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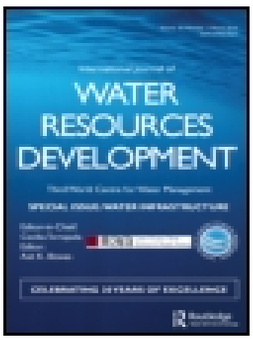

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Importance of internal factors for community-managed water and wastewater systems in Cochabamba, Bolivia

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ABSTRACT

Community management is often seen as part of the solution to increase access to drinking water and wastewater management where municipal services are lacking. This article intends to increase the knowledge regarding self-organized community-managed water and wastewater systems in urban and peri-urban areas. A theory-building case-study approach, including three different neighbourhoods in Bolivia and their respective community-based organizations, was selected. Four prerequisites – leadership, agreed vision, collective action and management – and associated enabling factors connected to three distinct planning and management phases were found to be of major importance for community-managed water and wastewater systems.

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Introduction

Rapid urbanization in our global cities means that many municipalities struggle to provide basic services to their growing populations. This means that many areas, especially informal peri-urban settlements, lack piped water and basic sanitation facilities. In 2015, 15% of urban dwellers lacked access to safely managed drinking water services, and 57% lived without safely managed sanitation services (WHO/UNICEF, 2017). Obtaining universal access to safe water and sanitation services, as specified by the Sustainable Development Goals, will require the investment of significant resources and time by many actors. The World Health Organization (2014) estimates that formal service providers currently deliver drinking water to 71% of the urban population, and sanitation services to only 50%. The rest resort to informal service providers, such as community-managed systems and private operators.

Worldwide there is an increasing trend towards participatory approaches that engage communities and citizens to take control of local environmental resources (Agrawal, 2001). Community management is often seen as part of the solution if all citizens are to gain access to safe drinking water (Barde, 2017; Calzada, Iranzo, & Sanz, 2017; González Rivas, Beers, Warner, & Weber-Shirk, 2014; Whittington et al., 2009). Mara and Alabaster (2008) argue that it is important to address groups of households and neighbourhoods

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Supplemental data for this article can be accessed here.

to speed up access to improved water and sanitation services. But there is no consensus on the impact of community-managed water and sanitation systems. Many studies criticize community management and question the ability of communities to implement or manage communal water systems (Adjei & Charles, 2015; Bisung, Elliott, Schuster-Wallace, Karanja, & Bernard, 2014; Blaikie, 2006; Chowns, 2015; Mandara, Butijn, & Niehof, 2013). Informal service providers are generally not regulated or supervised by the state (Gerlach & Franceys, 2010; WHO, 2014). It is often highlighted that community-managed systems need external support to function in the long run (Calzada et al., 2017; Foster, 2013; Harvey & Reed, 2006; Hutchings et al., 2015). The experiences of water projects in developing countries show that many systems break down and stop functioning due to lack of maintenance. In contrast, there are also many examples of functioning community-managed water and sanitation systems of varying complexity (Barde, 2017; González Rivas et al., 2014; Kyessi, 2005; Ostrom, 2011; Smits, Rojas, & Tamayo, 2013). Whittington et al. (2009) claim that the trend of failing communal systems has changed that and many community-based water systems actually do work. But there are different forms of community management, and the types of governance differ among community-based organizations (CBOs) (Bakker, 2008). Some authors, such as Moriarty, Smits, Butterworth, and Franceys (2013) and Hutchings, Franceys, Mekala, Smits, and James (2017), emphasize the importance of community management where CBOs proactively seek professional support.

Despite extensive research on community-managed water services, there is a need to better understand community-based water and sanitation services (Mandara et al., 2013; Moriarty et al., 2013), especially from a multidisciplinary point of view (Kumar, 2018). Some authors, such as Calzada et al. (2017) and Dickin, Bisung, and Savadogo (2017), argue that there are few in-depth studies regarding the underlying mechanisms behind community management, i.e., few theory-building studies. The study presented here was therefore not limited to a predetermined set of parameters but was inclusive and explorative in character. In addition, it tried to expand existing knowledge to self-organized communal systems and urban areas. Many studies focus on community-managed systems which have been initiated by external development programmes (Alexander, Tesfaye, Dreibelbis, Abaire, & Freeman, 2015; Chowns, 2015; Hoko & Hertle, 2006; Tigabu, Nicholson, Collick, & Steenhuis, 2013), though there are various forms of community management, including self-organized communal systems (Calzada et al., 2017; Ostrom, 2011; Pahl-Wostl, Lebel, Knieper, & Nikitina, 2012). Furthermore, few studies focus on community management in urban and peri-urban areas, despite its significance (Adjei & Charles, 2015; Cain, 2018; Kyessi, 2005; WHO, 2014), especially for the rapidly growing peri-urban areas (Butterworth & Warner, 2007).

Bolivia has a long tradition of community initiatives and various types of CBOs (Albro, 2006; Calzada et al., 2017). In the metropolitan area of Cochabamba, many neighbours join together and implement water and wastewater systems through community work and internal or external financing, due to the absence of state-driven service provision (Cabrera, Farah, & Teller, 2014; Hines, 2015; Marston, 2014; Minelli, 2012). In 2012, 56% of the residents in the metropolitan area of Cochabamba were served by community-managed water systems (TYPSA, GITEC, Land & Water Bolivia and Aguilar and Asociados, 2014). Due to this, many projects and studies regarding community

management have been conducted here, especially focusing on the importance of community-managed water systems for low-income areas (Bustamante & Médieu, 2012; Ledo, 2011; Linsalata, 2015; Menendez, 2015). Some of these focus specifically on how external support should be provided to CBOs that manage water or sanitation (Achi & Kirchheimer, 2006; Faysse et al., 2006). Other studies, such as that of Marston (2014), investigate the interaction and coexistence of communal service providers with other actors of the water sector. Cabrera (2018) explains how community management may contribute to fragmentation of the urban environment. In contrast, this article examines the internal factors that affect the implementation and operation of self-organized community-managed water and wastewater systems.

