Water, health & development in the non-networked world

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Outline

- Trends in water and sanitation infrastructure investment
- Three challenges of a non-networked paradigm
- Knowledge gaps and applied research
- Summary, Q&A
Trends in access to water and sanitation services

- Millennium Development Goals: proposed by the UN in the year 2000, adopted by all members
- Target 10: To reduce by ½ the proportion of people without access to improved water supply & basic sanitation between 1990 -2015

Data Source: Joint Monitoring Program
Improved water supply
• Piped connection to house/plot
• Public tap or standpipe
• Protected well or spring
• Rainwater

Unimproved supply
• Surface water
• Unprotected well or spring
Basic sanitation
• Toilet connected to sewer
• Toilet with septic tank
• Improved latrine (concrete slab)
• Composting toilet

Unimproved sanitation
• Traditional latrine
• Bucket/service latrine
• Open defecation
• Any shared facility
**Improved water supply**
- House/plot connection
- Public tap or standpipe
- Protected well or spring
- Rainwater

**Basic sanitation**
- Toilet connected to sewer
- Toilet with septic tank
- Improved latrine (concrete slab)
- Composting toilet

Valentina Zuin  
Jenna Davis  
Jenna Davis
Global water & sanitation infrastructure, 2010

- House tap, 53%
- Other 'improved', 36%
- Surface water, 3%
- Other 'un-improved'; 8%
- Open defecation, 19%
- Unimproved toilet, 19%
- Toilet + sewerage, 31%
- Toilet + on-site, 31%

2.5 billion
3.4 billion

Source: Joint Monitoring Program (2012)
All countries begin with unimproved, non-networked services

United States, 1800s


Lao PDR & Tanzania, 2000s

Amy Pickering
Regional trends in water access, 1990-2010

- In the world’s poorest regions, virtually all W&S gains during MDG period have been non-networked

Source: Joint Monitoring Program, 2012
Median construction cost per capita (US$), improved water supply options (2000)

Non-networked infrastructure...
1) Creates regulatory challenges
2) Confers investment and management responsibilities on users
3) Depends on accompanying behavior to realize health benefits
Non-networked infrastructure...

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Limited sanitation infrastructure options in many urban slums
Fecal sludge management is largely a private-sector function, difficult to regulate

Will supporting markets for recovered resources help realize public and environmental health goals?
Collection

HH Toilet

Transportation

Back-end Use

Resource Recovery
Cap Haitien, Haiti: Urban sanitation project

- Dense slum community of 1600 households
- Served only by 3 public toilets
- In-home bucket-based system, paired with resource recovery
Non-networked infrastructure...

1) Creates regulatory challenges

2) Confers investment and management responsibilities on users

3) Depends on accompanying behavior to realize health benefits
Can poor households afford networked services?

<table>
<thead>
<tr>
<th>Country</th>
<th>Haiti</th>
<th>Indonesia</th>
<th>Peru</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price/m³, non-networked</td>
<td>$5.50-16.50</td>
<td>$1.20-5.20</td>
<td>US$3.00</td>
</tr>
<tr>
<td>Price/m³, piped system</td>
<td>$1.00</td>
<td>$0.09-0.50</td>
<td>$0.15</td>
</tr>
<tr>
<td>Cost reduction factor</td>
<td>5.5 - 16.5</td>
<td>2.4 - 57.8</td>
<td>20</td>
</tr>
</tbody>
</table>

To what extent does limited access to financing impede household investment?
Hyderabad, India: Microfinance for W&S

- ~4 million residents, served by semi-autonomous Water Board
- Parent population: From 950 slums, 64 identified that were ‘notified,’ on government land, in service area, and had 100+ households without service
  - 10 slums sampled
  - 1174 household interviews attempted; 905 completed
Sample household characteristics

- Median HH size: 5 persons
- Median respondent age: 34 years
- 82% homeowners
- 26% of respondents self-identify as literate
- Median monthly reported “regular” expenditures: US$70
Water supply & sanitation services
Imagine a microfinance program...

