A TRANSDISCIPLINARY CO-DESIGN AND BEHAVIOUR CHANGE APPROACH TO INTRODUCING SODIS TO RURAL COMMUNITIES IN MALAWI

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Introduction

Despite the increasing volume of evidence demonstrating the efficacy of solar water disinfection (SODIS) as a household water treatment technology, there still appear to be significant barriers to uptake in developing countries. SODIS potential is often treated with skepticism both in terms of effective treatment, and the safety of plastics used. As such it is often dismissed in preference for more accepted technologies such as ceramic filters and dose chlorination.

We report formative findings of the WaterSPOUTT (Water – Sustainable Point Of Use Treatment Technology) project (www.WATERSPOUTT.eu), carried out at the Centre for Water, Sanitation, Health And Appropriate Technology Development Centre (WASHTED) at the University of Malawi – Polytechnic from June 2016 – September 2018. The outputs of this formative stage will lead to the piloting of a SODIS system for 12 months (November 2018 – October 2019) in Chikwawa District, Southern Malawi.

This posterhighlights activities pertaining to co-design process between the transdisciplinary research team, and potential end users. The process sought to ensure that the design is, socially accepted, locally adapted, and can be effectively operated and managed during field trials. We present results to date.

Methods

The development of the SODIS system was constructed to be an informed co-design process with the recipient communities, taking into consideration their specific needs, challenges and perceptions. As such the design process had 2 stages: (1) understanding the context, and (2) a cyclical design process (Figure 1). The processes took place over 18 months and ran concurrently at some stages.

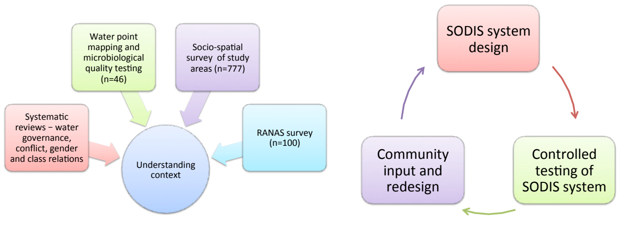

Figure 1: Stages one and two of the co-design process

Results

Understanding Context

The results of the systematic review indicated that although significant progress has been made in access to improved water systems in Malawi in the last 20 years, water access and governance in Malawi are affected by a number of issues including:

- Reducing volume of freshwater available per capita
- Political issues and power relations
- Resources to operationalise policy
- Slow pace of gender mainstreaming
- 82% of rural population dependent on groundwater
- Up to 39% of water points are non functional
- Areas of low coverage (Figure 2) due to hydrogeological challenges
- Average 90% of household water faecally contaminated but only 30% of population treat water

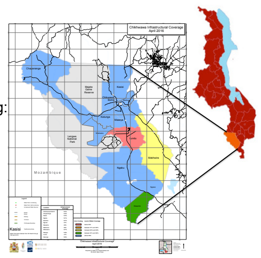

Figure 2: Chikwawa District in Southern Malawi highlighting water coverage by Traditional Authority (TA). TA Lundu shows lowest coverage due to hydrogeological and land use challenges

As a result of the **systematic review**, and in consultation with local government, Traditional Authority (TA) Lundu in Chikwawa District (Figure 2) was identified as suitable for this study, due to the poor coverage of improved functioning water points and poor water access in the area, with 79% of households using unprotected water sources. This is reported to be as a result of poor hydrogeological conditions and current land use for commercial sugar cane production. **Water points were mapped** both during dry season and wet season (Figure 3). Interestingly, there were more water points in dry season than in wet season. This was attributed to points being abandoned due to flooding and contamination of temporary wells that are used during the dry season. Microbiological testing of water points in the wet season showed 80% contamination with *E coli* of water sources overall (100% unprotected sources; 47% protected sources) https://www.idexx.com/en/water/water-products-services/colilert/). Turbidity of water sources ranged from 0 (boreholes) to 400NTU (open water sources) (Turbidity meter-HACH 2100Q).