The aim of this article is to build theory about why and how some urban and peri-urban neighbourhoods self-organize and succeed in implementing and operating communal water and wastewater systems internally (without external support), whereas others do not. Due to the broad and multidisciplinary character of the research question, an ethnographic and theory-building case-study approach of explorative character was selected to provide an in-depth understanding of three CBOs in the metropolitan area of Cochabamba, Bolivia. The cases aimed to represent different types of CBOs and had different socio-economic characteristics. In addition, they all represented unique opportunities for the first author to get to know the CBOs and their members in depth. The results identified a number of prerequisites and associated enabling factors connected to three distinguished phases of community-managed water and wastewater systems: initial implementation; long-term operation; and subsequent improvements. The intention was to lay the groundwork for a framework that contributes to increased understanding of the development of self-organized community-managed water and wastewater systems in urban and peri-urban areas.

Case study description

Cochabamba is the third-largest metropolitan area in Bolivia, with a population of 1.2 million. It is currently experiencing rapid population growth, with annual growth of 8.2% between 1992 and 2012 (Trohanis, Zangerling, & Sanchez-Reaza, 2015), mainly due to migration from other parts of Bolivia. The informal low-income settlements on the outskirts of the city are absorbing most of this growth (Alarcón, Terraza, Cabrera, Maleki, & Lew, 2013). Water and wastewater management are considered important issues in Cochabamba, as shown by relatively high connection rates. In 2012, 89% of the population were connected to piped water supply, and 62% were connected to a sewer system operated by municipal actors or CBOs (see Section S1 in the online supplemental data at https://doi.org/10.1080/07900627.2019.1616536 for more details). Sewerage does not in most cases imply adequate wastewater treatment. Only two of the seven municipalities in Cochabamba operate wastewater treatment plants, and these plants only treat some parts of the wastewater produced in these municipalities. In addition, in contrast to community-managed water systems, there are few CBOs which implement and manage sewer networks or wastewater treatment. Water contamination is a big threat to the water supply and environment in Cochabamba.

There are 619 community-managed water and wastewater systems in Cochabamba, providing 56% and 9% of coverage for water and sewerage, respectively (TYPSA, GITEC,

Land & Water Bolivia and Aguilar and Asociados, 2014); see Section S1 in the online supplemental data for more details. The most common forms of community-managed systems are OTBs (Base Territorial Organizations), service cooperatives and water committees. But there is no common terminology among concerned stakeholders. OTBs are part of the political and administrative system. The municipalities are divided into districts, subdistricts and OTBs, which need to fulfil specific administrative requirements. Each OTB represent a specific geographic area and should aim to manage community-led projects. The Law of Popular Participation specifies that 20% of the national budget is earmarked for OTBs and these projects. Some OTBs manage their own water systems independently or together with an informal water committee. Note, however, that OTBs address not only water and wastewater systems but also other neighbourhood improvements. *Juntas vecinales* are the precursors of OTBs, but they are not legal entities, which makes it more difficult to obtain external funding. Service cooperatives are a legal entity registered through an umbrella organization and they also need to comply with specific administrative requirements. But they have no direct connection to the political system, which makes it more difficult to apply for funding from the authorities. Water committees are an informal way of organizing, and there are no legal requirements on governance structure.

Study sites

Three distinct CBOs in the metropolitan area of Cochabamba and their respective neighbourhoods, labelled here Sites A, B and C, were selected as case studies (Table 1), covering successful and unsuccessful implementation and operation of water and wastewater systems at the community level. None of the neighbourhoods is connected to municipal water infrastructure; all have an active CBO that focuses on neighbourhood development, including improvement of water and wastewater services. Apart from this, the selection criteria attempted to select distinct and different cases to facilitate wide-ranging theory-building (Eisenhardt, 1989); even case study sites that lack community-managed water and wastewater systems offer learnings and contribute to more comprehensive findings (Yin, 2009). The cases represent neighbourhoods of different socio-economic characteristics and types of organizations with distinct water and wastewater systems.

Site A is an established middle-income urban area, which was founded in 1975 when the settlers started to buy plots. The original population was relatively homogeneous, but the neighbourhood has become more diverse over time due to migration (change of house owners and new construction). At first, each household tried to independently improve access to water and sanitation services by digging wells in their gardens or collecting water from nearby springs. Some households constructed pit latrines, while others practised open defecation. Many households later implemented pour-flush toilets. The wastewater was discharged into the open. The neighbours founded a community-managed water and sanitation system in the 1980s which still provides the residents water and sewer infrastructure. Since 2015, they also manage a small wastewater treatment plant. Currently they are organized as a service cooperative.

Site B is a relatively new low-income neighbourhood, settled in the beginning of the 2000s. It is formally registered as a rural area, but the neighbourhood is growing and is in direct connection to the urban area. Many of the initial residents are originally from

Table 1. Main characteristics of the different case study sites, the water and wastewater services offered by the respective community-based organizations (CBOs), and associated costs, in January 2018.

