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Working Paper

Guidelines for Community-led Multiple Use Water Services: Evidence from Rural South Africa

Barbara van Koppen, Virginia Molose, Kenny Phasha, Thando Bophela,
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Project

This study was implemented as part of the project *Operationalizing community-led Multiple use water Services (MUS) in South Africa* – Project K1/2609//1 of the Water Research Commission (WRC), South Africa, supported by the African Water Facility (AWF) of the African Development Bank (AfDB).

Collaborators

Water Research Commission (WRC), South Africa

International Water Management Institute (IWMI)

Tsogang Water and Sanitation, South Africa

Department of Water and Sanitation, South Africa

Office of the Premier, Limpopo Provincial Government, South Africa

Limpopo Department of Agriculture and Rural Development, South Africa

Donors

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Contents

Summary

These 'Guidelines for community-led multiple use water services' are derived from the replicable lessons learned during the implementation of the demonstration project *'Operationalizing community-led multiple use water services (MUS) in South Africa'* between late 2016 and early 2020. Supported by the African Water Facility of the African Development Bank and the Water Research Commission (WRC) of South Africa, this project applied a community-led infrastructure design and construction process in six diverse villages in Sekhukhune and Vhembe, two of the poorest districts of South Africa. The project envisaged local communities as the drivers of decision-making on institutional and small-scale technological improvements in self supply or public water infrastructure, or both. In new forms of co-management with the government, support was provided to the communities according to their own priorities in order to build on integrated use and reuse of multiple sources to meet multiple needs through cost-effective multipurpose infrastructure.

Accordingly, sociotechnical experts, in this case the nongovernmental organization Tsogang Water and Sanitation, facilitated a six-step participatory process in the community; gave institutional, technical and engineering advice; developed capacities; and inspected the construction work for quality control. While engaging in a continuous dialogue with government officials and other professionals at all levels, the MUS project team also assessed the replicability of this participatory approach in government and other water service provision structures.

This paper presents the lessons learned from lived experience during each of the steps and compares the timelines and costs of community-led MUS with conventional water infrastructure design and construction. In the first step of the process, agreement was reached with the community on future collaboration, and an inclusive local communication and leadership structure, the MUS Forum, was established. In the second step, the community and the support agency jointly diagnosed the existing water situation and analyzed its problems. In Step 3, the communities' solutions to these problems were systematized, screened, prioritized and translated into technical designs, which were then costed. The solutions included those that the communities had already had before the project and those that came up in Steps 1 and 2. In Step 4, final prioritization and detailed designs were approved by the overall manager and funder of the project, WRC in this case, and translated into a formal work plan and contracts. The MUS Forums turned themselves into Primary Cooperatives to enable this formalization. Step 5 started with the procurement of materials. This paper assesses the potential for and advantages of local procurement of materials, as preferred by the communities, in the light of the experience with central procurement, as implemented in this project. The communities recruited semiskilled and skilled workers to implement the work plans by adopting fair selection procedures. Modest stipends were paid to these workers in alignment with South Africa's employment generation programs. Construction was supervised by the sociotechnical facilitators and their engineers. These processes developed ownership in the community and improved technical and institutional capacities for future operation and maintenance of the infrastructure. When MUS Forum members participated in district, provincial, national and international dialogues, they underlined the MUS project's main lesson: 'Nothing about us without us'.

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Introduction

Community-led Multiple Use Water Services

Across the globe, governmental and nongovernmental institutions are seeking to progressively realize water and food security for all. These public institutions recognize the importance of user participation in water infrastructure development, operation, maintenance, repairs and upgrades (Moriarty et al. 2013; Hutchings et al. 2017). Community-led multiple use water services (MUS) take user participation a step forward, as will be elaborated in the guidelines presented here. This approach is especially relevant in low- and middle-income rural and peri-urban settings where the majority of the people who, in the words of the United Nations Sustainable Development Goals, are 'left behind' live and where multifaceted and agriculture-based livelihoods depend in many more ways on water than in urban settings.

Community-led MUS has five characteristics.

1. *Co-management*. In line with global debates, participation goes beyond just being informed about decisions taken by others; it is about decision-making by communities within the project framework of available financial, technical and institutional support. In this approach, communities are in the driver's seat, guided by the principle 'nothing about us without us'. New forms of co-management are forged in which communities and public service providers take up complementary roles and responsibilities. The forms of co-management depend on local contexts. Co-management can start when new infrastructure is constructed for first-time access. However, in the context of increasing emphasis on addressing maintenance backlogs and accommodating growing populations in expanding villages, co-management can also be introduced when maintenance, repair and upgrades are planned. Public support in such forms of co-management may be light-touch; for example, providing materials to improve small-scale infrastructure managed by communities for self supply. At the other end of the continuum are government-owned and operated bulk supplies, such as borehole systems in which end users may only take charge of small maintenance or repairs of reticulation. In all cases, the government remains the duty bearer to subsidize everyone's access to basic volumes of water, out of which 3–5 liters per capita per day (lpcd) must be safe for drinking.

2. *Participation from early planning phase onward*. Communities participate from the start of planning and then through all six steps of the process: (1) initiating collaboration (agreeing on goals and creating a community structure); (2) diagnosing; (3) envisioning solutions; (4) fitting the financial framework; (5) implementing (procuring materials, recruiting workers, and constructing); and (6) operating and maintaining in the use phase. This is an alternative to the planning approach in which funders, implementers, engineers and technical experts lead the prefeasibility and feasibility studies, design, lead the procurement of materials and construction, and only then hand the finalized infrastructure over to communities for their use—often expecting partial or full responsibility for its operation and maintenance (O&M). Figure 1 summarizes the steps of the community-led MUS process. These steps are not rigid; they only indicate that any next step requires actions and decisions of an earlier step. One may well go back to an earlier step. For example, diagnostic insights during Step 2 inform a design but insights continue to deepen throughout all following steps. Similarly, during construction of a certain design, new opportunities and obstacles come up for design adjustments.

3. *Building on self supply.* Community-led MUS recognizes the widespread investments that rural people make, as individuals or in groups, in self supply infrastructure to achieve water and food security for themselves and their neighbors (Butterworth et al. 2013; Woodhouse et al. 2017). In the temporary or permanent absence of public services, self supply is their only choice to meet even basic domestic water needs from unimproved sources. As one village technician involved in our MUS project explained: "As we are poor, we have to think and try even harder." Self supply can also meet the community's growing aspirations 'to climb the water ladder' for better services. In supported self supply, communities are knowledgeable co-investors and co-managers to improve their sustainable access to water to meet all their needs.

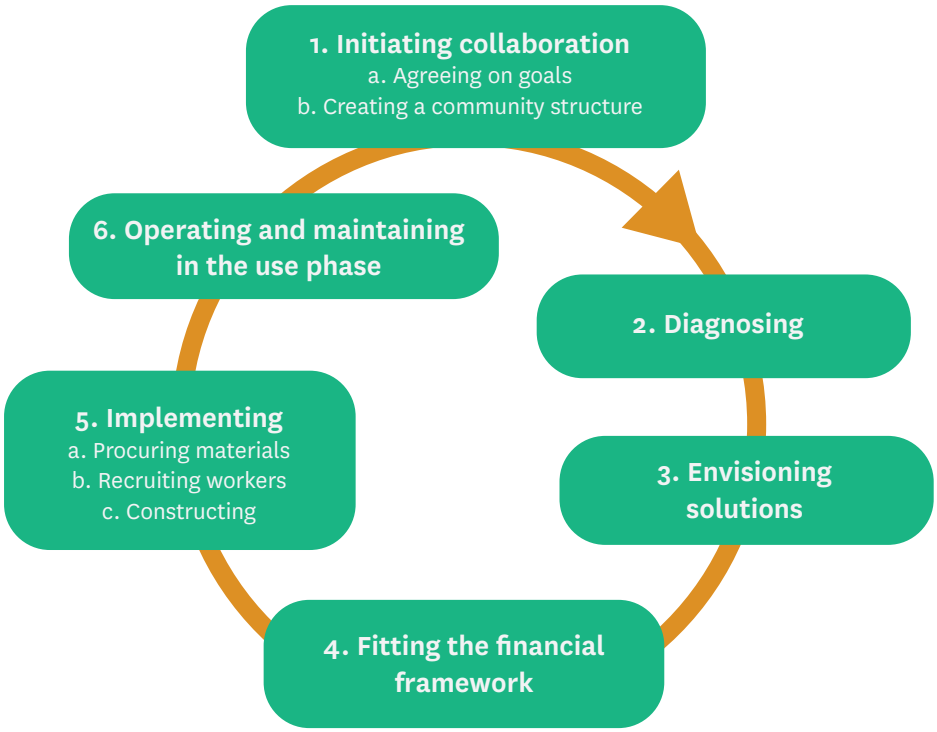

Figure 1. The six steps of the community-led multiple use water services process.
Source: Adapted from Adank et al. 2012.

4. *Welcoming local innovation in integrated water development and management*. When communities invest in self supply, they design multipurpose infrastructure where possible to meet as many needs as possible at that site of use: drinking water, other domestic uses, livestock watering, irrigation, brickmaking, enterprise and other productive and cultural uses. Multipurpose infrastructure is a cost-effective and water-efficient way of water provision—a principle also applied by formal engineers for large-scale infrastructure (Renwick 2007). Communities also use and reuse multiple rainfall, surface water and groundwater sources as a vital buffer to climate variability and infrastructure breakdown (van Koppen et al. 2020a). Local water disputes are addressed within local conflict resolution arrangements. Community-led MUS welcomes and builds on this innovative integrated water wisdom.

5. *Anticipating and planning for 'illegal' activities*. Community-led MUS recognizes the genuine needs that underpin some 'illegal' initiatives and seeks to address them in the planning phase. Community members often illegally modify, damage or vandalize infrastructure and create conflicts—for example, by laying illegal household connections; or drawing low-quality water from irrigation canals for drinking. Instead of just declaring these uses as illegal and trying to prevent them (usually in vain), community-led MUS aims at mobilizing the community's willingness to invest in these initiatives right at the outset in the design phase.

In sum, community-led MUS is:

> a holistic, participatory approach to planning and providing water services that support people's self supply and their multiple water needs, as identified by the community, and coordinates across government departments as needed.

The guidelines presented in this paper synthesize the evidence gathered and lessons learned from implementing and demonstrating community-led MUS processes. Focused on replicability, these guidelines aim at informing funders and implementers of water services in other low-income areas in South Africa, Africa or elsewhere where people's multifaceted livelihoods depend in many ways on water.