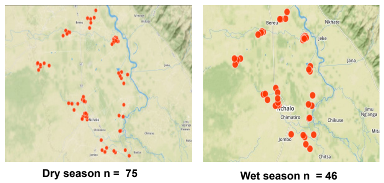

Figure 3: Maps showing water source seasonal variations

Figure 4: Images of water collection points within study area

The **socia-spatial survey** was conducted using a structured questionnaire in 777 households. Questions addressed issues of demography, socio-economic status, water access, water use, water quality, water governance, water treatment and community conflict. Key findings are outlined below:

Access
- 80% primary source unprotected
- 35% >1km away
- 98% collection by female adults
- 45% stated too far
  - 42% don't use nearest source
  - 83% walk for collection
  - 1-2 hours to collect
- 85% > twice a day
- 38% congestion
- 55% have faced water related conflicts

Containers

Collection
- 82% jerrycans
- 58% buckets

Storage
- 48% jerrycans
- 58% buckets
- 16% claypots

Treatment
- 54% said treated water
  - 45% chlorine
  - 9% boiling
- 34% stopped treatment
- 5% heard of SODIS
- 2% used SODIS
- No one currently using
  - Time to treat too long
  - Volume too small
  - Need to remove dirt
  - Cost
  - Don't trust its safe

Social capital
- 50% trust other members of community
- 40% can rely on community to help them
- 21% contributed to community WASH

Gender roles

Female
- 98% women collect and treat
- 99% responsible for hhld chores etc.

Male
- 74% of financial contributions
- 68% of decision making

Financial issues
- Mean income: €18 p/m
- Mean water expenditure: €0.3 p/m
- 88% do not spend money on treatment
- 6% buy water

The **Risks, Attitudes, Norms, Abilities and Self Regulation (RANAS) modelling** provided the data needed to identify behavioural factors which could impact on the likelihood of a water treatment being accepted and sustained at household level. The survey of 100 households identified the main factors in Figure 5.

Attitude	Norms	Abilities	Self Regulation
• Feelings	• Other behaviour • Others (dis)approval	• Confidence in continuation	• Action control • Remembering

Figure 5: Behavioural factors identified for water treatment

Co-Design

Having understood the context in which target communities are accessing and using water, we identified several factors for consideration in the development of a SODIS treatment system which can be categorised under 2 headings:

Physical design
- Larger volumes for household needs
- Remove turbidity
- Provide familiarity (e.g. buckets/jerrycans)
- Low cost and minimal maintenance cost
- Minimal impact on household chore time
- Demonstrate when water is safe

Supporting materials
- Convince of efficacy
- Target whole community to address social norms
- Full household participation to support sustainability
- Educational tools for use (practical) and behavior change

With these in mind, the design team developed several permutations of a large volume (20 litre) SODIS system with a combined simple filtration unit to reduce turbidity before SODIS treatment. These sample systems were subject to 3 levels of evaluation:

1. Efficacy – UV transmittance, longevity/aging, reduction and inactivation of *E coli, MS2* and *Cryptosporidium sp.* were conducted under controlled conditions (Figure 6)

Figure 6: SODIS 20 litre buckets undergoing controlled testing at CIEMAT-PSA

Figure 7: Meetings and testing with local manufacturers in Malawi

2. Ability to be produced locally – this was determined through discussions with local manufacturers and production of model units (Figure 7)
3. User acceptability – this was determined through shared dialogue workshops with community members, demonstrating and evaluating their response to sample systems (Figure 8).

Figure 8: Researchers meet and discuss potential water treatment solutions and designs with beneficiary communities to evaluate user acceptability

This iterative process led to the production of two final systems (Figure 9)

Figure 9: Two prototype systems to be field tested over 12 month (2018 – 2019)
(1) SODIS bucket;
(2) SODIS bucket with cloth pre-filter

Next stage

- Trial in Practice Study of prototypes to finalise designs
- Cluster randomised before and after trial with a control population of prototypes for 12 months

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