Case study	Site A	Site B	Site C
Municipality	Sacaba	Quillacollo	Cercado
Population (no. of households)	297	215	339
Property rights	Yes	Yes	Ongoing legalisation
Economic group[a]	Middle income	Low income	Low income
Main cultural group	Hispanic	Indigenous	Indigenous
Type of CBO	Service cooperative (initially a water committee)	OTB (initially a water committee)	Junta vecinal
Service by the CBO	Two wells, one storage tank and a piped distribution network to in-house connections; sewer system and a small wastewater treatment plant	Two wells and a piped distribution network to standpipes in the yards or in-house connections	Nothing
Quality	Non-continuous water supply with occasional high turbidity	Continuous water supply without regular water quality checks	n/a
Future plans	Purification stage and communal rainwater and surface water collection	Sewer infrastructure and a wastewater treatment plant	Connection to the municipal enterprise (SEMAPA)
Water tariff	Water: USD 0.25–1.00/m^3 Sewer: USD 0.10–0.16/m^3 (tariff increases with consumption) Wastewater treatment: 3.30 USD/month	Water: USD 0.3/m^3	n/a
Connection fee	Water: USD 597 Sewer: USD 274	Water: USD 678	n/a
Member fees	One-time inscription fee: USD 101	USD 0.3/month	USD 0.3/month
Sanction when missing activities	USD 7.20	USD 1.4–14.4	USD 1.4–14.4

[a]A qualitative assessment based on field observations.

the countryside of the Altiplano, i.e., they belonged to the same cultural group, with similar habits and traditions. This contributed to a strong sense of shared identity. However, recent migration from other parts of Bolivia has increased the diversity in the neighbourhood. At first, the residents went to a neighbouring area to buy water, but soon after the initiation of the neighbourhood they implemented an informal community tap connected to a storage tank, which they used briefly. They discharged the wastewater into the open. Some of the residents used some type of latrine, but many practised open defecation. Today all the residents are connected to the water system of the OTB, which the residents implemented together in 2001. The wastewater is still discharged into the open, but the OTB is currently implementing a sewer network in collaboration with neighbouring areas and the municipality of Quillacollo. The social pressure to construct some type of sanitation facilities in general is increasing, and an increasing number of households have constructed pour-flush toilets. But some residents still practise open defecation.

Site C is a relatively new low-income informal peri-urban settlement, founded in 2002. The leaders of a neighbouring area organized and initiated the settlement. According to the settlement leaders, the formal aim was to facilitate housing for poor tenants. But this was not entirely true, since many of the settlers were owners of plots even prior to the settlement, leading to disagreements among the residents. The residents of Site C originate from different parts of Bolivia, but they feel some common connection through belonging to the settlement. When entering the area, they formed a junta vecinal, which aimed to improve the neighbourhood, e.g., with property rights and infrastructure. Due to lack of formal property rights they could not form an OTB. Around 2006, they got informal promises to the land from the municipality, which contributed to increased investments in housing and neighbourhood development by the individual households and the junta vecinal. But the legal process is still ongoing. Many informants have emphasized that the residents of Site C really suffered from lack of water during the first years after the settlement in 2002. The little water that was used was discharged into the open, and the majority practised open defecation. The first years, they had to beg the water tankers to come and sell water as close as possible. It improved somewhat in 2004, when the junta vecinal constructed one of the main roads through internal financing by the residents. This enabled the water tankers to enter and sell water on a daily basis. The case study site is currently serviced by water tankers two or three times per day, except in the rainy season, when the residents collect rainwater. With time, as the neighbourhood improved, many households have constructed latrines or pour-flush toilets. Currently, after many years of waiting and hoping by the residents, the municipal enterprise (SEMAPA) are implementing water infrastructure in collaboration with neighbouring CBOs. But there are no formal plans regarding sewerage. Some informants are worried that even when the infrastructure is in place, there will be no water in the system. They have seen other neighbourhoods nearby where households with water connections still have to buy water from water tankers.

Methods

This study has a qualitative research design, which implies iteration between literature, data collection and analysis. An ethnographic and theory-building case-study approach

of explorative character was chosen to study the different CBOs in depth and the context in which they are located, as described by Yin (2009) and by Hammersley and Atkinson (2007). This is suitable because this article investigates technical matters intertwined with complex organizational and social issues. It is not possible nor desirable to develop a clear theoretical proposition or hypothesis before entering the field; instead, the aim of the study guided the course of action (Hammersley & Atkinson, 2007). Data were collected through interviews and observations by the first author during five months in 2013 and two months in 2014. They were complemented with interviews in the beginning of 2018 by a research assistant who already knew the study sites. The data collection and analysis methods described below are in line with both case-study methodology and ethnographic studies.

Data collection

Both formally arranged and spontaneous ethnographic interviews were performed in Spanish by the first author. The interviews took place in the premises of the CBOs, the informants' homes, or nearby, to make the informants feel relaxed and foster understanding of their role as residents of the case study sites, as well as members of the CBOs. The aim was to understand each respective neighbourhood and its CBO in depth. Descriptive information played an important role, as well as explanatory data, i.e., the informants' attitudes and opinions towards each respective neighbourhood and CBO, with emphasis on water and wastewater management. The data collection continued until theoretical saturation was met, when the interviews and observations did not reveal any new information (Flick, 2009; Hammersley & Atkinson, 2007).

Instead of a fixed interview protocol the interviewer had a list of topics to cover through reflexive interviewing (Hammersley & Atkinson, 2007). The following topics were discussed, and changes over time were accounted for by the informants: neighbourhood characteristics; water and sanitation services; and type of CBO and their activities (for details see Section S2 in the online supplemental data). Current and prior leaders of the CBOs were key informants, and the leaders who had the time and opportunity to participate were formally interviewed. Formal interviews with members of the CBOs were also included. These informants were selected through theoretical sampling (Flick, 2009; Hammersley & Atkinson, 2007); i.e., the selection was based on specific selection criteria, in this case gender, age, location of their house in the case study site, and length of time living there. At Site A, the service cooperative had three employees, who also were formally interviewed. The length and number of each interview depended on the informant and their willingness to talk. An additional interview was carried out with informants when some issue was not covered or complementing information was necessary. In total, 69 formally arranged interviews were performed with 47 different informants (for details see Section S3 in the online supplemental data). All formally arranged interviews were audio-recorded and transcribed word for word by the first author.

