Provision of Water after Major Disasters – Lessons Learned

Trevor Cone
Water Provisions after Major Disasters

• What is on the rise?
  • Severity of natural disasters
  • Frequency of natural disasters
  • Terrorism
  • Consequences
  • Water – **immediate need**

• Several case studies
  • local lessons
  • **common lessons**
Case Studies

2004 Indian Ocean Tsunami
2005 Hurricane Katrina
2009 Cyclone Aila – Bangladesh
2010 Haitian Earthquake
2010 Chilean Earthquake
2004 Indian Ocean Tsunami

• Overall Impact
  • 9.15 magnitude earthquake off coast of northern Sumatra, Indonesia
  • 12 nations
  • 225,000 lives lost
  • 3,000,000 people affected
  • $9,300,000,000 economic impact

(http://academic.evergreen.edu)
2004 Indian Ocean Tsunami – Sri Lanka

- Local Impact
  - 35,000 lives lost
  - 150,000 displaced
  - $2,150,000,000 in damages
  - 80% lost main source of income

- The System
  - Only 34% connected to piped water system
  - Most use individual or common shallow dug wells
  - Hand pump tube wells and surface water are also used

(http://movingimages.wordpress.com)
2004 Indian Ocean Tsunami – Sri Lanka

• Kaluthavalai and Kallady (7,000 and 9,000 people)\(^{10}\)
  • 73% and 90% reported salt water inundation of wells
  • 1\(^{st}\) month – bottled water/purification kits
  • Up to 24 months - water trucking
  • Reluctant to return to well use even when determined to be safe

• Andaman and Nicobar Islands (India)
  • Water supply systems wiped out
  • *Operation Rainshine*\(^{16}\)

[Links: Academic Evergreen, Lanka Rainwater]
2004 Indian Ocean Tsunami

Lessons Learned:

1) Provide **education** and **outreach** to locals – can they accurately assess the safety of a water source?

2) Offer **training** to those who operate private wells – can they properly clean their own well if it becomes inundated?

3) Develop **alternative water sources** – what is the back-up when the primary water source becomes compromised?

4) Develop a **national policy** on how to anticipate and mitigate effects of sea level rise
2005 Hurricane Katrina

- Overall Impact\textsuperscript{23,24}
  - Category 5 \rightarrow 3
  - 30ft storm surge
  - 1,300 lives lost
  - 300,000 homes damaged/destroyed
  - $156,000,000,000 economic impact

http://rs21.org.uk
2005 Hurricane Katrina

- **The system**\[^{20}\]
  - Carrollton and Algiers WTPs serve East and West Banks
  - Sewerage and Water Board of New Orleans (SWBNO) ensures water quality

- **Interruption of water services**\[^{21,23}\]
  - Power outages
  - Flood water persistence – 2 weeks
  - Boil water orders – several more weeks
  - Distribution networks damaged

<table>
<thead>
<tr>
<th>Category of repairs</th>
<th>Number of repairs[^{19}]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water mains</td>
<td>9,800</td>
</tr>
<tr>
<td>Hydrants</td>
<td>5,000</td>
</tr>
<tr>
<td>Valves</td>
<td>2,500</td>
</tr>
<tr>
<td>Localized service repairs</td>
<td>42,000</td>
</tr>
</tbody>
</table>
2005 Hurricane Katrina

• Water provisions\textsuperscript{17,23}
  • Shortage at emergency shelters
  • Algiers trucked water to Carrollton district
  • Bottled water – during and even after boil water orders

• Management challenges\textsuperscript{18}
  • Logistics – no supply tracking, uneven distribution
  • Communication – with public, across agencies
2005 Hurricane Katrina

• Role of private sector\textsuperscript{18,25}
  • FEMA's Craig Fugate – private sector already has been and needs to continue to be a part of the disaster management team
  • Walmart, Starwood, IBM, Mississippi Power
  • Food, water, fuel, generators
  • Efficiency, redundancy
  • Formalized role $\rightarrow$ increase reliability accountability
2005 Hurricane Katrina