- Loans of US$75-$250 available, earmarked for water connection, toilet/sewer, both
- Annual interest rate randomly varied between 15%, 20%, 25%, and 30%
- Repayment period randomly varied between 18 and 24 months
• Borrowing households must form “joint liability group”
• Each group member must save ~US$3 per week for 8 weeks before receiving loan
• Average monthly payments between US$6 - 15
• NGO provides on-site servicing, Water Board facilitation and information
- Complex program
- Respondent’s questions solicited, answered four times
- Handouts reviewed by enumerators
- Respondents given opportunity to think, discuss with family, and resume interview in a later appointment (1%)
Demand for water microloans
(Over all interest rates, repayment periods)

- **No water or toilet** (n=273)
  - Have toilet: 10%
  - No water or toilet: 90%

- **Have toilet** (n=353)
  - Want loan for water supply: 55%
  - Want loan for both: 45%
Reasons for declination
(Unprompted; multiple answers allowed)

- Don't want to form a group
- Satisfied with current situation
- Monthly payment too high
- Renter: Don’t want to invest
- Renter: Landlord won't permit
- Can't meet savings requirement
- Interest rate is too high
- Feels services should be free
Supply meets demand: Hyderabad

- Sample filters, reflecting lenders’ priorities, eliminated ~90% of the unserved from consideration
- Of those left in the sample, a little over ½ expressed willingness to borrow given program description
- Among these, half will likely not be desirable borrowers from an MFI’s perspective (housing stock, income, employment, home ownership)
- Implies that microfinance as currently structured will have limited impact, and will be utilized largely by better-off households
- Next steps: Program being launched in Kenya
Non-networked infrastructure...

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Greatest W&S-related health impacts associated with networked infrastructure

Mean reduction in child mortality (%)

- Water supply
- Sanitation

Developing countries, 1990’s & 2000’s
N~750,000

Gunther and Fink (2010)
Tanzania: Mapping household risk

- House entrance
- Household floor
- Food preparation
- Water activities
- No activities
- Latrine entrance
- Latrine floor
- H-L midpoint
- Location of soil sample
Water collected
Utensil cleaned
Hardware *versus* software

- Largest city in Tanzania (~3m)
- 9th fastest growing city in the world; population doubling time ~16 years
- ~1/3 of households connected to municipal water network, <10% to sewer network
- Water utility (DAWASA) targeting non-networked system investments in vulnerable populations
- Less-than-expected impacts on health
Collaborative research between Stanford, DAWASA, and Muhimbili University of Health & Allied Sciences

- Sampling of water at source, in the home
- Hand rinse samples
- Enumeration of fecal indicator bacteria

Photos: Amy Pickering
Finding: High-quality water at source deteriorates in storage

E. coli concentrations in source versus stored water

How to motivate improved sanitation, water management & hygiene?
• 300 HHs with >1 under-5 child in 3 neighborhoods
• 4 visits per HH over 3-month period
• Interview of mother / caretaker
• Sampling of stored, stored water
• Hand rinse samples

• Health messages booklet and strategy card reviewed, left with all respondents
• For 3 cohorts: Water, hand, or both test results provided & explained
Respondent’s sample (CFU per 100mL E. coli)

Median value for HHs in neighborhood

“Low” <10 CFU/100mL
“Medium” 11-100 CFU
“High” >100 CFU

“Low” <10 CFU/100mL
“Medium” 11-100 CFU
“High” >100 CFU
Selected results:

• Self-reported rates of handwashing and water treatment increased for entire set of study participants
• No effect of water/hand test; ‘information only’ cohort had highest rates of change
• Little association between behavior change and levels of fecal indicator bacteria.

Implications

• Current approach to infrastructure investments should not be expected to yield health gains.
• Are non-networked solutions really cheap?
Summing up

• Non-networked water and sanitation investments dominate in developing countries
• Full suite of costs, benefits, and impacts of this paradigm not understood
• Applied research can help address regulatory, management, investment, and health behavior challenges
• Opportunities exist (particularly in sanitation) to inform (inspire?) industrialized countries’ investment strategies
Thank you

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Photo: Amy Pickering