In addition to the formally arranged interviews, the current leaders and some of the CBO members were approached informally on a regular basis when the data were collected; here these are called spontaneous ethnographic interviews. No prepared list of topics was used. The informal interviews were an opportunity to get to know some of

the informants better and encourage them to speak more freely. They were used to verify descriptive data of the case study sites and their CBOs and collect explanatory data regarding the CBOs and their work. They were recorded by taking notes during the conversations or afterwards. To supplement the interviews the first author also walked around the case study sites almost daily throughout the data collection periods. Observations of the neighbourhoods and their water and sanitation systems were noted.

Implementation and operation of water and wastewater systems is a dynamic process over time. A longitudinal approach, which understands why and how water and wastewater systems develop over time, is suitable. Therefore, each case study site was followed up after the initial data collection periods to see what had happened, as well as to add information that had proved missing during the data analysis. A research assistant who knew the case study sites through the local University of San Simón visited all the sites in the beginning of 2018. She performed in total nine semi-structured interviews with both leaders and members, with three interviews at each case study site, which followed an interview protocol prepared by the first author (for details see Section S2 in the online supplemental data). Again, observations of the site and its technical systems were noted. The research assistant had continuous contact by phone and email with the first author during the collection process.

Data analysis

Data analysis was performed manually by the first author after the main data collection, with continuous input from co-authors. Relevant data from transcriptions and notes were coded and selected for further analysis (Flick, 2009; Hammersley & Atkinson, 2007). Descriptive and explanatory data were separated and dealt with separately. The descriptive data enabled deeper understanding of the study sites, the CBOs and their function, so detailed case descriptions constituted an important part of the analysis (Yin, 2009). Parts of the case study descriptions are included here; for more details see the online supplemental data (Section S4).

The theory-building was constituted by categorization followed by analytic induction and time-series analysis. The coded explanatory data were categorized for respective cases (Flick, 2009). Analytic induction was then applied to develop a theoretical proposition which was supported by all three cases (Hammersley & Atkinson, 2007). This led to identification of prerequisites and enabling factors for implementation and operation of community-managed water and wastewater systems. Time-series analysis, in the form of chronologies, as outlined by Yin (2009), was then applied to each case. The chronological case descriptions, including both descriptive data and explanatory data, enabled identification of distinctive phases connected to different prerequisites and enabling factors. Literature review and contextual information were incorporated into the analysis to facilitate and deepen understanding of the collected data, but it was also a way to strengthen and verify the theoretical proposition, i.e., the developed framework (Yin, 2009).

Limitations

The scope of this study is limited to internal factors, since the focus is on self-organized community management of water and wastewater services. External influences were not

included as variables. Furthermore, important issues, such as gender, democracy and social inclusion, were not considered. The functionality of the included water and wastewater systems was determined by looking at whether or not the desired technical service was provided. But technical factors per se were not included, since this study included different types of water and wastewater systems. In addition, it is assumed that technical constraints, such as lack of technical expertise and material, are not insurmountable barriers to implementation and operation of water and wastewater systems in urban areas.

Ethical considerations

The study presented here was approved by the University of San Simón of Cochabamba, Bolivia, in line with the concerned ethical guidelines. The CBOs of the case study sites and their members gave their approval before data collection began. Participation was voluntarily, and each informant could drop out at any point. All informants were informed about the study and its use before participation, to which they gave their informed oral consent.

Results

The analysis identified four prerequisites that were supported by all case studies and a number of case-specific enabling factors, i.e., different enabling factors allowing a community to fulfil the respective prerequisites. There is no single way of achieving, e.g., successful leadership, but rather multiple pathways for meeting these prerequisites for long-term community management. The importance of the different prerequisites varied over time, i.e., between the three identified phases: initial implementation, long-term operation and subsequent improvements.

Prerequisites for and distinct phases of community-managed water and wastewater systems

Four prerequisites for implementation and long-term operation of community-managed water and wastewater systems were identified: leadership, agreed vision, collective action, and management. All four are interconnected and taken as equally important. They are common to all three case study sites and meant to be relevant for other settings as well. The prerequisites were identified through coding and categorization of explanatory data followed by analytic induction, as outlined by Hammersley and Atkinson (2007). Time-series analysis of the data, following Yin (2009), identified three distinct phases: initial implementation, long-term operation and subsequent improvements. Different prerequisites and enabling factors were connected to the distinct phases.

Leadership

Leadership by one or several leaders is required to unite the residents and initiate collective action to realize an agreed vision. Many of the informants listed different leadership characteristics, but the most cited attributes were ‘inspiring’ and ‘dedicated’. Ability to coordinate and to listen to members were also highlighted by many

informants. It is absolutely crucial that the leader has a personal interest in obtaining community-managed water and wastewater systems. Leadership without formal payment, as is often the case in CBOs, requires personal benefits linked to the project. At both Site A and Site B, leadership originated in the necessities of piped water and wastewater collection for the families of the initial leaders. Many informants at Site C complained about the existing and prior leaders, and some mentioned that the leaders did not even permanently live in the neighbourhood. Note that leadership refers to leadership by one or several persons when implementing community-managed water and wastewater systems or executing subsequent improvements in this study; self-declared or assigned managers are considered with respect to the management prerequisite.

Agreed vision

An agreed vision which is communicated to all members is necessary for the implementation of community-managed water and wastewater systems. It unites the forces, so that the CBO members work together towards the same goal. It is important that everyone recognize and stand by the agreed vision, since discussions and disagreement block collective action. At all the case study sites, all the residents desired piped water and sewerage, i.e., there was a strong demand for water and wastewater services. All informants considered piped water and sewerage self-evident when asked about their preferences regarding water and wastewater systems. The difficulty of agreeing on a common vision was instead related to the type of water governance and to some extent the technical details of the system. At Sites A and B everyone agreed on implementing and operating community-managed water and wastewater systems, but at Site C there was no clearly agreed vision for a communal system. Some informants at Site C wanted a system managed by the CBO, and others preferred connection to the municipal system.