Lessons Learned:

1) Public **outreach** on individual **preparedness** and **responsibility** during disasters – every household should have emergency water supplies

2) **Permanent** emergency supply **facilities** close to the city but removed from disaster prone areas

3) Policy to formally incorporate the **private sector** in disaster management

4) **Alternative plan** for administering relief when floodwaters persist

5) **Alternative communication methods** when phone services are down and specify interagency communication protocol
2009 Cyclone Aila - Bangladesh

- Overall Impact
  - 180 lives lost
  - 318,000 acres of crops damaged
  - 600,000 homes damaged/destroyed
  - 4,800,000 people adversely effected
  - 4,000 freshwater ponds and 13,000 tube wells damaged

http://earthobservatory.nasa.gov
2009 Cyclone Aila - Bangladesh

- The system\textsuperscript{32,33}
  - Population: 160 million – 72% rural, 90% water access, often tube wells
  - Groundwater contamination – arsenic, salinity
  - Many forced to rely on untreated surface water

- Khulna District\textsuperscript{29}
  - Clean water scarcity – diarrhea outbreaks
  - Use of force – women and children most vulnerable
  - Persistent/repeated tidal flooding – supplies could not reach remote areas
  - Aid dwindled (many displaced over 2 years)
Lessons Learned:

1) **Primary** and **secondary** water sources in place so there is an alternate source when one becomes unavailable.

2) System for providing temporary shelter and prepositioned water supplies in anticipation of those displaced by flooding.

3) Strengthen long-term, **permanent** water supply systems that can withstand at least some of the common disasters faced in Bangladesh.

4) **Alternative plan** for administering relief when floodwaters persist.
2010 Haitian Earthquake

- Overall Impact\textsuperscript{34}
  - 7.0 magnitude earthquake 13 km beneath Port-au-Prince
  - 222,570 lives lost
  - 300,000 injured
  - 1,000,000 displaced
  - $10,000,000,000 damages
2010 Haitian Earthquake

- The system (fragmented)\textsuperscript{35,36}
  - 3 gov’t agencies involved, none in control, no comprehensive water policy
  - Gov’t only provides water access to 40% of population
  - Private water distributors often fill gaps
    - Water trucking, by the bucket, 7oz plastic water packets, no regulation

- Cholera Outbreaks\textsuperscript{40}
  - After 1 year, 258,000 cases reported
  - Half required hospitalization
  - 2% resulted in death
2010 Haitian Earthquake

- Water trucking$^{37,39,41}$
  - Partially privatized water sector vs. free water trucking
  - Phasing out done carefully, gradually
  - Poor communication with public about transition
  - Rural areas difficult to reach – GE example
Lessons Learned:

1) Need **national water policy** that includes **coordination** with private water distributors

2) Designate **single authority** to be in charge of national water supply issues

3) **Educate** public in **preventing** and **detecting** contamination in water sources – reduce the spread of water borne diseases, such as cholera

4) Develop plans for long-term, **permanent** water supply systems

5) Adopt an **attitude of preparedness** and precaution
2010 Chilean Earthquake

- Overall Impact
  - 8.8 magnitude earthquake 35 km beneath Concepcion
  - 521 lives lost
  - 12,000 injured
  - 800,000 displaced
  - 1,800,000 people affected
  - $30,000,000,000 economic losses

[Map and ShakesMap](http://mceer.buffalo.edu)
2010 Chilean Earthquake

• The system\textsuperscript{45}
  • Primarily modern WTPs and distribution networks
  • Coverage: 87% urban, 58% rural
  • Transitioned to privatized system in 1998
  • Ministry of Public Works – responsible for water sector policy

• Water services\textsuperscript{46,47}
  • Week 1 - urban zones restored
  • Week 2 – 100% restored (96.9% pipes, 3.1% trucking, etc.)
  • Only outside assistance for water was in camps (5-8 weeks)
### 2010 Chilean Earthquake