Evidence Base and Method

These guidelines are based on evidence generated by the demonstration project *'Operationalizing community-led water services for multiple uses in South Africa'* or, in short, the 'MUS project'. Funded by the African Water Facility (AWF) of the African Development Bank (AfDB), its implementation at the national level was taken up by the Water Research Commission (WRC) of South Africa. The nongovernmental organization (NGO), Tsogang Water and Sanitation (in short, 'Tsogang'), with long experience in community-led small-scale infrastructure development, implemented the project in six communities. As a sociotechnical facilitator with formal engineering expertise, Tsogang provided technical and institutional support to the communities by developing their

capacities, supervising construction activities and ensuring quality control. The International Water Management Institute (IWMI) led the research for these guidelines.

The project envisaged deriving widely replicable guidelines from the lessons learned in the project. So, in collaboration with relevant government departments (the provincial government, municipalities, and the provincial departments of water and agriculture and rural development), six villages with diverse settings were selected in Limpopo Province's poorest districts: Ga Mokgotho, Ga Moela and Phiring in the Sekhukhune District Municipality (SDM) and Tshakhuma, Khalavha and Ha Gumbu in Vhembe District Municipality (VDM) (see Figure 2). The villages differed in population size, levels of public and self supply infrastructure, surface water and groundwater resources and degree of productive water use. This not only enabled us to test the replicability of the participatory approach but also underscored the need for bottom-up participatory planning in each specific local context to provide tailor-made support instead of going in with a 'one-size-fits-all' model. In some villages, the project focused on particular neighborhoods, called sections, within the village.

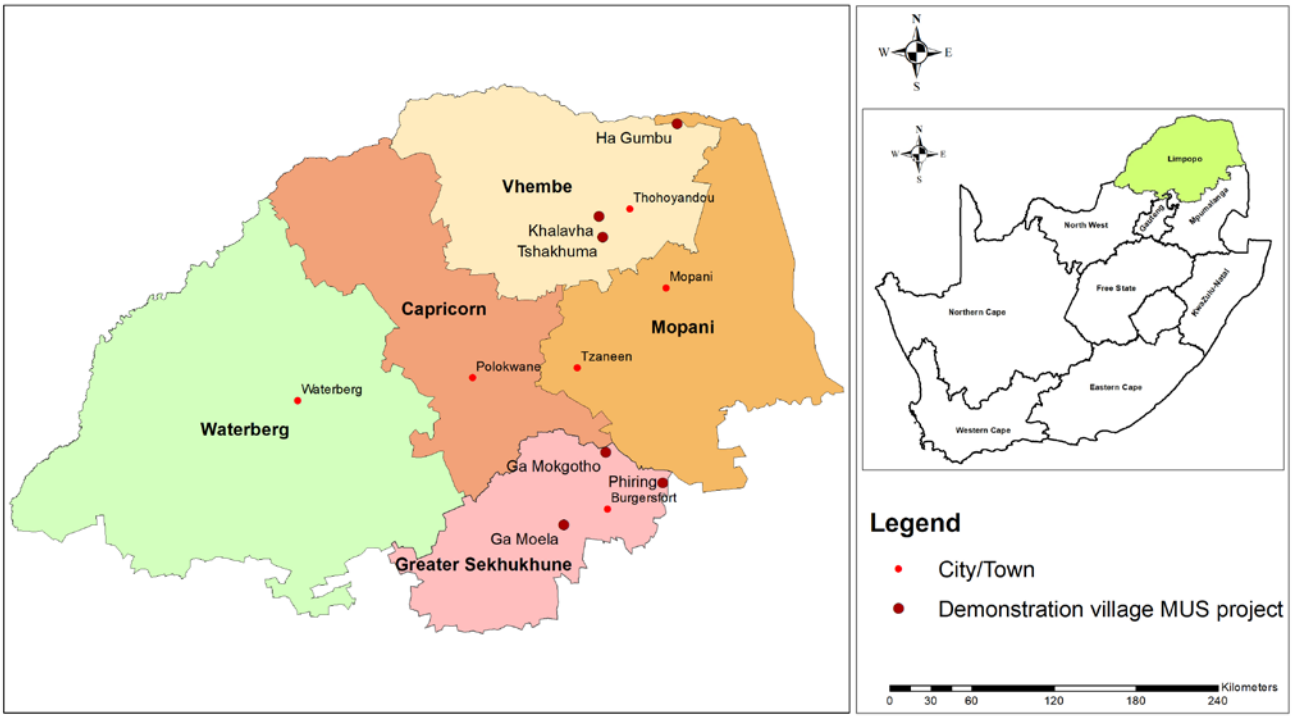

Figure 2. The six demonstration communities in Limpopo Province, South Africa.

This MUS project addressed the growing problem of maintenance backlogs and the need for support to self supply in particular through 'small investments for high benefits'. The project included the reticulation networks but *not* O&M or replacement of government-owned complex mechanized boreholes or bulk supplies requiring specialist engineering expertise. AWF earmarked EUR 200,000 for materials and construction work in the implementation stage (Step 5). In the preceding stage to this (Step 4, fitting the financial framework), the project management divided this amount among the six communities according to their needs and prioritized solutions. As detailed in Table 1, depending on the existing infrastructure, this encompassed the following works:

- Piped gravity systems in four villages: Rehabilitation and extension of 12 existing communal systems for self supply; one new system for self supply; and one public dam and gravity irrigation scheme. The works included: source development and augmentation; filter box; repair of main line; storage development; protection of valve boxes; repair and extension of reticulation and taps.
- Upgrades of five communal municipal boreholes in collaboration with the municipalities. The works included: pump house refurbishment; main line construction or repair; storage development; new reticulation or repair or extension.
- Support to household self supply: Distribution of 2,500-liter plastic storage tanks to 80 selected indigent households. There was no support to other forms of household self supply, such as private gravity pipes or private household boreholes.
- Other works: Repair of hand pumps and cattle troughs.

Table 1. Overview of the existing infrastructure and works constructed in the MUS project (shown in *italics*).

Village with sections	Main types of infrastructure	
	Communal piped gravity system: *Works realized in MUS project*	Municipal borehole systems: *Works realized in MUS project*
Ga Mokgotho (SDM) 800 households	NGO-funded, self O&M: *Augmentation of supplies, upgrades, repairs and extension of reticulation*	
Ga Moela (SDM) 118 households	–	• Tawaneng/Letlabela borehole: *New storage and reticulation* • Mabusa/Moela borehole: *New storage and reticulation*
Phiring (SDM) 420 households	Dam and pipe for irrigation and other uses: *Augmentation of water supply to dam and repair of leaks, extension to cattle dam*	• Municipal borehole system: *Refurbishing storage, repair of reticulation* • Municipal borehole system in Vrystad section: *No works*
Ha Gumbu (VDM) 1,652 households (total for 3 sections)	–	Municipal borehole system: *Repair of pump house, augmentation of storage, extension of reticulation, repair of cattle trough*
Khalavha, Thondoni section (VDM) 163 households	1 self supply system: *Source development, new storage*	–
Tshakhuma (VDM) 2,360 households (9 sections)	11 self supply systems: *Source development, augmentation of storage, one new system*	Maswie borehole: *Connecting to new storage*
Other	• Household plastic storage tanks provided to 80 indigent households in six villages • Repairs of communal hand pumps (Ga Moela, Ha Gumbu) • Animal drinking troughs (Ga Mokgotho, Ga Moela, Ha Gumbu, Khalavha, Tshakhuma)	

IWMI adopted a mixed method to document the participatory process from Steps 1 to 5. Unfortunately, the Covid-19 crisis delayed the handover to Step 6, the use phase. In addition to Tsogang's activities at the local level, IWMI staff and students conducted baseline studies in each village; made regular field visits to observe and interview villagers about their views on the process and performance of Tsogang as the implementing agent (IA); and analyzed Tsogang's progress reports and other data about their activities in each village. At the intermediate and higher levels, the MUS project team forged, from the village selection phase onward, collaboration with the District Municipalities, the Department of Water and Sanitation, and the Limpopo Department of Agriculture and Rural Development. Tsogang, IWMI and WRC organized learning alliance meetings and policy dialogues with district-level, national and international officials from these three government institutions, but also from the treasury, municipalities, other government departments, development and employment generation programs, financing institutions and the corporate sector. Community representatives and MUS project team members shared their experiences—which are presented here in quotation marks to indicate the salient words used by the participants—during the project and discussed its local replicability. These dialogues shaped the guidelines presented in this paper. By early 2020, postconstruction impact assessment and user satisfaction surveys had been conducted in Ga Mokgotho and Ga Moela (van Koppen et al. 2020b), and a detailed analysis of inclusion and exclusion in self supply had been finalized in Ha Gumbu (Magombeyi et al. In review). Further, in participatory videos[1] about this process, representatives from Tshakhuma and Ga Moela shared their views on the process and its outcomes.

Institutional Replicability and Method

In order to assess the replicability and to compare the costs of community-led MUS and conventional water service approaches, the three main parties to the process at three levels are identified, and also one main decision-maker among the three for each of the six steps. Table 2 indicates the main decision-maker for each of the six steps, and presents a comparison between community-led MUS (first column) and a conventional approach in which the overall manager and funder outsource tasks to consultants and contractors (second column). In reality, however, depending on the type of infrastructure and engineering expertise required, approaches tend to be mixed.

[1] Available at http://stories.iwmi.org/voicing-water-visions/mus-south-africa/

The three main parties involved in the process are:

- The community as end user at the local level (in Table 2, shown in light green when it is the main decision-maker).
- The local IA who directly works with the community and mediates between it and the overall funders and managers of the program at the intermediate and national or even international levels (light orange when it is the main decision-maker).
- The higher-level overall managers who keep the purse and are often accountable to the treasury or other central funders (orange when they are the main decision-makers).

Table 2. Step-wise planning and implementation of water services, comparing community-led decision-making and a top-down approach with outsourcing. The cells in light green indicate that the community is the main decision-maker in that step; those in light orange indicate that the implementing agent is the main decision-maker; and orange indicates that the overall funder/manager is the main decision-maker.