Collective action

As used in this article, 'collective action' is the mobilization of a community and actions taken by a group to achieve an agreed vision. Most informants emphasized that participation of all members, i.e., collective action, is crucial for the implementation and long-term operation of community-managed water and wastewater systems. Collective action also includes financing, since either funding is obtained through collective action internally (i.e., the cost is divided among the members), or financing may be requested from authorities or international donor agencies, which also requires collective action through formal requests and/or protests aiming to put pressure on authorities. At both Site A and Site B there has been directed collective action to implement and operate community-managed water and wastewater systems. In contrast, there was no reported collective action regarding community-managed water and wastewater systems at Site C.

Management

Management, defined as a governance structure which facilitates collaboration and coordination, is necessary for functioning operation and maintenance, and crucial for subsequent improvements and investments in communal water and wastewater

management. It can either facilitate or block subsequent improvements, depending on its structure and its appointed or self-declared managers. Most informants agreed that managers have a crucial role in the daily work and function, i.e., long-term operation, of water and wastewater systems. Many informants also emphasized the importance of work division and procedures to collect and administer member fees. There is a functioning management structure at all the case study sites. At Sites A and B the governance structure was formed in relation to the implementation of the communal systems, and it has developed over time. At Site C the junta vecinal was created to organize the informal settlement process, but it has not led to implementation of community-managed systems.

Distinct phases

Three distinct phases of community-managed water and wastewater systems – initial implementation, long-term operation and subsequent improvements – were identified through time-series analysis. The importance of the prerequisites varies over these different phases (Figure 1). Leadership, agreed vision and collective action are prerequisites for initial implementation, whereas agreed vision, collective action and management are prerequisites for long-term operation. Subsequent improvements through additional investments (e.g., renovations and implementation of new water and wastewater technology) depend on all four prerequisites: agreed vision, leadership, collective action and management.

Enabling factors for community-managed water and wastewater systems

At each case study site, the prerequisites were linked to different enabling factors describing how respective prerequisites may be achieved; i.e., the enabling factors are case-specific. The enabling factors connected to each prerequisite were identified through coding and categorization of relevant explanatory data followed by analytic induction, following Hammersley and Atkinson (2007). Through time-series analysis, as outlined by Yin (2009), the distinct enabling factors were then connected to the different phases of community-managed water and wastewater systems. The case studies are used as instructive examples of how events may occur and what measures can be used to fulfil a specific prerequisite. Note that the enabling factors that constitute the respective prerequisites vary somewhat between phases.

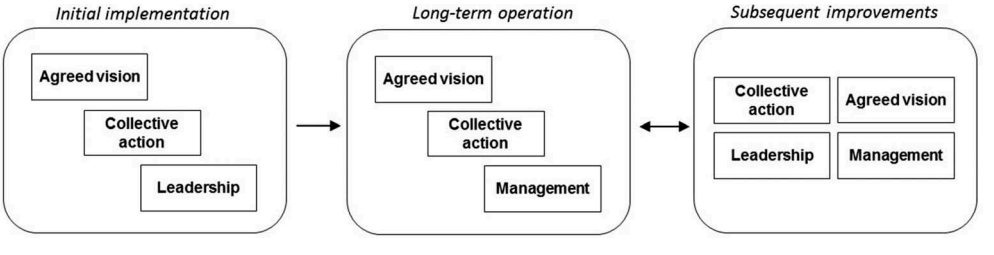

Figure 1. Community-managed water and wastewater systems have three distinct phases, which depend on different prerequisites.

Initial implementation

Leadership, agreed vision and collective action are prerequisites for initial implementation of community-managed water and wastewater systems. Different enabling factors constitute the respective prerequisites at each case study site (Table 2). Sites A and B, which have constructed community-managed water and wastewater systems, fulfilled these prerequisites at the point of implementation. Site C has not implemented communal systems, and thus they do not fulfil the three prerequisites for initial implementation. This can be seen in the low number of enabling factors that are present for each prerequisite.

At Site A, the neighbours implemented a community-managed water and wastewater system in the 1980s, a couple of years after the settlement process started. A communal system was identified and prioritized as a common goal, i.e., an agreed vision. A group of trusted residents provided leadership and united the residents in collective action. The residents financed the implementation internally through a bank loan, and they did as much work as possible themselves. Note that they did not receive external financial support for the implementation. At Site B, the residents implemented a water system in 2001, shortly after the arrival of the first settlers. The demand for piped water was high, and the residents were keen to implement a community-managed system, i.e., they identified and prioritized an agreed vision. Three residents who were trusted members of Site B directed the implementation process, i.e., provided leadership. They united the residents and involved them in collective action. The residents performed repeated protests and took advantage of political contacts to obtain municipal funding. The implementation was financed both through external financial support from the municipality and internal contributions from the members. Site C has not implemented communal systems, despite the intentions of both appointed managers and residents, since the settlement in 2002. Piped water is the desired solution among the residents. But

Table 2. Prerequisites and enabling factors for initial implementation at the three different case study sites. Sites A and B have successfully implemented community-managed systems; Site C (shaded) has not.

Prerequisites	Enabling factors	Explanation	Site A	Site B	Site C
Leadership	Trust	Crucial that the residents trust the leaders	X	X	
	Constructive feedback	Room for improvements by the leader(s)	X	X	
	Continuity	Standing by the agreements throughout the implementation process	X	X	
Agreed vision	Identification of goals	Realization of problems and challenges which need to change	X	X	
	Prioritization	Agreeing among the members on a common agenda and the means to achieve it	X	X	
Collective action	Shared identity	The sense of team spirit among the members	X	X	
	Involvement	Participation in communal activities, e.g., protests and community work	X	X	X
	Internal financing	Ability and willingness among the members to finance the implementation	X	X	
	Visible progress	Important to keep up the momentum among the members	X	X	
	Negotiation possibilities	Opportunities which favour negotiations (contacts, timing, etc.)		X	
	Repeated actions	The number of actions, e.g., protests, affects their impact		X	

there is disagreement over the governance structure: some residents are positive towards community-managed systems, and others prefer to wait for municipal water supply. Therefore, there is no agreed vision regarding communal systems. The residents are involved in the junta vecinal, the existing CBO, but many informants have complained of lacking leadership. The appointed managers are not trusted by the members, and they do not provide continuity, since they often do not support the efforts of their predecessors. Site C is serviced by water tankers two or three times per day, but the municipality (SEMAPA) is currently implementing water infrastructure. For detailed case study descriptions see the online supplemental data (Section S4).

