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Detailed Review of a Recent Publication: Getting handpump functionality monitoring right can help ensure rural water supply sustainability

Beyond 'functionality' of handpump-supplied rural water services in developing countries
Richard Carter and Ian Ross, Waterlines Vol. 35 No. 1 January 2016

> ***Key Policy and Programmatic Takeaways***
>
> - ***Handpumps will break down:*** *robust systems are needed that provide rapid repairs and keep downtime to a minimum*
> - ***Detailed functionality data are needed:*** *they should include numerous parameters, including age of pump, frequency of breakdown and length of downtime*
> - ***Detailed data can show systematic problems:*** *irreversible breakdown and abandonment early in handpump lifecycles require specific interventions*
> - ***Standard definitions and methods are key:*** *governments should require all agencies providing drinking water through handpumps to use them*

Estimates from the WHO-UNICEF Joint Monitoring Program (JMP), mandated to track progress on water and sanitation, show that in 2015 over half (56.1%) of residents of rural areas of the developing world were still using drinking water sources that fall into the "other improved" category. A substantial number of these sources are boreholes or tubewells fitted with handpumps, and the number of people relying on this technology is growing, rather than shrinking. For instance, JMP estimates prepared in 2011 show that the proportion of the population using boreholes in rural Southern Asia rose from 45% in 1990 to 56% in 2008, an increase of 250 million people.

The humble handpump is a low-cost, low-technology way to provide drinking water, especially to the poor, and has been an important part of the water supply landscape for many years. While some degree of breakdown can be expected with any infrastructure, handpumps have gained a reputation for being plagued with problems. Even assessing the extent of handpump functionality is problematic – there is no globally-accepted standard for defining and monitoring whether they are working. This hampers the efforts of policy makers and program managers to ensure that handpumps, where they are used, are sustainable and provide an acceptable level of service.

A recent paper by Richard Carter and Ian Ross, published in the journal *Waterlines*, explores theissue of handpump functionality, and examines how monitoring of this parameter can be improved.

The paper challenges the reader to think beyond a simple binary definition of functionality that only describes whether the pump was working or not working at the time of assessment. As they point out: "The functionality of a water point today tells us nothing about its functionality yesterday or tomorrow." The paper urges readers to "move beyond measuring and reporting functionality to the use of more informative indicators" and proposes an extended set

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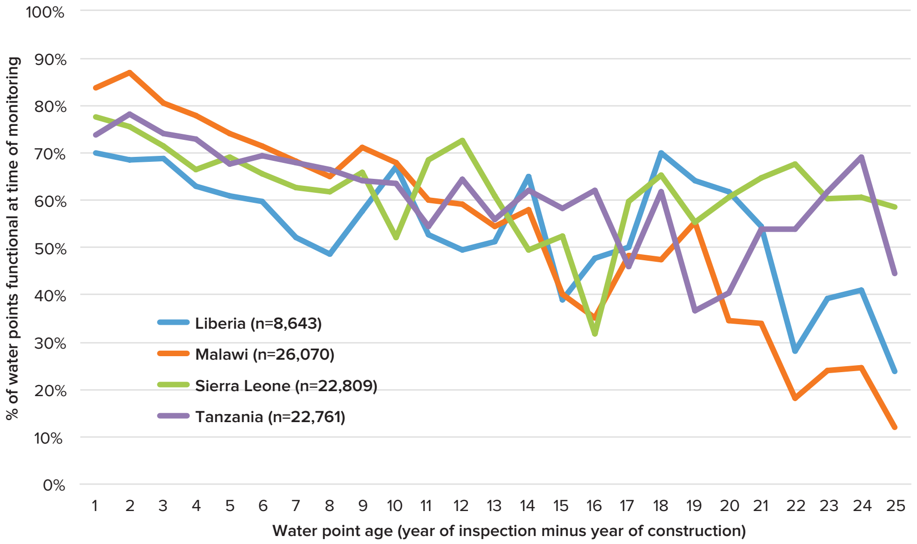
Figure 1. Functionality of water points by age in 4 African countries
(analysis by OPM, data from RWSN WPM group)



Source: Tincani, L., Ross, I., Zaman, R., Burr, P., Mujica, A. & Evans, B. (2015) Regional assessment of the operational sustainability of water and sanitation services in Sub-Saharan Africa, Oxford Policy Management project report available at www.vfm-wash.org

of functionality categories that allows more detailed description of both the status of the pump and the likelihood that it will return to service if it has broken down.