Approach	Community-led MUS facilitated by sociotechnical experts	Conventional approach with outsourcing to consultants and contractors
Step 0. Acquiring likely funding	Identifying broad funding frameworks	Identifying broad funding frameworks
Step 0. Appointing IA	Tendering and appointing sociotechnical facilitator for the entire project cycle	Tendering and appointing technical consultant for the prefeasibility study
Step 0. Village selection	Selection according to funder's criteria	Selection according to funder's criteria
Step 1. Initiating collaboration	Agreeing on goals and mutual contributions; forming a committee	Minimal contact with community
Step 2. Diagnosing	Mobilizing local knowledge through participatory mapping, transect walks, interviews, and other	Prefeasibility study
Step 3. Envisioning solutions	Identifying sociotechnical solutions that leverage existing public infrastructure and self supply with technical advice, broad prioritization	Prefeasibility study
		Approving prefeasibility study
		Tendering and appointing technical consultant for feasibility study
	Technical expert advice, checks, costing designs, further prioritizing	Feasibility study with final costed designs
Step 4. Fitting the financial framework	Final prioritizing, approval and contractual arrangements	Technical check of feasibility study and approval
	Formalizing community structures and agreements	Tendering and appointing contractor for construction phase
Step 5a. Procuring and storing materials	(Potentially) community-led procedures for local purchase, with technical/financial checks; developing capacity and contacts with suppliers	National procedures across all tiers
	Community responsible for storing, safeguarding and transport to site	Site development with security measures, transport to site
Step 5b. Preparing construction and training	Community-led budgeting and recruiting semiskilled and skilled workers; training	Contractor-led provision of semiskilled and skilled workers, partial local recruitment
Constructing	Works for stipends and on-the-job training	Works for wages
Adjusting designs	Flexibility	Limited or no flexibility
Testing and signing off	Quality check by IA experts and community	Quality check by experts and handover
Step 6. Using, operating and maintaining (hypothesized effects)	O&M training; experienced committee continues; protection against vandalism; incentive for preventive maintenance; contacts with suppliers; capacity development; multiple uses for health and wealth	New committee and training needed; no capacity developed; hardly any incentive for maintenance; risk of vandalism; unplanned and suboptimal multiple uses
	For government-owned bulk supplies, e.g., boreholes: community-led responsibilities for reticulation and small repairs	For government-owned bulk supplies, e.g., boreholes: long supply interruptions for even small repairs

In the MUS project, WRC and AWF were the highest-level agencies. The guidelines presented in this paper are based on their experiences. However, community-led MUS can also be replicated by municipalities, local governments and government departments of water, agriculture, rural development, climate change adaptation, disaster management programs, public employment generation programs, or NGOs, development banks, corporates operating corporate social responsibility programs, private consultants and engineering companies, and philanthropy and charity organizations.

These highest-level institutions can have their own internal staff as IA on the ground or they outsource the responsibility to an external IA, for example, consultants, contractors or NGOs. Any IA with the required sociotechnical expertise can implement community-led MUS. In the MUS project, Tsogang was our IA; so when these guidelines refer to the IA, they refer to the actions of Tsogang.

In Table 2, Step 0 is the broad framework in which the overall manager (likely) has funding, can mobilize expertise to deliver water services and has selected the village for intervention. In broad development and employment generation projects, the choice of the type of activities to implement may be left to the communities. In such cases, these guidelines become relevant once the communities have prioritized a focus on water services. In some cases, funding for all six steps may already be available, or is highly likely to be available. Otherwise, the 'bankable design' resulting from the first three steps may still need to be shopped around for funding. In the MUS project, funding was available for all six steps in six villages. As described above, in Step 0, the MUS project had selected the villages as advised by government institutions and in conformity with the selection criteria of low income and diversity. The village authorities had approved the project too. So, in the next section, our description of the steps in the process starts with Step 1.

Cost and Time Comparison

We also explore the replicability of community-led MUS through a qualitative and quantitative comparison of the time and costs of the two approaches. With regard to the time duration, community leaders in the MUS project emphasized an important point: Community participation requires patience and time to reach a consensus—"till everyone agrees." Good facilitation and, as Tsogang said, creating the space to "sit back and talk" are key. As qualitatively shown in Table 2, time requirements for community-led projects are not necessarily longer than the time that external agencies require for prefeasibility and feasibility studies and final approval, appointment and monitoring of external contractors for construction and centralized procurement procedures. In neither case should external agencies' spending pressure determine the pace and content of water services. In addition to achieving suboptimal results, it is only likely to create new inequalities and conflicts at the village level.

Our quantitative cost comparison follows South Africa's 'Cost benchmark for water services projects' (DWS 2016). This uses the capital costs (materials plus labor) as the basis. The costs incurred by Tsogang for its facilitation are calculated as a percentage of these capital costs. As elaborated below, material costs were the sum of the amounts stated in the WRC's purchase orders for supply of materials, plus a few additional materials bought during the construction process, plus tools bought for the project. This added up to a total of ZAR 2,707,056[2]. The total local labor costs were ZAR 446,690. So, the total capital costs amounted to ZAR 3,153,746. As the project had no external contractor for local work, there were no such costs in this definition of capital costs. In conventional costing approaches, contractor costs are likely to be included as 'labor'.

Other costs, expressed as a percentage of capital costs, included Tsogang's facilitation, capacity development and supervision costs. The following were the staff time and travel costs:

- Community facilitator (daily rate ZAR 1,000; travel 3.47/km);
- Technologist (daily rate ZAR 1,547; travel 3.47/km); and
- Senior technician/engineer (daily rate ZAR 3,636; travel 4.5/km).

Other costs incurred for Tsogang included two district offices for fieldwork at ZAR 1,000/month. For two 4-day indoor training programs in the village (one for construction and the other for operation and maintenance, including water quality measures), the costs for lunch amounted to ZAR 100/person. Lastly, the overhead cost of running the IA's overall provincial office was computed at 12% of the total cost. Our cost estimates for villagers, Tsogang and WRC in Step 4 are qualitative. We also compared the costs of materials purchased in central procurement with (potential) local procurement costs. We further calculated and analyzed employment generation on the basis of data provided by Tsogang.

[2] USD 1 = ZAR 15 (approximate rate taking into consideration exchange rate fluctuations between 2007 and 2020).

Step 1. Initiating Collaboration

Step 1a. Agreeing on Goals

Purpose and Action

Co-management starts with agreeing on broad goals and stipulating mutual commitments, and setting up representative communication and local leadership channels. After informal visits to check the eligibility of a village—without raising unrealistic expectations—the IA and relevant extension workers of the collaborating government departments obtain an endorsement for the project from the community authorities and ward committee members of the village and then organize a mass meeting. Everyone is invited to this meeting, including women, youth and the most vulnerable people who risk being left behind. Public water services are for everyone.

In this mass meeting, the IA:

- Provides feedback on earlier informal visits.
- Introduces the implementation team.
- Explains that the project seeks to improve water supply in the village, building on any water infrastructure that already exists and serving water uses according to that community's priorities.
- Sets the condition that the project should be inclusive and benefit the community as a whole.
- Clarifies the participatory approach and each of the steps to be taken.
- Indicates the expected voluntary contributions, such as attending meetings, and whether food and drinks will be provided.
- Responds to participants' questions, for example, about paid employment or not.

In this way, the IA ensures it is welcome and creates a space to "sit back and talk." In this step the community can, if it chooses to, decline collaboration "without hard feelings." The IA can decide to end the collaboration too, or seek solutions to problems that might jeopardize the project in subsequent phases.

Lessons Learned

Clarifying Participatory Process

Managing multiple water sources to meet multiple needs through multipurpose infrastructure is evident in rural communities. In the words of one community member, it is like "the blinking of an eye." Yet, a process of community-led infrastructure development that takes local water management as starting point, was new in the six villages. Community members unanimously felt that in the past outsiders came, decided and implemented water infrastructure projects leaving no role for them. At best, they informed the tribal authorities and recruited some local labor. Now for this MUS project, the IA's explanation of the step-wise participatory process did provide some clarity but it became tangible and visible to the communities only in Step 5. "Initially we didn't understand it, but now our eyes have opened," said one MUS Forum member. Ultimately, as articulated by another forum member who participated in the district, provincial and national learning events and policy dialogues, "Community-led MUS means 'nothing about us without us'."

However, despite the overall enthusiasm, some communities did withdraw from the process during the first phase. In Tshakhuma, for example, residents of the Luvhalani section left the MUS project after the first meeting, suspicious that it would take over their self supply communal gravity system.

Managing Expectations and Keeping Promises

Confusion, disappointment and frustration over big promises made but not fulfilled by earlier external support agencies were rife among the villagers, especially in Ga Moela and Vrystad section in Phiring. Outside agencies were seen as 'companies' that are accountable upward to higher-level officials in government or other support agencies, but not downward to communities. "Companies came and asked many questions, made promises but never came back," was a typical experience. In Ga Moela, for example, a dam was promised at a cost of ZAR 2.3 million. In Vrystad, the contractors disappeared without finalizing the construction of a borehole and reticulation, without indicating a date of return, without even leaving behind a mobile phone number but taking with them the keys to a pump house to prevent anyone else from stepping in. Otherwise, unused equipment was kept in safety, but more often it was taken out for the contractors' own collective or individual purposes, or was vandalized. In Maswie section in Tshakhuma, the finalized borehole remained unused for years for no clear reason. In some cases, municipal boreholes had no fuel, so users had to organize and buy it themselves (as in Tawaneng section of Ga Moela), or just wait for the municipality to arrange fuel (Letlabela section in Ga Moela). Sometimes boreholes broke down and were not repaired or replaced for a long time (Tawaneng and Mabusa sections in Ga Moela, Phiring, Ha Gumbu). Such frustrations underscore the need for infrastructure projects to manage expectations in the community and fulfil promises made to it. "Tsogang kept its promise," was the most cited appreciation of the performance of the MUS project's IA.

In the introductory phase of a project, it may be tempting for an IA to make promises in order to mobilize a buy-in among the villagers and create legitimacy for a proposed process that could otherwise be seen as just talk. Similarly, for technicians, it may be tempting to already jump to Step 3 and promise definite solutions, saying "we can fix that." Villagers too appeared to have long lists of unmet needs and requests for materials. They hope to see "trucks with loads of material arriving soon" or aspire for employment opportunities from the project. However, such promises tend to backfire when an implementing agency has to return to a village with solutions other than what were promised, or none at all. Communicating the bad news that promises simply cannot be kept because of budget or other constraints "requires much courage, but is needed," as one district official said.

In the community-led MUS project, the IA, project officials and community leaders alike managed expectations by invoking a spirit of voluntary time and effort for communal action and self-reliance; by pointing at the tangible difficulties experienced by people due to water problems; by emphasizing mutual learning as equal partners; "meeting each other half-way"; emphasizing that there was "no big money" in this initiative; and avoiding any upfront reference to paid jobs or handouts. Also, community leaders challenged the pervasive notion of 'mine' and 'yours'. Instead, they emphasized that "the government and the communities are one; in fact, communities ARE the government." At the same time, they welcomed the government's valuable guidance and support.

Step 1b. Creating a Community Structure

Purpose and Action

In the first or second mass meeting, the participants appoint a community structure, which is called the water committee in the local language or the MUS Forum in English.