Long-term operation

Agreed vision, management and collective action are prerequisites for long-term operation, but relatively few enabling factors make them up (Table 3). The exact details of the management structure, i.e., the organizational form, seem to be less important for water and wastewater services, since different types of organizations successfully manage water and wastewater systems in the metropolitan area of Cochabamba. Sites A and B are examples of this: despite distinct organizations, both are operating communal systems. But, as noted earlier, the organizational form does affect access to external funding, e.g., only OTBs have access to some parts of the municipal budget.

At Site A, the residents founded an informal water and sanitation committee, which was responsible for operation and maintenance, when they implemented the water and sewer system. In 1995, the members of the informal committee changed its form and registered the organization as a service cooperative. According to the informants, this did not imply any difference in the service quality, but the by-laws and management structure changed quite a lot. At Site B, the neighbours also founded an informal water committee responsible for long-term operation, in connection with the implementation of the water system. In 2013, the informal water committee merged with the OTB (for the same area) to increase involvement in the OTB. The informants stated that the change in governance structure did not change the quality of the service provided. In addition to a management structure, at both Site A and Site B, it was important that the agreed vision was maintained over time, i.e., the residents demanded community-managed services over time. The demand for communal services enabled collective

Table 3. Prerequisites and enabling factors for long-term operation of community-managed water and wastewater systems. Sites A and B are successfully operating water and wastewater systems.

Prerequisites	Enabling factors	Explanation	Site A	Site B
Agreed vision	Standing by agreements	Maintaining the agreed vision, i.e., the common agenda and means to achieve it, among the members	X	X
Management	Self-declared or appointed manager(s)	One or several members who are responsible for the daily work, i.e., operation	X	X
	Internal communication	An open dialogue which contributes to awareness and encourages feedback	X	X
	Transparency	Insight in the daily work, e.g., collection and administration of fees	X	
Collective action	Internal financing	Ability and willingness among the members to pay operation and maintenance fees	X	X
	Involvement	Participation in community work when needed	X	X

action in the form of payment of operation and maintenance fees, as well as community work when needed. See the online supplemental data (Section S4) for more detailed case study descriptions.

Subsequent improvements

Both Site A and Site B have made changes and improved their water and wastewater systems since the initial implementation (Table 4). Some changes were triggered by demands from the members; other improvements were initiated by leaders, who convinced the members of the need for change. All the prerequisites – leadership, agreed vision, collective action and management – are necessary for additional investments in community-managed water and wastewater management. Management was not considered necessary for initial implementation, as written above; on the contrary, the governance structure may facilitate or block subsequent improvements, i.e., it may speed up or slow down implementation processes.

Site A has performed various improvements since the initial implementation of their water and wastewater system. Over the years they have drilled a number of wells and implemented one storage tank, and they have also implemented an additional sedimentation tank (Project A1). In 2015, the service cooperative inaugurated a small

Table 4. Prerequisites and enabling factors for subsequent improvements for Sites A and B. The successful implementations are unmarked; the non-executed ones are shaded.

			Site A				Site B		
Prerequisites	Enabling factors	Explanation	A1	A2	A3	A4	B1	B2	B3
Leadership	Trust	Crucial that the residents trust the leaders	X			X	X	X	X
	Constructive feedback	Room for improvements by the leader(s)	X			X	X	X	X
	Continuity	Standing by the agenda throughout the implementation process	X			X	X	X	X
Agreed vision	Identification of goals	Realization of problems and challenges which need to change	X	X	X	X	X	X	X
	Prioritization	Agreeing among the members on a common agenda and the means to achieve it	X			X	X	X	X
Collective action	Shared identity	The sense of team spirit among the members	X	X	X	X	X	X	X
	Involvement	Participation in communal activities (e.g., protests) and community work	X	X	X	X	X	X	X
	Internal financing	Ability and willingness among the members to finance the subsequent improvements	X					X	
	Visible progress	Important to keep up momentum among the members	X			X		X	X
	Negotiation possibilities	Opportunities which favour negotiations (contacts, timing, etc.)				X	X		X
	Repeated actions	The number of actions, e.g. protests, affects their impact					X		X
Management	Effective decision making	Governance structure which facilitates agreements on changes					X	X	X
	Internal communication	An open dialogue which contributes to awareness and encourages feedback	X	X	X	X	X	X	X
	Transparency	Insight in the daily work, e.g., collection and administration of fees	X	X	X	X			

Note: The subsequent improvements projects at Site A included: (A1) additional wells, storage tank and sedimentation tank; (A2) water purification stage; (A3) wastewater treatment plant without external involvement; (A4) wastewater treatment plant in collaboration with two local NGOs. Site B planned and/or implemented the following projects: (B1) sewers and WTP in collaboration with a local NGO; (B2) additional well; (B3) sewers in collaboration with the municipality.

wastewater treatment plant, consisting of an anaerobic reactor and a wetland, which they implemented in collaboration with two local NGOs (Project A4). Many informants stated that for both Project A1 and Project A4 leadership and agreed vision have been critical for momentum and direction. Financing is of course also needed – either internal financing, as in Project A1, or external financial support, enabled by negotiation possibilities with two local NGOs, in the case of Project A4. Some planned improvement projects have not been realized. One example is that the service cooperative has not implemented a water purification stage (Project A2), despite an obvious need for one, due to occasionally high turbidity. Many residents also wanted to improve the wastewater treatment prior to 2015 (Project A3), when they inaugurated the new wastewater treatment plant, but none of the earlier plans were executed. According to many informants, lack of prioritization and shortage of internal funds were the major reasons that Projects A2 and A3 were not executed. Also, there was no member that took on the leadership role for these projects.