The categories differentiate between water yield and quality limitations, including seasonality constraints, as well as limitations in well siting, design and installation. For instance, the "non-functional" category contains several subcategories, including "non-functional due to mechanical failure at the time of monitoring, but will be repaired," "yield and water quality acceptable, not seasonal" and "non-functional and abandoned; reasons may include unacceptability of water quality or yield, or repeated mechanical failures."

The authors present data that show that as many as a quarter of water points fall out of service within the first year after they are installed (see Figure 1). This is surmised to be as a result of deficiencies in siting, design, construction and construction supervision. The reasons for these deficiencies can be systematic: poor implementation approaches, lack of quality control, lack of accountability of installation agency – and require different solutions than those for problems of on-going management.

The paper points out that some lack of functionality is normal (the authors provide calculations which suggest that any given set of handpumps cannot be expected to exceed 85% functionality), and it is how a system responds to lack of functionality that is important; "breakdown is a challenge that those responsible for managing the water point will inevitably have to face." Repairing a handpump quickly is imperative, as otherwise users are obliged to return to sources likely to be both unsafe and distant. Physical infrastructure must be supported by monitoring, management and financing arrangements that enable the delivery of water over time. A properly drilled well can have a design life of over 25 years, and a handpump is made up of replacement components, allowing it to provide service over an equally long time period.

The authors encourage readers to consider functionality within the context of a broader "service delivery" framework. Recognizing that a binary (functional / non-functional) indicator provides insufficient information to address service sustainability concerns, the authors recommend "the collection of quantitative data on rates of abandonment, frequency and duration of breakdown, combined with descriptive narratives of actions to manage and repair water points, in order to generate more nuanced understanding of service performance."

The paper is well-written, thought-provoking and comprehensive, and the findings have several important policy implications. These include:

Governments should accept that there will be service breakdowns and design robust systems to address them. This means not only reducing the number of breakdowns per year, but also focusing on minimizing the time it takes to repair a pump (downtime). Governments should set realistic targets for functionality, expressed using relevant metrics, and collect data accordingly.

Policy-makers should seek data that are not based simply on binary definitions of functionality, but provide insights into the determinants of sustainability. This means creating data sets that allow differentiation between 1) water yield and quality limitations, including seasonality constraints 2) limitations in well siting, design, and installation, and 3) limitations of handpump maintenance and financing arrangements. Datasets should include information on water point age, frequency of breakdown, and length of downtimes. Understanding these will allow policy-makers and programmers to be able to take appropriate corrective action.

Governments should analyze functionality data to determine whether irreversible breakdown and abandonment is occurring early in handpump

lifecycles, as this indicates problems in site selection, installation, and commissioning. These problems can be rectified through better planning, improved contracting, and building of capacity of well-drillers.

Governments should require all agencies providing drinking water through handpumps to use standard definitions and methods to measure functionality so that a national picture can be drawn. Data collected should include the age of each installation in order to be able to develop a better picture of trends in functionality. A complete picture will include all water points, including those that have been abandoned. The Sustainable Development Goals, adopted by the Member States of the United Nations in September 2015, challenge governments to ensure that everyone has access to drinking water by 2030. One of the proposed parameters to track success is that water is "available when needed." For countries where handpumps are used, a standardized system to monitor, analyze, and respond to functionality concerns will be required to ensure that this aim is met.

Reviewed by Jeffrey Goldberg, Water and Sanitation Advisor, USAID and Clarissa Brocklehurst, UNC Water Institute affiliated adjunct faculty member in Environmental Sciences and Engineering.

Literature review: handpump functionality monitoring

This section provides a review of literature on handpump functionality monitoring. It seeks to highlight some of the functionality measurements used in the literature and describe the challenges that emerge from inconsistencies in the way the results of functionality studies are presented by authors.

