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Water system hardware and management rehabilitation: Qualitative evidence from Ghana, Kenya, and Zambia

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ABSTRACT

Background: Sufficient, safe, continuously available drinking water is important for human health and development, yet one in three handpumps in sub-Saharan Africa are non-functional at any given time. Community management, coupled with access to external technical expertise and spare parts, is a widely promoted model for rural water supply management. However, there is limited evidence describing how community management can address common hardware and management failures of rural water systems in sub-Saharan Africa.

Methods: We identified hardware and management rehabilitation pathways using qualitative data from 267 interviews and 57 focus group discussions in Ghana, Kenya, and Zambia. Study participants were water committee members, community members, and local leaders in 18 communities (six in each study country) with water systems managed by a water committee and supported by World Vision (WV), an international non-governmental organization (NGO). Government, WV or private sector employees engaged in supporting the water systems were also interviewed. Inductive analysis was used to allow for pathways to emerge from the data, based on the perspectives and experiences of study participants.

Results: Four hardware rehabilitation pathways were identified, based on the types of support used in rehabilitation. Types of support were differentiated as community or external. External support includes financial and/or technical support from government or WV employees. Community actor understanding of who to contact when a hardware breakdown occurs and easy access to technical experts were consistent reasons for rapid rehabilitation for all hardware rehabilitation pathways. Three management rehabilitation pathways were identified. All require the involvement of community leaders and were best carried out when the action was participatory.

Conclusions: The rehabilitation pathways show how available resources can be leveraged to restore hardware breakdowns and management failures for rural water systems in sub-Saharan Africa. Governments, NGOs, and private sector actors can better build capacity of community actors by focusing on their role in rehabilitating hardware and management and to ensure that they are able to quickly contact external support actors when needed for rehabilitation. Using qualitative and participatory methods allows for insight into rapid rehabilitation of hardware and management.

1. Introduction

Sufficient, safe, and continuously available drinking water is important for human health and development (Bain et al., 2014b; Bartram and Cairncross, 2010). However, 26% of water sources in sub-Saharan Africa contain fecal contamination (Bain et al., 2014a). In rural sub-Saharan Africa nearly 60,000 handpumps and other types of water systems are installed every year; however, one in three handpumps are non-functional at any given time (Rural Water Supply Network, 2009; Sansom and Koestler, 2009). Water system breakdowns force users to use other, often contaminated water sources; and even a few days of consuming water from unimproved sources during a water system breakdown can undermine the health benefits provided by an improved water source (Hunter et al., 2009).

Identifying the causes of rural water system breakdowns and how to address them requires an understanding of rural water supply management (Amjad et al., 2015; Bonsor et al., 2015). Management factors associated with water system non-functionality arise within a community-based management paradigm for rural

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water supplies that was embraced in the late 20th century (Chowns, 2015; Lockwood et al., n.d.; Whittington et al., 2009). Specifically, community management with access to external technical expertise and spare parts has been implemented for rural water system management (Hutchings et al., 2015). External support for community-managed water systems is provided through post-construction support programs, which often focus on technical and administrative guidance and assistance (Kayser et al., 2014; Whittington et al., 2009).

Because most water systems will fail, effective and rapid rehabilitation is vital to ensuring continued access to safe drinking water. While the community management model, coupled with access to spare parts and external technical expertise, has been championed in rural water supply, there is a limited understanding of how the community management model facilitates the rehabilitation of broken water supplies in sub-Saharan Africa. Literature on rural water system sustainability describes factors associated with functionality, including the availability of tools, fee collection, and distance to spare parts (Alexander et al., 2015; Fisher et al., 2015; Foster, 2013). In order to increase the functionality of community-managed water systems, it is important to understand not only what factors are associated with non-functionality, but also how non-functional water systems are rehabilitated. As effective management can efficiently address technical breakdowns, it is also important to understand how to address management failures. To address these gaps, we identified rehabilitation pathways for broken water systems and for management failures, the actors involved in these pathways, and barriers to complete rehabilitation steps using qualitative data from Ghana, Kenya, and Zambia.