Site B has also performed some improvements since the implementation of their water system. Leadership and agreed vision were highlighted by many informants as important for subsequent improvements. Recently they implemented a new well (Project B2), due to the decreasing water level in the initial well. In addition, they are currently implementing sewer infrastructure with the neighbouring OTBs and the municipality (Project B3), but the details and design of the wastewater treatment plant have yet to be determined. Before the ongoing sewer infrastructure project, Site B planned to implement sewer networks and a wastewater treatment plant in collaboration with a local NGO (Project B1). The NGO was paid with internal funds for the planning of sewer networks and a wastewater treatment plant, but the system was never built due to lack of building permit, i.e., external factors blocked this project. Note, however, that this article only includes internal factors in the following data analysis (theory-building). For more details of subsequent improvements at Sites A and B, see Section S4 in the online supplemental data.

The developed framework – theory-building

The theory-building process in this article developed a framework consisting of prerequisites and enabling factors associated with distinct phases of community-managed water and wastewater systems (Figure 2). The developed framework is meant to visualize the elements that are needed for community-managed water and wastewater systems to

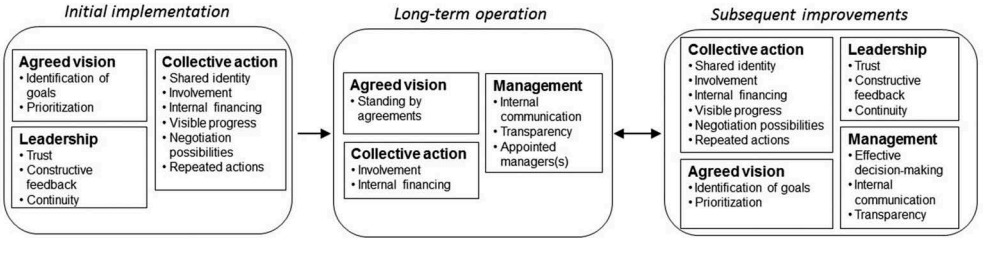

Figure 2. Framework developed for community-managed water and wastewater systems, consisting of prerequisites and associated enabling factors, which differ between the distinct phases of community management.

function over time. Categorization and analytical induction, as outlined by Hammersley and Atkinson (2007), identified four prerequisites common to all the case study sites, as well as associated case-specific enabling factors. Time-series analysis, as described by Yin (2009), found that the prerequisites and enabling factors varied with time. The prerequisites are meant to be relevant outside the case study sites, whereas the enabling factors may serve as inspirations and examples of pathways to fulfil the different prerequisites. Also, as part of the analytical process the different prerequisites were connected to existing theory. All of the prerequisites can be found in various publications, but they are not grouped together as in this article, nor linked to distinct phases.

The findings of this article highlight the importance of local leadership. This is supported by other studies on local governance of water resources (Huntjens et al., 2012; Hutchings et al., 2015; Kyessi, 2005; Ostrom, 2011) and sanitation systems (Dickin et al., 2017), as well as work on change within organizations (Al-Haddad & Kontour, 2015; Kotter, 2012). Giest and Howlett (2014) highlight the importance of local leaders to self-organize and perform local governance. Eckstein (2006) argues that engaged leaders are critical for triggering mobilization. Many publications emphasize the importance of trust (Adhikari and Goldey, 2010; Huntjens et al., 2012; Ostrom, 2011), which is included as an enabling factor for leadership in this article. The findings in this study are thus in line with current research on organizational governance. We found that leadership was important for initial implementation and subsequent improvements, due to the implementation of something new and innovative, e.g., implementation of water and wastewater systems in a context that lack piped water and sewer infrastructure. In contrast, long-term operation depended on self-declared or appointed managers for operation, i.e., to keep the already implemented system going. But leaders may also become managers of communal systems, and managers may provide leadership and turn into leaders for subsequent improvements.

An agreed vision, i.e., having a clear aim that contributes to reaching it, is a widely recognized prerequisite for change (Haque, Amayah, & Liu, 2016; Jaros, 2010; Parish, Cadwallader, & Busch, 2008). Kotter (2012) claims that change within organizations partly depends on a clear and communicated vision. The connection between agreed vision and communal systems is less documented. We find that all phases – initial implementation, long-term operation and subsequent improvements – partly depend on an agreed vision. The agreed vision for initial implementation of communal systems connects to both the governance structure of community management and the type of water and wastewater technology. Long-term operation depends on a stable agreed vision of the governance and management of communal systems, i.e., the members need to demand the service provided by the communal systems over time. For subsequent improvements, the agreed vision typically concerns technical improvements of the water and wastewater systems, e.g., water purification.

Collective action as a prerequisite for community-managed water and wastewater systems is supported by research on governance of common-pool resources, such as that of Ostrom (2011). We find that shared identity and involvement are important enabling factors for collective action. This is similar to the results of Roberts and Portes (2006), who argue that strong social networks facilitate mobilization. It also connects to group dynamics, which is highlighted as crucial in the literature on change management (Al-Haddad & Kontour, 2015). Many studies emphasize social capital as critical for

community management, i.e., social networks, knowledge and trust among residents (Bisung et al., 2014; Calzada et al., 2017; Dickin et al., 2017). The prerequisite of collective action also includes financing, since obtaining financing depends on collective action in the case of community-managed systems. Funds for implementation and subsequent improvements are collectively obtained through requests of external actors (typically including protests), or individual economic contributions (internal financing). Another reason to include financing in the prerequisite of collective action is that community-managed systems try to minimize costs through as much community work as possible, during the initial implementation, long-term operation and subsequent improvements.