The IA then explains that the purpose of the structure is to serve as a link for communication between the IA and the community and lead the implementation of the project. The IA also sets out the relevant criteria for selection of MUS Forum members: gender balance, youth involvement, representation for existing water and other community structures, and representation for all relevant sections of the village. The focus is on voluntary leadership to serve the whole community. The IA repeatedly emphasizes the need to keep the minutes of each meeting and to report back to the community.

Selection of members is based on a nomination process. It can be open when the participants feel that "we know each other." In such a case, the volunteering candidates raise their hands signaling their availability, or participants propose a person's candidature, followed by one or two others who second the proposal. Representatives of the tribal authority and village ward committee are often ex-officio members of the MUS Forum.

In large villages, the MUS Forum can consist of one or more representatives from each section.

The newly established MUS Forum then holds an internal follow-up meeting to appoint the chair, vice-chair, secretary, vice-secretary, treasurer (and, as needed, vice-treasurer), and additional members. These appointments are the Forum members' responsibility. Thereafter, the IA assesses their skills and training needs on how to plan, organize, coordinate and run effective meetings, financial management, agriculture and health.

Lessons Learned

Inclusivity and Downward Accountability

In the smaller villages, invitations to the mass meetings reached almost everyone except some elderly and disabled persons. Many of the invitees attended, unless they were away, or were unable to go, or felt they would be informed of the proceedings by family members or neighbors anyway. Taking part in the mass meetings gave participants a voice; for example, nomination by the participants elicited some accountability from the candidates who made it to the MUS Forum (a blind election process might have given participants more power). Nevertheless, the IA had to keep emphasizing the need for continuous reporting back from the MUS Forum to the community.

The persons chosen to the MUS Forums included current or aspiring political leaders, chairs of other village committees, local technicians with engineering expertise, retired teachers, officials, migrant workers and a few dynamic youngsters, for example, from within the tribal authority circles. In the much larger village of Tshakhuma, which had 11 gravity systems serving over 2,300 households, the operator and one or more others from each system served as representatives on the committee.

These MUS Forum members brought skills, experience, literacy and technical expertise and significant voluntary effort. Throughout the successive steps of the process, the actions of the MUS Forum were appreciated in the village, with a typical reaction being "now we have someone to go to with our water problems." Modest expectations and continued emphasis on voluntary contribution prevented the wealthier elite and those well able "to bring the project and its money" from "capturing" the project and become unaccountable gatekeepers between the community and the IA.

Women participated equally in the meetings and in the MUS Forum. However, invariably, the 'village engineers' who constructed or managed the infrastructure, other technicians and artisans were middle-aged or elder men. Youth were less represented, and often kept silent,

partly because of lack of experience. Also, when youth did participate in the MUS Forums, new opportunities for study or work outside the village rendered work in the committees difficult, as we saw in Ga Moela.

Strengthening Relations with Leadership Structures Within and Outside the Village

From the start of the MUS project onward, the participatory approach was embedded in and depended on the wider relationships within the village. Endorsement by the tribal authorities was indispensable. Chiefs have the authority to enforce rules and solve disputes in the rare instances when rules are breached; this ensures preventive compliance. As custodians of the land, water and other resources, chiefs are vital to catalyze collective action. In Tshakhuma, for instance, the traditional village-wide authority structures ensured cohesion across the 10 sections and mediated in one project-related dispute.

While some political representatives and members of water subcommittees of ward committees were part of the MUS Forums and thus knew first-hand about project decisions and activities, others were kept informed of such things. When any confusion arose, immediate clarification was supplied, as for example in Khalavha, where the local civic body initially confused the MUS project with another project. Here and elsewhere, the practice, as articulated by an MUS Forum member, was to "tell the leaders again and again till they get tired. And then they suddenly support."

Party politics played a lesser role within the MUS Forums even in villages where there were two or more parties. Some of the forum members and leaders were able to profile their—voluntary— leadership qualities which could attract votes during elections. However, the IA's purposive avoidance of politics and the project's independent financing stream minimized the scope for politicization.

The risk of intravillage conflicts and jealousies as a result of competition for (other) external projects was most clearly evident in Phiring, a village that has had experience of expensive government projects since the 1950s when the community was forcefully removed from where they lived, and settled in Phiring. There had been tense relationships about benefits from external projects within the post-1994 ward committee and between this village and a ward councillor from another village. In May 2018, the Integrated Development Plan (IDP), South Africa's primary tool for bottom-up and inclusive participatory planning, was presented to communities in the area. However, MUS Forum members suddenly heard of a ZAR 2,353,179 water project being awarded to Phiring. Without any transparency and participation in the project design and planning process, a few individuals had forged their own contacts with government officials to 'bring' and manage that project locally. These individuals critiqued and discouraged the MUS Forum and delayed implementation.

The MUS project was aimed at strengthening broad relationships between the community and government line agencies and local municipalities at the ward, district, provincial and national levels. Community representatives participated in the learning events and policy dialogues. MUS Forum members appreciated being brought into contact with intermediate and higher-level stakeholders as a good opportunity to 'market' their village. In Ga Mogkotho, this helped in mobilizing materials from the water services department of the Tubatse Local Municipality. Where municipal borehole systems were to be upgraded, the IA secured preproject oral permission from the municipalities and for continued monitoring of the envisaged postproject co-management with the communities.

Step 2. Diagnosing

Purpose and Action

In Step 2, community members and the IA develop a shared understanding about the village, in particular the sociotechnical aspects of the water situation, problems that need solutions and short- and long-term needs of the community. Publicly available data are to be used, but they are often limited to location (including Google maps), demography, rainfall and temperature. In the community, diagnosis of the situation starts with participatory resource mapping of the location. A mass meeting is called and participants are asked to draw maps on the ground indicating the roads, houses, schools, churches, the tribal office, other site marks such as electricity lines, and water resources (streams, springs, surface water bodies), and existing water infrastructure such as pipes, boreholes, intakes and reservoirs (Figure 3). A few participants copy the ground maps on paper to archive them for later use, for example, to clarify technical designs (Figure 4).

The IA solicits further information in focus group discussions and individual interviews (see the checklist of issues below). These can run parallel to the resource mapping exercise or be conducted at the next mass meeting. The IA follows up with transect walks with resource persons to further identify, discuss, confirm and

Figure 3. Participatory mapping in Phiring and Ga Mokgotho.
Photos: Barbara van Koppen.

Figure 4. Maps of Ga Moela and Ga Mokgotho.
Photos: Barbara van Koppen.

complete information. The IA may already start with more precise flow measurements to assess water resource availability, global positioning system (GPS) location, and detailed state and performance of the infrastructure. The IA may also at this stage call in its professional engineering expertise, or postpone it to Step 3.

After this, at another mass meeting, the IA gives feedback on the paper maps and other information collected to check their validity and conduct a further probe, for example, on specific technical problems. Thus, in some 3–4 days, villagers get to share and learn about their current water situation and inform the IA at the same time. This co-created diagnosis is confirmed at the feedback meeting and becomes the basis for Step 3.

Lessons Learned

Generating Knowledge

Participatory resource mapping united the participants in a lively and highly informative interaction. Most of them were enthusiastic about contributing to the maps. The few who could not follow the actions said they would have liked some more explanation but felt too shy to ask. Problems were identified and discussed. When copying the ground maps to paper, discussions continued in order to ensure accurate maps with meticulous details. The paper maps proved useful tools in the next step of the process as well.

During these map-making activities, the participants said they were amazed to be able to look at their village "from the sky." They were curious about the situation in the other sections of their village and interested in learning things that they did not know. These activities made some participants realize that "if we do things together as a village instead of criticizing each other, we will achieve more." Remarkably, not everyone appeared to be aware of the community's water resources and infrastructure. Only a few people, typically elderly men, really knew about the water infrastructure and its technical details. The mapping exercise provided a platform for sharing such knowledge.

Mapping and transect walks with resource persons were effective in informing the IA or other outsiders about the village and its water resources and infrastructure. Possible solutions to a problem easily emerged from these discussions and shared understanding of the genesis of the problem.

Optional: Participatory Geographic Information System (GIS) Mapping

Participatory GIS mapping with open access information sources was explored in three of the six project villages ('t Hart 2017). Information from the participatory maps

was transferred as several layers to a GIS map, and other layers were added, such as contour lines to calculate the water pressure and the required gravity pipe size and valves. The transect walks enabled checking and detailing of the information gathered during the resource mapping exercise (Figure 5).

In Tshakhuma, MUS Forum members were well able to interpret the electronic map and indicate the precise location of the water supply reticulation (Figure 6). For example, they pointed out on the downloaded GIS map houses that had been abandoned. Sufficiently large GIS maps enabled all participants to focus their attention and co-create a shared understanding.

However, participatory GIS mapping may require expertise beyond many professionals' capacity. A middle path would be to use a large print of a Google map with the correct directions and scale and add by hand information from the participatory ground maps and transect walks.

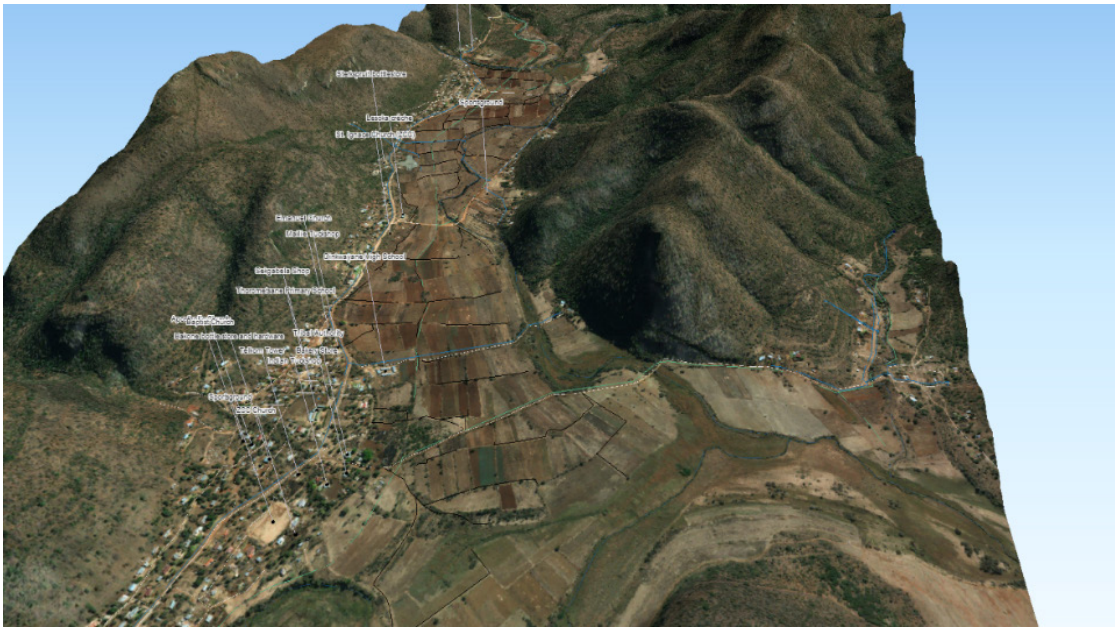

Figure 5. Three-dimensional participatory GIS map of Phiring.
Source: 't Hart 2017.