2. Methods

Data were collected in eighteen study communities – six each in Ghana, Kenya, and Zambia. Study setting, data collection, and general data analysis are described in Behnke et al., n.d.

Study communities had a water system that had been implemented by World Vision (WV) and that was reported to be functional and managed by a water committee at the time of a representative survey of water systems supported by WV (Kayser et al., 2015). Water systems included handpumps, mechanized pump systems (solar-powered or generator-powered), or gravity-fed piped systems. Data were collected between June and August 2015. Researchers spent one week in each study community conducting interviews, focus group discussions, and participatory activities with water committee members, community members, and local leaders. WV employees, government employees, and private sector employees engaged in supporting the water systems were also interviewed. All participants gave verbal consent to be included in the study and to have the interview or FGD in which they participated recorded. Audio recordings were transcribed in English.

Dedoose ("Dedoose," 2015) was used to code the data. A two-stage coding process was used to allow themes to emerge from the data. Excerpts within groups of codes were examined to analyze themes. Water system hardware and management breakdowns were broadly identified during coding. Further analysis of coded excerpts was focused on identifying type of support used, generalized steps for rehabilitation, the actors involved at each step, and barriers to rehabilitation. Constraints were separated into: those that slow the rehabilitation, resulting in a longer breakdown period; and those that halt rehabilitation, resulting in a terminal failure of the water system.

A broad definition of hardware breakdown that includes anything but complete functionality was used. This includes systems that were not functional or at reduced functionality (e.g. functional but turbid water or functional but hard to pump) as defined by Leclert's classification of the operational status of a borehole (Leclert, 2012). As there were occasions when a water committee was mostly serving its purpose but could be improved, a similar approach is taken for management rehabilitation: anything less than complete functionality was considered amenable to rehabilitation.

2.1. Ethics statement

Ethical approval and all relevant research permits or exemptions from the US university (exemption, project 15-0902), Ghanaian Ministry of Water Resources, Works and Housing (physical project approval letter, reference number SCR/JQ-52/173/049), Kenyan National Commission for Science, Technology and Innovation (physical permits, NACOSTI/P/15/8498/6556 and NACOSTI/P/15/8024/6557) and Zambian Ministry of Housing and Local Government (physical approval letter, reference number MLGH/101/18/22) were received.

3. Results

3.1. Hardware rehabilitation

Four pathways were identified between the recognition of a hardware breakdown and the return of a water system to functional status, based on the types of support actions involved in rehabilitation:community support actions; community support with external financial support actions; community support with external technical support actions; or community support with both external technical and external financial support actions.

Support actions carried out by the community are involved in all successful rehabilitation pathways; in no case in the data did an external actor rehabilitate the water system without involvement of the water committee or other community leaders in the study communities.

While data on the frequency of each pathway were not collected, analysis involved counting excerpts that mentioned a specific rehabilitation pathway. The two pathways that occurred most frequently were those involving only community support actions and involving community support with external technical support. The pathway involving community support with external financial support actions occurred least frequently, accounting for less than 10% of excerpts that referenced a specific rehabilitation pathway. Of the three study countries, the pathway including both external financial and technical support was more common in Kenya than in Ghana and Zambia. Most of the water systems in study communities in Kenya were mechanized as compared to handpumps in most study communities in Ghana or Zambia; water committees more frequently accessed both external financial and technical support for the more complex mechanized systems in Kenya than for the handpumps in Ghana and Zambia.

Functional roles necessary for rehabilitation are defined and examples are given for each functional role in Table 1. Several actors fulfill multiple functional roles.

Fig. 1 shows the steps for each rehabilitation pathway and the functional roles in each step. The step of contacting technical support requires the same functional role – referrers – regardless of pathway, although the referrers connect with different actors depending on the pathway. System users often help with the actual repair of hardware when external technical support is not involved.

Table 2 shows the constraints that slow or halt rehabilitation at each rehabilitation step, which are discussed with each pathway description below.

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