The need for management for long-term operation is widespread knowledge. We find that management is necessary for long-term operation and important for subsequent improvements. CBOs may implement systems without a deliberate governance structure in place, but to operate and improve the system over time, some type of management organization is needed. The details of the management structure may be of less importance, but the enabling factors, e.g., self-declared or appointed managers and internal communication, show that some characteristics are of course important. This is in line with Alexander et al. (2015), who highlight that some management characteristics, such as maintaining good records, holding regular meetings and having a caretaker, correlate with long-term functionality, whereas others, such as by-laws and regular elections of committee members, do not. Much work emphasizes the need of external support for operation and maintenance of existing community-managed systems, so they function in the long run (Calzada et al., 2017; Harvey & Reed, 2006; Montgomery, Bartram, & Elimelech, 2009; Moriarty et al., 2013). But this is not the case for the CBOs of Sites A and B. Neither has received external support for operation of its water systems, but the systems have delivered the desired technical service for many years. Both CBOs have access to technical and administrative knowledge among their members and by hiring professionals. Site A did receive external support when implementing wastewater treatment, and the municipality is currently facilitating implementation of wastewater collection and treatment at Site B.

Discussion

The framework developed in this article intends to identify prerequisites and enabling factors, and to connect them to distinct phases over time: initial implementation, long-term operation and subsequent improvements. Including the time perspective is of major importance for understanding community management. The distinct phases enable categorization of neighbourhoods and CBOs to direct and customize external support. Neighbourhoods need different support depending on which of the distinct phases they belong to, i.e., external efforts should focus on the missing prerequisite(s) for the respective phase. Initial implementation is relevant for neighbourhoods that lack community management, where the residents may be triggered to self-organize and implement community-managed systems. For example, the presence of a CBO at Site C indicates that they probably would be able to operate a communal system, but they do not have any of the three prerequisites for initial implementation: leadership, agreed vision and collective action. Long-term operation should only be the focus if the targeted neighbourhoods already have implemented a communal system, but this

system is not in use or not properly functioning. Experiences all over the world show that implementation of technical systems is not enough for delivering water and wastewater services. Long-term operation of community-managed systems requires proper maintenance. And long-term operation depends not only on management (including maintenance) but also on agreed vision and collective action. Subsequent improvements are an important component in development programmes that target neighbourhoods that are already served by community-managed systems. If these communal systems are to function also in the future, the service needs to keep up with user demand, i.e., the system needs to improve over time. This is in line with Moriarty et al. (2013) and Hutchings et al. (2017), who argue that community management needs to deliver advanced technical solutions to function in the long run. We find that subsequent improvements depend on all four prerequisites: leadership, management, agreed vision and collective action.

The aim of the study presented in this article was theory-building regarding internal factors that affect the adoption and operation of community-managed water and wastewater systems in urban and peri-urban areas. It was designed as an ethnographic and theory-building multiple case study of explorative character. The three case studies constituted unique opportunities, as outlined by Yin (2009), to obtain detailed information, due to willingness to participate and a very open dialogue with many of the informants. In-depth data regarding each case were obtained through inclusion of many in-depth informants per site, but for a small number of sites. Many of the informants were interviewed several times, and some informants at each site were approached on an almost daily basis during the data collection for informal chats, i.e., spontaneous ethnographic interviews. The prerequisites are meant to be relevant outside the included cases. Generalizations are not possible in this type of qualitative study, but future studies may include development and verification of the presented framework through both qualitative and quantitative studies (e.g., randomized trials of CBOs managing communal services). All prerequisites are supported by much research, which makes it likely that they can be considered in similar contexts. The enabling factors are seen as context-dependent and as illustrative examples, which may be used as suggestions for pathways to fulfilment of the respective prerequisites.

The external environment, which is out of the scope of this article, is of course of major importance for community-managed water and wastewater systems (Hutchings et al., 2017; Mansbridge, 2014; Marston, 2014, 2015; Moriarty et al., 2013). For example, the lack of a building permit hindered the implementation of sewers and a wastewater treatment plant at Site B in 2012–2013 (Project B1). The lack of property rights at Site C affected the willingness and ability of the residents to implement and operate community-managed water and wastewater systems. It is therefore crucial that future studies include external factors and connect to earlier studies of community management in Cochabamba. Existing work has deliberately not been used as a starting point for theory-building in this article, due to predetermined limitations that imply inclusion of only internal factors. Connection to studies, such as that of Marston (2014), of community management in relation to external actors, as well as studies of the development of the waterscape of Cochabamba (Hines, 2015; Linsalata, 2015), will take the findings of this article one step further.

Conclusions

Growing peri-urban settlements constitute a challenge for public service providers. Throughout developing countries, municipal enterprises fail to connect all citizens to their water and wastewater systems, often excluding low-income informal settlements. Self-organization of CBOs that implement and operate community-managed water and wastewater systems could be part of the solution to meet Sustainable Development Goal no. 6, providing clean drinking water and sanitation for all and increasing the proportion of adequate wastewater treatment. But there is limited in-depth knowledge of the internal factors that affect the self-organization that leads to implementation and operation of community-managed water and wastewater systems. This article aims to fill this gap by laying the groundwork for theory-building. The developed framework, consisting of relevant prerequisites and context-dependent enabling factors, aims to explain why and how CBOs implement and operate communal water and wastewater systems in urban and peri-urban areas.

The framework may be used by policy makers and development practitioners to strengthen community management and support CBOs which have failed to implement or operate communal systems. When targeting communities that have not implemented or do not operate existing communal systems, the framework helps identify the missing prerequisite(s) which hinder implementation or operation. The enabling factors may serve as inspirations and potential measures that can be taken. But it is important to bear in mind that all CBOs have their unique ways of fulfilling the different prerequisites. And when applying the framework in another context, earlier traditions of community management should be considered and interventions tailored to build on local experience.

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