#### Comparison of Haitian and Chilean earthquakes of 2010

<table>
<thead>
<tr>
<th></th>
<th>Haiti</th>
<th>Chile</th>
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<tbody>
<tr>
<td><strong>Magnitude</strong></td>
<td>7</td>
<td>8.8</td>
</tr>
<tr>
<td><strong>Distance from population center</strong></td>
<td>25km</td>
<td>105km</td>
</tr>
<tr>
<td><strong>Depth</strong></td>
<td>13km</td>
<td>35km</td>
</tr>
<tr>
<td><strong>Deaths</strong></td>
<td>222,570</td>
<td>521</td>
</tr>
<tr>
<td><strong>Injuries</strong></td>
<td>300,000</td>
<td>12,000</td>
</tr>
<tr>
<td><strong>Displaced</strong></td>
<td>1,300,000</td>
<td>800,000</td>
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<tr>
<td><strong>Damage Estimate</strong></td>
<td>$10 billion</td>
<td>$30 billion</td>
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<tr>
<td><strong>Building Codes</strong></td>
<td>none</td>
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</table>
Lessons Learned:

1) Improve disaster response services to rural areas or develop education programs that emphasize individual preparedness and coping strategies when assistance is limited or unavailable

2) While earthquakes are the most common disaster, ensure strong policy is in place for other disaster events as well (i.e. major flooding)

3) Continue updating, implementing, and enforcing building codes designed to withstand seismic activity

2010 Chilean Earthquake
General Lessons

1) Adopt a **culture of preparedness**
2) Include plan for **secondary disasters**
3) Develop **secondary water sources**
4) Rural areas should expect slower emergency response and make **appropriate preparations**
5) **Relatives and friends** that can provide temporary shelter helps alleviate water supply and contamination issues common in displacement camps
6) **Redundancy** in preparedness, management, and response
## Summary of Consequences

<table>
<thead>
<tr>
<th>Event</th>
<th>Fatalities</th>
<th>Displaced</th>
<th>Homes Damaged/Destroyed</th>
<th>Damages ($billions)</th>
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</thead>
<tbody>
<tr>
<td>2004 Indian Ocean Tsunami</td>
<td>225,000</td>
<td>3,000,000</td>
<td></td>
<td>9.3</td>
</tr>
<tr>
<td>2005 Hurricane Katrina</td>
<td>1,300</td>
<td>800,000</td>
<td>300,000</td>
<td>156</td>
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<tr>
<td>2008 Cyclone Aila - Bangladesh</td>
<td>180</td>
<td>829,000</td>
<td>600,000</td>
<td>0.04</td>
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<tr>
<td>2010 Haitian Earthquake</td>
<td>222,000</td>
<td>1,000,000</td>
<td></td>
<td>10</td>
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<tr>
<td>2010 Chilean Earthquake</td>
<td>521</td>
<td>800,000</td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>
Future Research

How can the private sector be more formally included in disaster management plans?

• International Bottled Water Association (IBWA)
  • “Throughout the years, bottled water companies have responded to the need for clean water after incidents such as the 2013 chemical spill in Charleston, West Virginia; Hurricanes Sandy and Katrina; and numerous floods, wild fires, and earthquakes.”

• Anheuser-Busch
  • Donated over 1,000,000 cans to Sandy Relief
  • “Relief workers and people in the region are in need of safe, clean drinking water, and Anheuser-Busch is in a unique position to produce and ship large quantities of emergency drinking water.”
References

General


2004 Indian Ocean Tsunami

References continued

2005 Hurricane Katrina


2009 Bangladesh Cyclone

2010 Haitian Earthquake


2010 Chilean Earthquake

44. Superintendencia de Servicios Sanitarios (2010), Gobierno de Chile. Resumen de Situación al: Domingo, 14 de Marzo de 2010.
46. Ganadillo, Michael (2011). UN Coordination Associate for Haiti, personal communication, 12 April 2011.
Thank You

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