The earliest surveys of handpump functionality date back to 1974, but their use for analytical purposes in the literature do not seem to occur until some years later. For example, McPherson and McGarry (1987) cite a 1974 World Health Organisation survey that found that 50% of handpumps installed on tube wells in Bangladesh and Thailand were inoperative at the time of assessment. Mudgal (1997) cites a 1974 UNICEF survey in India that found that 75% of handpumps were inoperative at the time of assessment. These early surveys expressed functionality in terms of a simple binary "working/not working at time of assessment" measurement. This binary assessment standard spans the literature; for instance Cairncross et al. (1980) estimated that 30% of water systems throughout the developing world were not working at any one time and a USAID study in Ethiopia (Schweitzer, et al. 2015) found that 43% of 21 handpumps surveyed were not working at the time of visit.

Other measures have evolved which use additional parameters designed to capture greater nuances in handpump and waterpoint performance. This unfortunately makes cross comparison of results from different functionality studies highly problematic. The challenge of cross comparison is illustrated in a useful compilation of water service failure statistics maintained by Improve International (2015). A total of 125 studies are referenced, drawing upon an array of different survey methodologies, expressing functionality results using a range of different indicators.

Varying measurements of functionality are the focus of a recent literature review covering 117 handpump functionality studies (Wilson et al., forthcoming). This review groups studies into six classes depending upon how they define and measure functionality.

Studies falling into the first class--for example, van der Linde (2015) and Deneke and Hawassa (2008)--do not define functionality but use a binary "working/not working" measure by default. Studies in the second class, including MWE (2010) and UNICEF (2014), define functionality but still use a "working/not working" measure. Studies featured in the third class present a more complex interpretation of functionality, using descriptions such as "needs repairs," "semi-functional," "minimally functional," "broken," "missing parts," and "seasonal," for example, SNV (2014) and Truelove (2013). The fourth class, including the study by Carter and Ross (2016) reviewed in the first part of this Digest, and one by Tincani et al. (2015), feature detailed tiered definitions of functionality, but use a simple binary measurement if more detail is not present.

More than three-quarters of the studies reviewed by Wilson et al. were carried out since 2008, illustrating a growing interest in measurement of functionality and water supply sustainability. Most studies were unpublished grey literature (sixty items), and twenty-four were published in peer-reviewed journals. The review resulted in the following findings:

1. There is no single widely-accepted definition of functionality;
2. Even within individual studies, functionality is often not explicitly defined;

3. It is difficult to compare the results of different functionality surveys due to the lack of clarity on definitions, survey domains and survey methods;
4. A simple binary (functioning/non-functioning) approach is the most common method used in both national surveys and local studies; and,
5. The limitations of a binary approach to defining functionality have led some to define multiple categories, such as partial functionality, but this has made cross comparison of surveys even more difficult.

Although handpump functionality monitoring has been a sporadic feature of rural water supply programmes since the early 1970s, literature on the issue reveals that no consistent monitoring standards have evolved and no widely-agreed indicators yet exist. The lack of a sector-wide standard incorporating multiple parameters jeopardizes the usefulness of many surveys as they may oversimplify the problem of handpump/borehole failure.

A sector-wide standard could include temporal aspects (frequency and duration of downtime), as suggested in Carter and Ross (2016). In this case, challenges associated with user recall would have to be addressed. Fisher (2013) found user recall is best within a two-week timeframe; beyond two weeks there is the risk that recall bias creeps into survey responses. Despite this risk, Fisher recommends looking at failure rates over a year to capture seasonality.

The literature suggests that a useful place to start in order to harmonise functionality monitoring would be, at the very least, to encourage all those tracking functionality to state the definition of functionality used, the domain in which they are sampling, and the methods used to survey functionality. Agreement on a detailed, sector-wide standard for measuring functionality would allow more light to be shed on the true level of service that users receive, contribute to understanding of the determinants of functionality, and help to align policy and programmatic responses.

This literature review was prepared by Vincent Casey of WaterAid, and Alan Macdonald and Paul Wilson of the British Geological Society.

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