Figure 6. Resource mapping exercises in the project villages. Left: An MUS Forum member shows the location of water supply reticulation in Tshakhuma. Right: In Phiring, forum members discuss details of a participatory GIS map.
Photos: Barbara van Koppen.

Examples of Diagnostic Findings

The diagnosis conducted in Step 2 confirmed that water resources were sufficient in the six villages, except in two of the 11 water supply systems in Tshakhuma, which share the same weak source, and the dam in Phiring, which dries up in the dry season.

The main technical problems identified were related to the piping: low-quality and leaky pipes; disconnecting joints and taps; some problems in managing pressure in the undulating terrain given that distances sometimes stretched up to 5 km from intake to storage or taps; damage to above-ground pipes, notably by porcupines and other animals; and theft of steel parts. The top four

management problems that caused or contributed to the technical problems were: free-riding instead of collective contributions; illegal household connections; unreliable and inequitable water distribution; and damage, vandalism and theft.

For municipal boreholes the problems diagnosed have already been described above (Step 1a. Managing expectations and keeping promises). For the irrigation system in Phiring, the lack of affordable agricultural inputs and fencing, plant diseases and storage and marketing problems came up in the diagnosis.

Diagnosis Checklist

The diagnostic exercise collected information on the following aspects in each of the six villages:

Community Features

- History
- Location and sections
- Tribal authorities; local government representatives; other leaders; political parties
- Number of households; demography and migration; expected population growth and water needs
- Poverty and health profile (e.g., asbestos-induced lung disease and tuberculosis in Ga Mokgotho, malaria in Phiring, human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS)
- Water-dependent and water-independent livelihood strategies, and social grants
- Electrification; roads; connectivity
- Other public support (schools, healthcare, extension, ongoing projects)
- Other village organizations (committees linked to various departments; informal structures such as burial societies or women's groups)
- Villagers' priority needs for improvement, such as roads, communication, water, clinics, schools
- Other issues, such as crime, public safety, etc.

Water Sources

- Rainfall, surface water, groundwater, wetland; location; seasonal availability
- Possible competition during the dry season and drought years; dispute resolution arrangements

Water Infrastructure

- Overview of all water infrastructure, including ownership (public; private communal or private individual; vendors; public tankers) and responsibilities of government departments and users for the following items.
- *Initiation:* Timeline, initiative, design, financing and construction
- *Technical*
  - Intake/abstraction, storage, main flows/ canals/pipes (volumes, GPS location, elevation); street taps; yard/house taps; field intakes
  - Technical state
- *Financial:* Labor and monetary costs to collect water; life-cycle costs for operation, maintenance and replacement
- *Managerial:* Management structures; rules of operation, e.g., rotations; (preventive) maintenance and compliance; service delivery performance (quantities, quality, reliability)
- *Sites of use with primary and secondary sources and storage:* Homesteads and, if available, adjacent fields; distant fields; other sites of use (e.g., streams, springs, surface water bodies)
- Abandoned or unfinished infrastructure; reasons

Users, Uses and Reuses

- *Uses at and around homesteads:* Drinking, cooking, cleaning utensils, house cleaning, bathing, laundry, livestock watering, irrigation, brickmaking, crafts, other uses
- *Irrigation at homesteads and distant fields:* Crops, cropping cycle, use of the crop; fencing/protection to animals; agricultural inputs, skills, marketing
- *Other sites of use:* Uses and frequency (year-round or fall-back) of such uses (e.g., livestock, enterprise)

Water Quality

- Quality of water, especially the 3-5 liters per person per day for drinking and cooking; treatment facilities and point-of-use treatment; pollution sources including pit latrines; sanitation; hygiene awareness

Step 3. Envisioning Solutions

Purpose and Action

Step 3 identifies, systematizes and scrutinizes a range of solutions and translates them into designs for new infrastructure, repairs, upgrades or extensions and related institutional changes. Approximate costs are assessed. Gender-differentiated groups are formed from which different solutions and priorities often emerge (Figure 7).

Figure 7. Women's and men's groups plotting the location of new storage and street taps in Ga Moela.
Photos: Barbara van Koppen.

Where feasible, a common longer-term vision on the desired water situation is articulated as well. Medium- or long-term and large-scale spatial planning of water infrastructure encourages out-of-the-box thinking in which "all flowers bloom." Moreover, it proactively identifies multipurpose infrastructure and integrates public and self supply infrastructure where feasible. Longer-term visioning at larger scales ensures alignment with changing residential and productive land uses, roads and other infrastructure.

In this process, in order to identify solutions, the IA provides the engineering expertise to check, advise and develop the community's technical capacity. The IA, including the professional engineer, conducts technical inspections of water resource availability, assesses the precise problems in the existing infrastructure, and screens the proposed designs—for example, with regard to topographies including height differences and GPS locations. In collaboration with the few community members who can interpret the maps, the IA draws up designs and estimates the approximate costs as required for final approval and funding. When certain solutions appear to be too costly for the available budget, they are dropped right away. Underlying causes, in particular communal management challenges, are also analyzed. This is the moment for the IA and MUS Forums to articulate clear conditions, especially managerial conditions that the community should fulfil before proceeding to concrete investment.

When solutions and conditions have been crystallized and ranked according to their priority, the IA presents the list at the next mass meeting for further discussion, feedback, prioritization and endorsement. The IA reiterates the selection criteria spelled out in the introductory meetings, such as inclusion of marginalized groups. Solutions should be feasible within the project's overall time framework. Where possible, the IA can set the criteria and monitor compliance but leave the detailed decision-making to the MUS Forum or the local tribal or political structure.

Once the options are endorsed, the IA finalizes the technical designs and compiles the Bills of Quantities in continuing discussions with the MUS Forum and finalizes the cost estimates. Labor arrangements and their costs are part of this scope of works, but may warrant further consultation with the financier in Step 4. This list stays within the available budget, or may exceed it by a bit. The IA clarifies to the community that the scope of works reports are drafts only—pending further discussion, adjustments and approval by the funder in Step 4. Even then, the prioritized solutions are not cast in stone. Unforeseen opportunities or obstacles can call for adjustments during construction in Step 5. Approved and financed designs may well differ from the 'as-built designs'.

The IA submits the scope of works reports to the overall manager and funder. In the case of the MUS project, this was WRC, supported by AWF of AfDB.

Lessons Learned

Some of the solutions had already been identified before the project and came up for discussion in Steps 1 and 2. At least some of the community members had clear and perhaps long-standing solutions to well-known problems. Similarly, an external specialist with a hammer is inclined to see nails. Step 3 provided the space to further examine such already existing solutions, also building on the more in-depth problem analysis conducted in Step 2 and to agree as a community on incremental improvements.

Accordingly, communities in both communal gravity systems and municipal borehole systems prioritized improving the water sources and storage and extending reticulation to meet increasing demand, as well as repairs to the existing reticulation and street taps. The location of new street taps was partly left to the women and men of the community because they knew best the neighbors with whom they could share and maintain the tap.

Yard connections were aspired to in two villages, Ga Mokgotho and Khalavha. The IA left the financing and organization of yard connections to the respective MUS Forum and community, but promised to assist technically to avoid damage to the reticulation lines. In Khalavha, the community also envisaged connecting the existing municipal reticulation to the new reticulation in consultation with officials. However, by early 2020, communities had not organized as yet. In three villages, the IA introduced cattle troughs, an infrastructure that was new to the communities.

For the upgrades of idle borehole systems (Maswie/ Tshakhuma) or underused boreholes and reticulation (Phiring, Ga Moela, Ha Gumbu), the District Municipalities were informed. In Ga Moela, the primary school had a borehole; so the idea came up to extend it to provide water to 10 surrounding households. However, the School Governing Board rejected the proposal.

As part of the MUS project design, distribution of 2,500-liter plastic storage tanks to selected households was envisaged to ensure no one was left behind. The IA left the selection of these households to the MUS Forum, the tribal authorities and local government. Some suggested that the list of indigent households be used for this purpose. Others submitted a long list of prospective beneficiaries to the tribal authority to make a selection. In other cases, however, the selection process was less transparent. Some of the storage tanks ended up with some MUS Forum members who were active irrigators. They justified this by citing the project's emphasis on multiple uses.

The aspired-for solutions had to be costed to see whether they fitted the budget. In Ga Mokgotho, the village's long-standing vision was to develop a new dam for both domestic and irrigation uses at a spot along the distant Diphalafaleng stream. However, after measuring the distance, 5 km, and making a rough design and costing for the long pipe required, the solution appeared too costly for the available budget, and was dropped.

The MUS Forum in Phiring proposed a similar idea. Here, water from a dam that feeds by gravity into a central pipe to irrigate a scheme of 300 ha (and other purposes) dries up in the dry season. The MUS Forum proposed to augment supplies by also tapping water from another distant stream, the Setunyeng, and then connect it with a 2 km long pipe to the central pipe where it starts just below the dam wall before it runs into the irrigation scheme. This option fitted the available finances, and so was included in the proposed list.

Future operation, maintenance and water distribution were discussed too. Gravity systems would remain or become the users' full responsibility. Municipal boreholes would be co-managed. In Ga Mokgotho, the IA stated that any further support to the project would be on the condition that managerial problems are solved first. Here, almost all the 800 households shared one communal piped gravity system. Since its construction in 2007, the community operated and managed it. However, over the years, the voluntary pump operator became the only active manager; there was no community authority structure to oversee him. Illegal yard connections became his only source of income. Taps and steel pipes were stolen and sold at the nearby scrap metal store. The infrastructure became dilapidated and most water users were frustrated. This not only fostered massive participation in Steps 1 and 2 of the MUS project, but also the IA's condition that these issues should be solved first sparked action. Supported by the tribal leadership, MUS Forum members disconnected a few illegal household connections to re-establish the communal authority over the system. The active MUS Forum chair, a competent new operator, and representatives of all sections in the new MUS Forum continued taking leadership of the technical design and refurbishment of the scheme, and set clear rules and procedures for O&M.

Thus, Step 3 culminated in the IA submitting scope of works reports with designs and Bills of Quantities to the WRC. These included high-density polyethylene (HDPE) pipes, control valves, plastic storage tanks of various sizes, cement, 19 mm stones, river sand, building sand, HDPE fittings, galvanized pipes, irrigation hydrants, steel tank stands, stand pipes, taps, re-bar, mesh wire, fence poles, tools and shade netting.

