Sustainable Household Groundwater Supply: Building Upon Five Decades of Experience in Eastern Madagascar

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Overview

1. Introduction
   - Self-supply
   - Research Context / Country Context

2. PART A: Pitcher Pump Systems Madagascar
   i. Technologies: Suction Pump and Manually Driven Well
   ii. Assessment of market in eastern Madagascar
       - Extent of Use
       - Water Quality
       - Cost

3. PART B: Pilot Study - Building upon existing drilling practices
   i. More-recent history of manual drilling in Madagascar
   ii. Alternative well casing for driven well
   iii. Preliminary Results and Next Steps
Self-supply

“the improvement to household or community water supply through user investment in water treatment, supply construction and upgrading, and rainwater harvesting” (Sutton, 2009)

• based on idea of users making affordable, incremental improvements to their private family or neighborhood water supply systems (e.g. improving an existing hand dug well)

• can be complementary to conventional community water supply systems

• Self-supply has been vital to achieving rural water supply coverage in the ‘developed world’, and still plays a big role in the US
Madagascar Pitcher Pump Assessment

Objectives:

1) To assess user experience and associated water quality of a locally-manufactured household groundwater supply system prevalent in eastern Madagascar

2) To assess local manufacturing practices and sales of these systems

* first in-depth assessment of this type of system in Madagascar
Madagascar

- Population est.: 22 million
- 151st out of 187 countries (HDI), 2012 Human Development Report

Water Supply

- as of 2011, 34% of rural population estimated to have access to improved drinking water source [16% in 1990] (JMP, 2013)
- In urban areas of Madagascar, improved drinking water source coverage was estimated to be at 78% in 2011 (JMP, 2013)
- Given the low rate for improved water supply coverage in Madagascar, it is important to consider all feasible options to increase coverage
- Madagascar has a significant history of Self-supply systems using low-cost technologies for accessing groundwater, which offers potential for research and further development
Pitcher Pump

Reprinted from Mihelcic et al., 2009, with permission of Linda L. Phillips

Photo: M F MacCarthy
Construction and Installation
## Research Methodology

**Mixed methods**
- Household Water & Sanitation Survey
- Water Quality Testing
- Water Infrastructure Inspection
- Semi-Structured Interviews
- Focus Group Discussions (3)
- Observation of System Construction and Installation

<table>
<thead>
<tr>
<th>Location</th>
<th>No. of household visits (including survey and water infrastructure inspection)</th>
<th>No. of semi-structured interviews</th>
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<tbody>
<tr>
<td>Tamatave (City)</td>
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<tr>
<td>- Mangarivotra South</td>
<td>18</td>
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<td>- Analankinina</td>
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<td><strong>TOTAL</strong></td>
<td><strong>53</strong></td>
<td><strong>16</strong></td>
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RESULTS – PITCHER PUMP ASSESSMENT

EXTENT OF USE
- Estimated that there are **9,000 Pitcher Pump systems used in Tamatave** (by 170,000 out of 280,000 population)

WELL RELIABILITY
- 94% (50 out of 53 households) reported that their Pitcher Pump wells provide water throughout the entire year.

PUMP ATTRIBUTES
Analysis of focus groups of owners of Pitcher Pump systems showed the attributes that pump owners found important were:

1) Low purchase cost and low running costs (i.e. operation and maintenance) of the systems,

2) Reliability of the system (compared to either a piped water supply system or a community well), and

3) Convenience, i.e. ease of access to their system and proximity (compared to community water points)
LOCAL CONSTRUCTION
- Pitcher Pump systems are built by an estimated fifty separate local small businesses in Tamatave
- Pitcher Pump system installation (well drilling/installation, pump attachment) typically takes 1-4 hours on site

SYSTEM COSTS
- Unsubsidized retail prices of US$35-100
  - typically US$15-25 for pump itself
  - US$5-7 per meter depth (minimum 4-meters)
- All surveyed systems were reported to be 100% UNSUBSIDIZED

* We believe this to be the most significant example of an unsubsidized household handpump market in sub-Saharan Africa.
## WATER QUALITY - MICROBIOLOGICAL CONTAMINATION

<table>
<thead>
<tr>
<th>Location</th>
<th>No. of Pitcher Pump systems sampled</th>
<th>Measured Thermotolerant Coliforms (per 100 ml)</th>
<th>No Growth</th>
<th>0-10</th>
<th>11-100</th>
<th>greater than 100</th>
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<td><strong>18</strong></td>
<td><strong>5</strong></td>
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<tr>
<td>% of total Pitcher Pump systems sampled</td>
<td>27</td>
<td></td>
<td>27</td>
<td>35</td>
<td>10</td>
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According to the WHO, lead exposure is related to numerous health issues, including neurological issues, cardiovascular disease and issues with fertility and pregnancy (WHO, 2011).
Possible Sources of Pb Contamination

The presence of lead in water extracted from Pitcher Pump systems is likely from a combination of three sources:

1) lead commonly used in the two pump valves (as weights on leather valve flaps)

2) lead leaching from brass well screens

3) lead-containing solder used to attach the well screens to the galvanized iron well casing.
Potential options for ‘technology improvements’ focus on improving water quality, and include:

(1) **Adaptations to Pitcher Pump system components:**
   - Elimination of lead-containing pump components
   - Use of wellhead protection
   - Possible increased well installation depth

(2) **Household Water Treatment and Storage.** Focus on existing boiling practices.

(3) **Household Rainwater Harvesting for drinking water**

(4) **Formative Research – Social Marketing**
   - Identify factors that both adopters and manufacturers find important / appreciate about Pitcher Pump systems (i.e. why do consumers keep buying/using them, why do manufacturers keep making/selling them)
   - Develop a plan within a Social Marketing Framework for improvements to the existing Pitcher Pump market, and assess recommended changes for feasibility and sustainability

(5) **Pilot study: Alternate well drilling/installation practices, that build upon existing knowledge and practices**
PART B: Pilot Study - Building upon existing drilling practices

More-recent history of manual drilling in Madagascar

Several manual drilling techniques have also been introduced to Madagascar over the past decade, including:

- hand-augering introduced by an FAO project
- jetting by MedAir
- rota-sludge drilling by the Practica Foundation, and
- hybrid percussion-jetting-rotation (‘standard EMAS’) manual drilling by Bushproof.

While each of these technologies has played a role in increasing access to groundwater in parts of rural Madagascar, none of them have achieved scale in an unsubsidised Self-supply market.
Installation of Monitoring wells
Part B: Next Steps

- Research of shallow drilled well installation practices in Bangladesh, India
- Testing of Pitcher Pump on PVC (pressure rating) well casing
Acknowledgments

• Support from USAID & the National Science Foundation*
• Marie Onnie Razafikalo, local research assistant
• James Mcknight, USF Dept. of Global Health (College of Public Health)
• Dr. Maya Trotz, Dr. Jeff Cunningham, and Dr. Sarina Ergas, USF Dept. of Civil & Environmental Engineering

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PART A- New, open-access publication on this topic in October 2013 edition of Water Alternatives journal, available at:
http://www.water-alternatives.org/index.php?option=com_content&task=view&id=45&Itemid=44

*This material is based upon work partly supported by the National Science Foundation under the “Graduate Scholarships to Achieve Sustainable Infrastructure at the Water-Energy-Global Nexus” program (Grant No. OISE-0965743). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.