• Water supply;
• Sanitation;
• Drainage.

“Software”:
• Hygiene promotion.
Faecal pollution
Water-borne diseases

- Transmission: through ingestion of contaminated water;
- Improvement of supplied water quality;
- Prevention of the use of contaminated or unprotected sources.
Water-washed diseases

• Transmission: depends on water availability and quantity;

• Personal and domestic hygiene;

• Increase in water coverage, quantity and continuity.
Water-washed diseases

Wash your hands.
Protect the health of others.
Health laws require employees to wash their hands with soap and warm water before beginning work and after visiting the toilet.

New York City Dept. of Health
## Water quality

<table>
<thead>
<tr>
<th>Worst we can tolerate?</th>
<th>Best we can achieve?</th>
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<tbody>
<tr>
<td>- Developing countries;</td>
<td>- Industrialised countries;</td>
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<td>- Appropriate technologies;</td>
<td>- “High tech” approach;</td>
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<tr>
<td>- Acute risks (e.g. water-related disease).</td>
<td>- Precautionary principle (chronic risks).</td>
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</table>
Appropriate technologies

• ...techniques that can be implemented/operated by the beneficiary community;

• Closely tied to “sustainability” or “maintainability”;

• Depends on:
  – Available skills and resources;
  – Cultural and environmental settings.
Developing countries

- Humanitarian emergencies (Asian Tsunami, Pakistan Earthquake);
- Development (Rwanda);
- Collaborations with Oxfam and Univ. of Surrey.
Development
Service indicators:

1. Coverage (maximum number of people);

2. Quantity (varies with climate and cultures: 20 to 120 L/head/day);

3. Continuity (days/year and hours/day);

4. Quality;

5. Cost.
Rwanda

• 1994 genocide:
  • 800,000 victims
  • 100 days of massacre

• Mass exodus

• Mass return in 1996
Case study: Rwanda

- Nyabwishongwezi
- 18000 people
- Water???
- Iron in groundwater
- Little yield from wells
Umuvumba River
• Reduce particulate loadings to slow sand filters;

• **Together with SSF form multi-stage filtration systems.**
Improvement: not ideal, but much better!
Problems though!

- Low usage → low income from tariffs;
- No community ownership → no previous community;
- High costs of pumping diesel;
- By 2004 WTP stopped working.
Not as bad as...

Ntoma
Continuous flow sedimentation basin

(when operated properly)
(when not operated properly)
Abandoned pre-filters

Unused slow sand filters
Emergencies
Microbiological safety: no pathogens
Water must look and taste nice...
Queuing time less than 15 min
Less than 3 min to fill a 20 L vessel
Or else...
Quantity vs. Quality?

- Most diseases due to inadequate amounts of water for hygiene;
- Priority for sufficient quantities;
- Large amounts of good quality water is better than...
- Small amounts of excellent quality water.
Emergency phases

Immediate (1st weeks)
- 1 to 5 L/p/d
  - Survival (drinking and cooking)

Late emergency (1 to 6 months)
- 10 to 20 L/p/d
  - Stabilisation (Other needs: bathing, laundry, livestock)

Post-emergency (> 6 months or years)
- > 20 to 25 L/p/d
  - Relative stability (search for more durable/sustainable water supplies)
The Asian tsunami...
Roads from Banda Aceh to Meulaboh remain impassable. Humanitarian access primarily through sea and air.
Oxfam Field Upflow Clarifier Kit
Yield = 10 m$^3$/h
FUC run no. 3 - 9640 L/h; alum dose = 40 mg/L

![Turbidity vs Run Time Graph](image)

- Raw water
- Treated water

**Axes:**
- Y-axis: Turbidity (NTU)
- X-axis: Run time (h)

**Data Points:**
- Raw water turbidity decreases over time.
- Treated water turbidity decreases more significantly over time.

**Observations:**
- Raw water turbidity remains relatively high compared to treated water throughout the run.
- Treated water shows a significant reduction in turbidity, indicating effective treatment.

**Conclusion:**
- The alum dosage at 40 mg/L is effective in reducing turbidity in the treated water compared to raw water.
Simplified field jar-test.

- Raw water turbidity: 109 NTU;
- Fast mix: 30 seconds;
- Slow mix: 2 minutes;
- Optimum dose is visually estimated in the absence of a turbidimeter.
Service indicators:

1. Coverage (maximum number of people);

2. Quantity (varies with climate and cultures: 20 to 120 L/head/day);

3. Continuity (days/year and hours/day);

4. Quality;

5. Cost.
Sustainability/maintainability:

- Efficient and reliable service at desired level;
- Financially and technically feasible to maintain;
- Can be used efficiently without negative effects on the environment.
Conclusions

• By-the-book designs only work if they are run by-the-book (skills and resources);

• Adequate design is needed to maximise donor funding and public health impact;

• More advanced processes (e.g. coagulation) can be “suitable” or “appropriate” in certain circumstances;

• Main bottleneck is knowledge transfer!

• Tariffation (maintenance) must also be considered.
So, what’s the way forward?

1. I don’t know... still working on it!

2. Community involvement!

3. Capacity building – “software”; 

4. Current trend: decentralised household treatment approach;

5. Must consider improvement to livelihoods... not just health.
Thanks!!! Any questions???