Steps 1–3 Costs

From early 2017 to December 2017, it took an average of 8 months per village to conduct Steps 1, 2 and 3. The number of days of staff time, with rates, travel costs and level of expertise required for these three steps are given in Table 3.

Table 3. Staff time (days) required per village for Steps 1–3, leading to designs with cost estimates.

	IA staff		
	Facilitator	Technologist	Engineer
Staff time rates and travel costs	ZAR 1,000/day; ZAR 3.87/km	ZAR 1,527/day; ZAR 3.87/km	ZAR 3,636/day; ZAR 4.5/km
Steps	Number of days for IA staff		
Step 1	3	2	-
Step 2	4	1	1
Step 3	4	5	3
Total	11	8	4

Table 4 shows the total costs incurred for the six villages in terms of staff time, travel costs and other facilitation costs. These costs amounted to 13% of the total capital costs (see *Introduction*). Community-led design compares well with the national Cost Benchmarking Guide, which indicates planning and design fees between 12.5% and 22.5%, depending on the overall size of the project's capital cost.

Table 4. Facilitation costs during Steps 1–3.

Facilitation costs	Costs (ZAR)
Ga Mokgotho	50,635
Ga Moela	56,884
Phiring	56,660
Khalavha	61,971
Ha Gumbu	78,911
Tshakhuma	52,429
Total	357,490
Other costs	
Rental for district offices (8 months)	16,000
Total IA expenditure	373,490
IA overheads (12%)	44,819
Total costs for IA	418,308
Total capital costs (see section *Cost and Time Comparison*)	3,153,746
Costs of Steps 1-3 as proportion of capital costs	13%

Step 4. Fitting the Financial Framework

Purpose and Action

In Step 4, the technical designs and cost estimates of the range of solutions prioritized in Step 3 are taken forward for final approval and contracting. The final prioritization is reworked into a budget- and time-specific work plan that fits the conditions of the funders. The work plan specifies the implementation modalities for procurement of materials, labor, construction and quality control. The respective responsibilities, remuneration and compliance rules are agreed upon, resulting in legally binding contracts among all partners, including the communities, IA and the overall project managers and funders, as well as relevant government structures.

So, the highest-level overall manager and funder (in this case, WRC reporting to AWF) screens the designs and costs; compares the plans of different villages; agrees

on procedures for procuring materials and construction labor, supervision and quality control; and adjusts solutions as needed to put all together in a final work plan and budget (in this case, a budget of EUR 200,000 for construction materials and labor) for signing off. When the allocation for various materials depends on the outcome of a tendering process, the budget is on the safe side. The budget also includes payment rules and contingencies. In international financing, contingencies include currency fluctuations.

Procurement of materials can follow central government procurement procedures (in this case, those stipulated by WRC, which is a government entity, and endorsed by the AWF), or more localized procedures.

This step also includes final decision-making on the construction modalities to be followed and the recruitment and contracting of all involved. This includes the recruitment of skilled and semiskilled workers; the modalities for storage of materials and construction; inspection to see whether works are being done satisfactorily; and monitoring of payment arrangements as well as insurance payments. If the communities are taking up formal roles, especially if they are to handle funds, local structures may need to be formalized for contracting.

All through Step 4, the IA mediates between the local communities and the national-level decision-makers. The IA clarifies bottom-up to the funder all the needs and proposed solutions laid out in the draft design books with drawings and costings. And top-down, it communicates the national- or other higher-level decisions to the district-and local-level stakeholders. The IA's own future contractual commitments with all partners (the overall manager/funder, community and the government structures that own bulk infrastructure) are also clarified.

Lessons Learned

Finalizing Construction Labor Modalities

The six MUS Forums and other community members unanimously and firmly endorsed community-led construction. Citing how "contractors come and go," many villagers pointed at failures of contractor-led construction in their own or a neighboring village. Very few villagers commented that "it does not matter as long as the contractor does his job." The MUS project's IA too was committed to construction by communities rather than contractors. The agent had the sociotechnical capacity to train and supervise as needed, even for specialized installations, and accepted final responsibility for quality control and insurance.

Five arguments favored community-led recruitment and construction. In principle, these advantages apply for construction of any design, even when outsiders decide the designs without community involvement.

The five advantages were:

- Local workers have a strong incentive to perform well because they or their families and neighbors benefit from the result.
- Some or all semiskilled labor may even be contributed voluntarily to achieve the above benefit, especially when quick and off-hours action is required.
- Own efforts tend to lead to continuous care, protection against vandalism, and preventive maintenance.
- Local capacities are developed by on-the-job training, which ensures sustainable operation, maintenance and future upgrades and swift repair in case of breakdown instead of having to wait for external help.
- For communities that had designed and constructed their communal self supply systems, as in Tshakhuma and Khalavha, there was no reason whatsoever to hire external contractors and laborers.

The next question then was: will all work be voluntary or paid? The five advantages listed above held in both scenarios. In fact, payment may even erode existing voluntary arrangements, and risk strengthening a dependency syndrome of waiting for outsiders instead of taking community action. On the other hand, voluntary works tend to take long. However, even a minor reward accelerates implementation. Also, with high unemployment levels, people need paid jobs; and employment generation is an important goal of the government. Last but not least, payment is common in national programs and alignment with that principle is important. Hence, the MUS project adopted the existing payment arrangements followed by two well-appreciated employment generation programs in South Africa: the Community Works Program and the Extended Public Works Program. The villages were familiar with them. The MUS Forums therefore agreed and adopted the payment rate for semiskilled work prescribed in these two public programs, which was ZAR 90 per day. However, the MUS Forums decided to call the payments a 'stipend' and *not* a 'wage' to avoid any potential demand for formal labor conditions. The rate was set at ZAR 250 per day for skilled work (builders, welders, plumbers). The IA left it to the MUS Forums to decide about the recruitment procedures for skilled and semiskilled workers (see below, Step 5).

The implementing agency split all designs and work plans into daily tasks for semiskilled workers at the rate of ZAR 90 each, and lump sum assignments for skilled workers. The main semiskilled tasks included trench digging (6 m, 70 cm depth and 50 cm width; paid ZAR 90), and pipe laying and trench backfilling (6 m, 70 cm depth and 50 cm width; paid ZAR 30). In all six villages, workers were well able to explain this core task-based payment arrangement. The total costs of the proposed works in the six villages amounted to a total of ZAR 562,600. The WRC paid this amount to the IA's account provided there were monthly works supervision reports and transparent recording of all workers' contributions and payments.

The MUS Forums meticulously noted any amount mentioned in the work design books in Step 3, but knew that they were *drafts*. After the overall managers had decided on the final work plan and funding for each village, the IA communicated these final amounts to the villages. The communities kept welcoming the support even when the amounts proposed in the drafts were trimmed. As an MUS Forum chair commented, "It does not matter whether it is ZAR 25 or ZAR 5, as long as it is clear." As outside funding was a sensitive issue in the villages, the IA's transparent explanation of the budgets and the reasons given for any reduction were appreciated. The chair of one MUS Forum said this was different from the government projects that came via political representatives and local government. For the latter, they would have demanded full transparency in the budget allocation process and criteria for allocation of materials and labor.

Even though it gradually became clear to the IA and MUS Forums that there would be stipends paid for the works, both kept emphasizing and reiterating that voluntary contributions were necessary to attain improved access to water. This avoided any expectation of formal wages.

The liability for the quality of work and the required training and supervision and output-based payment remained with the IA. The agent obtained a contractor's risk insurance of ZAR 4,000 per village for loss of construction goods and damage to works due to fire, theft or unforeseen weather conditions like floods, and other risks, including personal injury, during the construction period of six months.

Formalizing MUS Forums

When it became clear that the communities, in particular the MUS Forums, would have to take responsibility for formal tasks, including handling money, a legal structure with a bank account and transparent bookkeeping became necessary. Such a structure would avoid the well-known risk of being accused of 'eating money' and also lead into sustainable O&M. This formalization, which was similar across the six villages, took much effort by MUS Forum members and the IA. The total costs were about ZAR 3,300 per village, in principle to be paid from the MUS Forum members' own pockets.

The institution of 'close cooperatives' appeared to be popular in the communities. They are formally called Primary Cooperatives under Section 7 of the Cooperatives Act 2005 (Act 14 of 2005). This lean structure is entitled to do business—and, hence, obliged to pay taxes to the South African Revenue Service. It is registered, and certificates of registration are issued by the Companies and Intellectual Property Commission (CIPC) of the Department of Trade and Industries Group. This Commission has decentralized branches in the local municipalities. Officials of the CIPC branch in the local municipality are easy to access for information and help. Since most cooperatives collapse after being registered due to lack of information and business management skills, they also provide free courses (the IA enabled the participation of five MUS Forum members in such a training program conducted during December 4–6, 2018, in Sekhukhune district).

The requirements for registering as a Primary Cooperative are:

- Certified copies of the Identity Documents of all members.
- All members should be present and be part of the decision-making and signing.
- Minutes and attendance register of the meeting in which it was agreed to register a Primary Cooperative.
- Four names should be proposed for the cooperative; the CIPC representative will choose one.
- Proof of residence of each member.
- ZAR 300 (deposited in the bank).
- A valid constitution that covers: place of the cooperative; application for membership; objectives of the business; membership Terms and Conditions; management of the cooperative; general meetings; finance and amendments.
- Annual renewal through submission of documents and fee payment. Failure to do so results in deregistration.

Moreover, a Primary Cooperative requires annually renewable tax clearance certificates issued by the South African Revenue Service (SARS). If tendering requirements include a Broad Based Black Economic Empowerment (BBBEE) status, a BBBEE certificate is needed as well. This is also signed by a Commissioner of Oaths, through the CIPC. A Level 1 BBBEE means that the business is entirely black owned, with a significant proportion of female members. These certificates require annual renewal.

The IA enquired about the precise requirements of the CIPC and bank accounts; held community meetings to explain these requirements and to motivate people about the benefits of Primary Cooperatives; arranged visits to banks, the municipality and CIPC; transported community members on some occasions (on other occasions members had to pay for transport and food); helped in filling the forms; and picked up documents from offices. Some members wrongly copied details from their identity books or wrote another part of their name, or signed with a different signature; so the process had to start over again. The benefits, progress and challenges of formalization were discussed during innovation forum meetings in which people from the three villages in each of the two districts shared their experiences. The advanced MUS Forums helped the others.

For registration as a Primary Cooperative, it was agreed that members of the MUS Forums would continue as members (called 'directors') of the Primary Cooperative even though the implications of this were not totally clear at that stage. In Phiring, one MUS Forum member was already the chair of another Primary Cooperative but had failed to share his experience.

