RWSN 2014 Webinars
(Sept – Dec)

- UPGro – Africa Groundwater Research
- Rainwater Harvesting
- Water Point Mapping

A series of webinars in English and in English/French

23rd September – 9th December 2014

Register on:
http://tinyurl.com/RWSN2014
Sustaining Groundwater Supplies

• Water for Wajir. Assessing Risks of Developing Groundwater Resources of the Merti Aquifer Kenya - Jan de Leeuw

• A Hidden Crisis: unpicking the causes of failure of handpump boreholes - John Chilton

• Discussant — John Gowing
A hidden crisis
unravelling the causes of failure in rural groundwater supply

Helen Bonsor, Naomi Oates, Vincent Casey, Richard Carter, Alan MacDonald, John Chilton, Roger Calow, Rebecca Alowo, Paul Wilson, Martin Tumutungire and Bennie Mangeni

Presented by John Chilton
Crisis, *What crisis?*

- Mounting evidence that 20–40% of rural handpumps are non-functional in 2 years
- Therefore, for many the benefits of improved access to water are lost
- Cumulative cost estimated to be $1.2bn
- Often hidden – focus is on coverage

*And:* 300 m people are still without access – with significant investment planned to meet SDGs.
Many of these people are in highly groundwater dependent countries
Why DO handpump supplies fail?

Largely anecdotal, but many reasons are given;
Mechanical breakdown, inadequate groundwater quantity and quality, lack of community involvement, no effective maintenance, increasing demand, climate change…………………

But why do they REALLY fail?
UPGro offered a unique opportunity to improve the evidence base for supply failure:

“The underlying causes of failure of groundwater-based water supplies are complex and multifaceted, but with the correct expertise and methodologies the reasons for failure can be understood, diagnosed, predicted and mitigated”
Symptoms, causal factors and underlying conditions

This is why we needed so many different skills in our team!
Exploring causal linkages

Failure of water supply service

Problems with access

- Borehole produces too little water
- Water quality not acceptable

Operation and management too burdensome

- Handpump is unreliable
- Revenues are insufficient to cover costs

Water quality not acceptable

- Why? Taste, smell and/or appearance are unpleasant
- Why? Water quality testing has failed to reflect these aesthetic factors
- Why? WQ testing has not been enforced

Why? Water chemistry or microbiology are below national standards

Why? Borehole is too distant from or far down-slope of community

Why? Borehole was poorly sited from user point of view

Why? Alternative sources are more convenient and free

Why? Some or all of users are restricted from using the source

Why? Repairs and maintenance are beyond the skills of the community

Why? Community does not receive external support to manage its water point

Why? There is no culture of paying for water

Why? Users are unwilling to pay the required tariff

Why? Users are unable to pay the required tariff

Why? There is very little cash

Why? There is little income-generating activity

Why? Inadequate understanding of borehole design principles by client organisations

Why? Inadequate test pumping and decision-making

Why? PWL is too deep

Why? Borehole not deep enough

Why? Borehole poorly sited

Why? Low transmissivity

Why? Geogenic reasons, poor source protection and/or corrosion of inappropriate pump materials

Why? Inadequate test pumping and decision-making

Why? Use of inappropriate standard designs

Why? PWL is too deep

Why? Borehole not deep enough

Why? Borehole poorly sited

Why? Low transmissivity

Why? Productive layers cased off

Why? Poor quality control

Why? There is no QC authority for handpumps

Why? Inadequate test pumping and decision-making

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Why? Inadequate understanding of borehole design principles by client organisations

Why? A few communities lack cohesion or the willingness to work together

Why? Conflicts, lack of trust and/or weariness with volunteering reduce WUC effectiveness

Why? Inadequate test pumping and decision-making

Why? Water quality testing has failed to reflect these aesthetic factors

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Approach to pilot study

**definition of failure:**
“an inability to supply sufficient quantity or quality of water for domestic needs, year-round”

Study focused on boreholes with handpumps in the Basement aquifer in Amuria and Katakwi Districts, Eastern Uganda
Community surveys

Discussion with the community of history of planning, siting, construction, operation and management and financing of the supply

Dominant symptoms of failure

- Poor yield (year round)
- Poor quality (year round)
- Poor yield & poor quality (year round)
- Seasonality (yield & quality)
- Mechanical failure
Taking pumps and boreholes apart

• Observe pump operation and condition
• Take out, observe, measure, photograph the failed pumps
• Measure borehole depths, water levels and verticality
• Inspect borehole with CCTV
• Carry out pumping tests
• Take full field and laboratory chemistry

*This is an important novel aspect of the study*
# Symptoms and causal factors

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<th>Site</th>
<th>Pattern of failure</th>
<th>Symptom of failure</th>
<th>Causal factors of failure</th>
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<td></td>
<td>Repeated</td>
<td>Groundwater resource</td>
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<td>Early catastrophic</td>
<td>Resource quality</td>
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*Orange – poor quality; purple – low yield; blue – pump head, grey - other contributory factors*
Symptoms and causal factors of supply failure

*asking why?*

**Symptoms**

- poor water quality and mechanical breakdown from corrosion (4 sites)
- insufficient yield and poor water quality (2)
- insufficient yield (3)
- mechanical breakdown of pump head (1)

**Dominant causal factors**

- Low natural groundwater pH and Eh; use of GI materials
- Borehole design inappropriate for the aquifer; use of GI materials
- Poor siting; design not suited to the aquifer; low groundwater potential
- High water demand; limited capacity of community to maintain

*Also looked at the different parts of the service delivery chain (planning, construction, maintenance)*
Looking at the service delivery chain

<table>
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<td>Process for siting</td>
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In our pilot study, problems derive most frequently from the construction phase.
Underlying conditions and root causes

*Again asking why?*

- Entrenched practices in implementing agencies
- Lack of understanding of local groundwater conditions affecting design of boreholes and pumps
- Deficiencies in procurement processes and contracting arrangements
- Almost total lack of field supervision of construction

*All these derive partly from an absence of technical capacity*

- For communities, lack of training, difficulty of financing and poor communication channels

*These would have been important, but at these sites the programme-related root causes haven’t really given the communities much of a chance!!!!*
What next?

We need to:

• examine the roles, responsibilities and capabilities of the several levels of government;
• look at the relationship between community management and wider governance and institutional arrangements;
• look harder at the various roles of the private sector;
• investigate more sites: our field sample was inevitably small and biased;
• look at seasonal and time factors; both technical and community investigations were “snapshots”; 
• continue to think conceptually about the science, philosophy and logic of cause and effect;

Fortunately we have an opportunity to do these, and to extend to Malawi and Ethiopia in the full UPGRo Consortium Grant
Every picture tells a story

And some of them lead back quite a long way!!

Thank you
Unlocking the Potential of Groundwater for the poor

upgro.org

RWSN’s Groundwater Community:
https://dgroups.org/RWSN/groundwater