Accordingly, the MUS Forums compiled a constitution; collected money for transport and food and for the registration fee (ZAR 300) and certificate (ZAR 1,500) as 'joining fees'. Obtaining the BBBEE certificate required visits to the CPIC official in the local municipality's offices and picking it up afterward. Tshakhuma was the first of the six villages to register as a Primary Cooperative in September 2017, and it so happened that the chair of the Primary Cooperative already had a tax clearance certificate that met the requirement. Ga Moela was the last to register in May 2018. For the villages in Sekhukhune district, the local branch of SARS was at such a distance that the task of registration for a tax number and a Tax Clearance Certificate was outsourced to a consultant for ZAR 400.

When it came to opening a bank account, Tsogang and the MUS Forum chairs examined various terms and conditions of banks: waiting time for account opening; identity documents; mandatory presence of members; proof of residence of the Primary Cooperative and its members; and the costs, which ranged from ZAR 500 to ZAR 1,500 plus transport and food for all directors who had to be present. Different villages opted for different banks.

An important rationale for the IA and some MUS Forum members opting for formalization was that Primary Cooperatives are eligible to tender for business as a service provider to the government. Government rules indeed favor local allocation of 30% of the budget. Engaging in such business might ensure the continuity of the MUS Forums, which would be necessary for the continued O&M of the water systems. To bid for government jobs, Primary Cooperatives are required to register online with their BBBEE status on the National Data Base of service providers. Accordingly, all Primary Cooperatives had 'multipurpose' in their name, and some highlighted their broader goals of taking up water and road construction projects, recycling (without water pollution), catering, cleaning, or qualifying for the Extended Public Works Program. By March 2020, the MUS Forums in Ga Mokgotho, Khalavha and Tshakhuma had successfully taken up such opportunities. However, intravillage competition intensified among the growing number of Primary Cooperatives. Thus, South Africa's fierce competition for tenders at the intermediate and national levels is trickling down into communities.

The final arrangement in the MUS project was that the IA kept the funds in its account, and upon satisfactory completion of tasks within a period of some weeks, it transferred the required payments into the Primary Cooperative's bank account. In hindsight, for the water works alone, a joint bank account by the community structure and IA would have fitted the purpose as well. Alternatively, the IA could have directly paid the workers, either in cash or fund transfer into their individual bank accounts.

Formalizing Relations between IA and Primary Cooperative

The relationship between the IA and the MUS Forum as Primary Cooperative was formalized in a Memorandum of Agreement (MoA) signed by the chair of the cooperative, witnesses and a representative of the IA. Prior to signing the agreement, a workshop was held to arrive at a common understanding of the clauses of the agreement. The workshop was meant to prevent the common tendency of one or two people just reading and signing in order to advance to the next step.

The MoAs formalized the following points:

- A brief overview of the existing infrastructure and a description of the agreed infrastructural solutions.
- Duties of the IA: Technical designs and bills of quantities; support and supervision of construction and financial management; technical and managerial capacity development; relations with government entities; quality assurance and completion certification; handover; need for as-built designs; postconstruction care; reporting to WRC; support to upscaling through local government's Integrated Development Plan processes and otherwise; engineering and technical advice to WRC in procurement of materials.
- Duties of the Primary Cooperative: Representing the community; providing water for multiple uses; planning project activities; recruiting workers and keeping materials safe; developing dispute resolution processes; recording and

weekly reporting; developing a maintenance system with user contributions; receiving training; collaborating with village leadership and external water support agencies; protecting against vandalism; ensuring long-term O&M, including purchasing spares and tools; advocating uptake of MUS in Integrated Development Plan processes; and sharing lessons.

- Financial management and reporting and stipends for each type of work and payment procedures: For this, the IA keeps in its accounts the money payable as stipends. The MUS Forum keeps a record of the workers and their tasks. Upon satisfactory completion of the tasks, as judged and signed by two members of the MUS Forum and the IA facilitator, the IA pays the total amount into the MUS Forum's bank account in tranches. The MUS Forum either withdraws the money and pays workers in cash, or deposits it in each worker's bank account if he or she has one. Bank payments are quicker and protect against theft. Cheque requisitions, payment vouchers, the monthly cash book, bank reconciliation and other supporting documents are filled and kept. The IA reports to WRC by submitting monthly work supervision reports and income and expenditure bank statements.

- Duration (the coming year), dispute resolution, confidentiality.

- The ultimate handover, after which the community owns the infrastructure in co-management with the District (as Water Services Authority). Precise co-management depends on the infrastructure with self supply at the one end and municipalities' ownership of boreholes at the other end.

The step-wise participatory process in general, and these forms of formalization in particular, were new to the communities and therefore required capacity development. As the chair of one Primary Cooperative said, "These new arrangements are like getting a car. Then one also needs to learn how to drive and get a license."

To our questions whether the MUS Forums would have preferred having more say on available funding, some of the more experienced members said that might work for relatively smaller amounts if the community structure and the financier co-sign cheques. However, larger amounts could trigger a temptation "to buy a Mercedes Benz!" Less experienced MUS Forum members preferred the IA to handle the budgets, allocation of money and even recruitment of workers to avoid "finger pointing" or bullying by people saying "I didn't vote for you not to get a job." Handling money and resources, even small amounts or modestly remunerated works, makes MUS Forum members vulnerable. In one village even the risk of being killed was mentioned. Transparency from the IA's side and clear, openly available recording of agreements and budgets is indispensable to prevent or silence rumors that MUS Forum members 'eat'.

Formalizing Upgrades of Municipal Boreholes

For the proposed upgrades of municipal boreholes, the IA compiled a draft MoA with the municipality. This formally included signing off by the municipality (as Water Services Authority) on the designs; a joint survey of the site; establishment of a Project Advisory Committee; a letter of support to the AWF; arrangement of an independent certifier to issue a completion certificate; and the Water Services Authority's continued ownership and responsibility for O&M after finalizing the works. The latter clause would include delivering more fuel or electricity to enable the higher volumes of water that would be consumed. In Sekhukhune district, the IA showed the draft agreement to officials who did not object and continued their interactions. However, they never signed the agreement. In Vhembe, after repeated visits and support from the Department of Water and Sanitation, the District Municipality wrote a letter to permit upgrades to their municipal systems in Maswie/Tshakhuma and Ha Gumbu.

Step 5a. Implementing: Procuring Materials

Purpose and Action

The first action in implementing the approved work plans is obtaining the materials. This can be by way of central procurement according to standard procedures, or decentralized local procurement from local warehouses by the IA or communities or combinations. Procurement includes transport and safe storage of materials.

Lessons Learned

Central Procurement

The WRC follows South Africa's central government procedures, which allow procurement by 'shopping' when the total cost of simple and readily available materials is less than ZAR 500,000 (as was the case with five of the six

villages in this MUS project). 'Shopping' requires notifying and obtaining quotations from at least three suppliers who are registered on the National Data Base. For higher amounts (Tshakhuma in this case), nationally advertised tendering processes have to be followed. In both cases, black-owned companies, especially those owned by women, are favored in order to achieve broad-based black economic empowerment goals. These procurement procedures were well-implemented but time-consuming. The trajectory for 'shopping' started with WRC's MUS project research manager, and moved from there to WRC's Supply Chain Management to prepare two bids—one for three villages in Sekhukhune district and the other for two villages in Vhembe district—stating the specifications ('specs') of the materials required including transport; from there to the Bid Evaluation Committee for the Request for Quotations (RFQ) with its form of conditions (having local presence, registration number in the national suppliers data base, tax clearance certificate and BBBEE certificate); then to local suppliers that had been identified by the intermediate-level IA; back to WRC's Supply Chain Management to transparently evaluate the received quotations and write a report; then to WRC's Bid Adjudication Committee for final judgement; to the WRC Chief Executive Officer to sign off; and finally to the winner of the bid. The estimated total WRC staff time for the 'shopping' was 15 person days.

In Sekhukhune district, the winning bidder needed a loan, which took more time. He delivered the materials in batches from May 19 to June 28, 2018, as supervised and signed off by Tsogang. In Vhembe district, the winner, a black woman, had forgotten to include the 14% value-added tax (VAT) in her quotation, which therefore was cancelled and the process had to be started over again. The new bids came in only in June. The new winner was selected on July 6 and given the WRC's purchase orders in mid-July. He delivered all the materials during July 18-22—working "even during the night," as some villagers complained. The IA had to check and sign off each delivery in both districts. The last batch was delivered on July 31.

For the tendering of materials in Tshakhuma, the additional internal steps in the WRC were that the specifications prepared by its Supply Chain Management Committee and evaluated by the Bid Evaluation Committee (which found some ambiguity and duplication in the description of materials, which had to be corrected and the amount reduced) were to be approved by the WRC board at the start of the new financial year on April 1. Then, it was advertised in the national government gazette on July 20. In addition to registration in the National Suppliers Data Base and submission of tax and BBBEE certificates, the bidders had to furnish three reference letters showing that they had the experience of performing similar tasks. Further discussions for clarification of costs of material took place at WRC on November 26. The total WRC staff time for Tshakhuma was estimated to be 10 person days. Delivery in batches with repeated checking by IA and the MUS Forum went on till January 17, 2019. Delays were also due to weather, the December holidays and electricity outages.

In sum, WRC diligently implemented the normal government procedures for procurement of materials. This required 25 days of well-paid civil servants' (of WRC in this case) time. The delays were mainly due to the phenomenon of middlemen and women 'tenderpreneurs' who comply with the clause of black- and women-owned enterprises but have little experience—for example, forgetting VAT—but are attracted by centralized government procurement. Many well-established chains appeared not so interested to directly supply to government; they lacked tax clearance certificates, registration on the national data base of suppliers, and BBBEE certificates. Although 'tenderpreneurs' claimed to be local, they operated from offices in Gauteng and only bought from local hardware shops. They were not familiar with the local conditions either. For example, the supplier for Sekhukhune district was not familiar with the steep and rocky access road to Ga Moela, so the IA and MUS Forum had to arrange transport. Moreover, in Phiring, his specifications for the rubber material for irrigation hydrants appeared so unclear that the item was entirely dropped (later, the legs of the tank stands in Ga Moela appeared of inferior quality). Especially in Tshakhuma, the process between submission of the scope of works and delivery of materials took a year, also because the Bills of Quantities had to be thoroughly checked. This time lapse affected trust in the project.

Comparing with Local Procurement

These experiences led the MUS Forums to advocate local procurement of materials as it has many advantages over centralized procurement. It would avoid the situation of materials that are locally available, sometimes even freely, such as river sand, being bought and transported far at high cost. It would also save costs when local stakeholders with a direct interest in high quality material and with some technical advice as needed, seek quotations, assess and buy in local shops of providers who know the transport requirements. Also, local buyers are able to buy from more than one shop to get the best deal. The option to negotiate discounts for bulk purchases would still hold. Upon delivery in the village, communities can scrutinize the lots provided. Local procurement also increases the communities' knowledge of available materials, their quality and prices and contacts with suppliers. This provides a strong basis for future maintenance and extensions.

Last but not least, the purchase price is likely to be lower in local procurement. Table 5 compares the final amounts stated in the purchase orders of WRC with the highest of three quotes obtained by the IA from local shops stating 'on-the-shelf' prices of the same materials, including transport and delivery costs, plus a margin of 2% for inflation. The comparison shows that local costs were considerably lower in five villages, especially in Vhembe where mark-ups in the tenders were more than one-third.

Table 5. Cost (ZAR) of materials centrally procured compared with cost of materials locally procured.

Village	Amount on purchase order	Local on-the-shelf price, including transport cost	Price difference	Price difference (%)
Ga Mokgotho	27,462,648	24,488,092	2,974,556	12
Ga Moela	34,957,947	33,601,400	1,356,547	4
Phiring	34,292,307	35,413,868	-1,121,561	-3
Khalavha	40,014,026	28,746,965	11,267,061	39
Ha Gumbu	33,999,383	25,298,533	8,700,850	34
Tshakhuma	88,879,696	66,114,962	22,764,734	34
Total	259,606,007	213,663,820	45,942,187	22

Source: Tsogang.

Only in Phiring did the supplier provide at a slightly lower cost than the on-the-shelf price.

Due diligence on local procurement of defined lots can include the condition that a legitimate community structure obtains three quotations from local shops, selects the best of them on the basis of transparent criteria, applies the required technical advice, and checks the quality upon delivery to sign off. If these conditions are met, the funder can pay the provider. Alternatively, in the case of more expensive purchases, the IA can receive the funding, list or technically check the specifications, render its advice on local suppliers, evaluate the bids, check the quality of materials delivered, and sign off for payment, all in consultation with the community structure. In fact, the IA in the MUS project performed all those local actions anyway, but only to inform the decision-makers upward. A revival of the government's past service centers with spare parts is another option.

Community-led Storing and Safety

Upon delivery in the villages, the MUS Forums took charge of storing the materials—pipes, cement and plastic storage tanks—in a safe public space. This saved the costs that contractors might have run up by establishing a plant and guarding against vandalism. In four of the six villages, the tribal chiefs and headmen offered their places for storage. Elsewhere, a tribal hall and a secondary school were used. Some of the villages kept a list of all the materials.

Where construction sites were accessible by car, suppliers could deliver materials like building material and river sand direct to the sites. However, in most cases, the IA used its pick-up truck or engaged a local transporter to carry construction material such as cement, cement blocks, pipes and tools from the store room to the site. This was a voluntary in-kind contribution or one done for a small allowance. Members helped in the loading and offloading of materials. Where construction sites were inaccessible by car, such as springs in the mountains, workers carried the material to the site.

The IA provided the construction tools for semiskilled workers, such as picks, spade shovels, nose shovels, wrangles, crowbars, saws, sledges, pliers, spirit levels, stamper, rakes, tape measure, hammers and fishlines. It also moved tools from the more advanced village to the next one. Skilled builders brought their own trowels, spirit levels, tape measures and fishlines. Some protective clothing was provided, like dust masks and gloves. The IA also kept a first-aid kit. The total cost of these tools was ZAR 25,000 at an average of ZAR 4,167 per village.

Step 5b. Recruiting Workers

Purpose and Action

In Step 5b, semiskilled and skilled workers are recruited according to agreed procedures. As employment is a scarce good, competition is likely; so conflicts have to be avoided. Procedures should also ensure equitable representation of women and men and include youth. The rate of payments and conditions, such as protective clothing and first-aid kits, have to be agreed upon. Keeping worker remuneration low can generate funding for material or other unforeseen expenditure, at least if the village has control over those funds. Those who are liable for technical quality, in this case the IA, have to prepare and train the recruited workers.

Lessons Learned

Recruiting Semiskilled Workers

The MUS Forums held intensive discussions to reach a consensus on recruitment. Learning from each other and

advised by the IA, they agreed upon and implemented the following recruitment process for semiskilled workers: A mass meeting was called in which everyone could participate. Slips of paper with 'yes' or 'no' written on them were put in a bowl or hat from which candidates had to randomly pick a paper. To ensure gender equality, there was one bowl for women, and one for men. Those drawing a 'yes' got the job. Alternatively, identity cards of applicants were put in a hat and the chairs drew them at random. Those whose card was drawn got the job (Khalavha). Villages unanimously saw these procedures as fair. Those who did not get the jobs accepted it too, hoping, as one of them said, their time was "still going to come."

In most of the villages, the MUS Forum members who volunteered time on "bringing and implementing the project" reserved jobs for themselves or were otherwise remunerated for their efforts. While a few villagers noted and criticized this, most others accepted it, realizing that the MUS Forum's efforts were for the general good.

The IA and MUS Forum preferred to call the workers 'volunteers' working for the common good of improved access to water. The word in SePedi, the local language, for stipend is 'baithaupi', meaning a reward given to somebody as a way of saying 'thank you' after that person helped voluntarily. In some of the villages, the MUS Forum did not mention any payment during the recruitment. One villager complained about this: She had been invited to a mass meeting for recruitment but did not attend because "I did not know that recruited people would be paid and I thought they were just volunteers; I was confused." She realized the truth only after the first round of payments was made. Only a few workers or others criticized the rate being paid, which was lower than South Africa's minimum wage, as a "robbery" if not "slavery." Especially in Phiring, this criticism discouraged others, so the few MUS Forum members themselves had to finalize works.

Recruiting Skilled Workers

Skilled builders (masons, fence installers, welders, plumbers, etc.) were needed to fence springs and storage and to build spring or stream intakes with division boxes, valve boxes, tank stands and concrete slabs for 2,500-, 5,000- or 10,000-liter plastic reservoirs and cattle troughs. In the six villages, recruitment of skilled workers started with a meeting of the MUS Forum, the IA and local builders to explain the technical designs, either orally or, if the builders understood them, with drawings. Builders were then invited to submit quotations for the overall works. Further, the bidder's previous works were inspected for quality.

All the project villages except Ga Moela had one or more skilled workers; so builders from Ga Mokgotho had to go over to build cattle troughs and valve boxes and train the local people in Ga Moela. All the skilled builders were male. The IA frequently brought attention to this disparity and the need for gender equality, and encouraged women to come forward, if not now, then in the future.

Negotiating Rates to Save Money

Once the IA had calculated the overall labor costs for local construction, it communicated the estimates to the MUS Forums. This fixed fund allocation became an incentive to negotiate the lowest possible rates and costs for both semiskilled and skilled work, lower than those budgeted to the WRC. The money thus saved was used for the common good. It served to fill gaps in materials, transport of materials from storage site to construction site, or transport costs to withdraw stipend money from the bank. It also enabled adjustment of designs, either to take advantage of new opportunities that emerged once works started, or to overcome unforeseen obstacles during construction, or when testing newly built infrastructure. Table 6 shows how labor cost reduction varied among the six villages but was on average 20%.

Contractors, who are only accountable upward, lack such an incentive to reduce labor costs for a transparent common local good. Their incentive for saving money might be business, if not personal gain.

It became important to keep the invoices of purchases and records in order to silence rumors that money

Table 6. Use of funds (ZAR) allocated to MUS Forums.

Village	Workers' compensation	Material and other costs	Total amount allocated for local spending	Materials and other costs as a percentage of total amount allocated
Ga Mokgotho	6,150,000	312,215	6,462,215	5
Ga Moela	12,389,000	4,829,225	17,218,225	28
Phiring	8,135,000	4,380,516	12,515,516	35
Khalavha	6,250,000	657,326	6,907,326	10
Ha Gumbu	5,315,000	419,501	5,734,501	7
Tshakhuma	6,430,000	500,810	6,930,810	7
Total	44,669,000	11,099,593	55,768,593	20

Source: Tsogang.

was being misappropriated. As only a few villagers had knowledge of bookkeeping, records were kept mainly by the IA. The insights provided by the budget led to some MUS Forum members and others comparing this project with other projects. Invariably, they remarked how the MUS project created much more value with a smaller budget, and, moreover, finished the promised work.

Training

Throughout the discussions during Steps 3 and 4 on designs, materials, costs, and scope of works, the IA developed local skills. In an indoor session before construction started, it provided further technical training to all the MUS Forums. The topics included: Occupational health and safety, working as a team and identification of quality material. It also demonstrated laying of pipes and associated fittings and valves, trench marking, excavating, bedding, backfilling, compacting and shoring. The training continued during construction as well. Significantly, had more funding been available, the IA would have prioritized further training on bookkeeping and technical skills, or hired a local technician for daily supervision.

Step 5c. Constructing

Purpose and Action

Finally, construction begins on the basis of the designs but is also adjusted to unforeseen obstacles or opportunities (see Figure 8). Workers are organized, trained and supervised. Works can be allocated across sections of a village, without considering whether the semiskilled workers can work on their own segment of the water supply system or on other parts. This strengthens community spirit. On the other hand, working on infrastructure in one's own neighbourhood for direct benefits may be an extra incentive to do high quality work.

Selected workers can take up as many tasks as possible and invite family members to help. This enables them to do more tasks per day. Alternatively, workers can stick to certain assignments, and so once one batch of workers has finished its work, the next batch gets an opportunity. Selected workers can also choose to get together as a group and work independently on a specific task for which the group is paid the sum of the stipends.

The IA and skilled MUS Forum members continue on-the-job training, and regularly go to work sites to advise and monitor the quality of work. They especially supervise key activities, such as junctions of pipes and testing for leaks before backfilling.

All works with related stipends are carefully recorded. Both semiskilled and skilled workers are only paid after their works are checked and certified as satisfactory. At regular intervals, the total amount due as stipends is drawn from the bank, and paid either in cash or, for ease and safety, deposited in the worker's bank account, if she or he has one. When construction is nearing the end, the MUS Forum members are trained for the handover.

Figure 8. Semiskilled workers digging a trench in Maswie section of Tshakhuma.

Photo: Barbara van Koppen.

Lessons Learned

Performance

Construction was fast and smooth. The IA facilitator also worked, and explained that this was "to avoid giving an impression of commanding." Villagers appreciated that she worked late at night even "under the light of the smart phone." Women and men claimed to work equally hard. Pointing at the hard work done by all also appeared to be an effective way to silence "the negative people who are always there" and those "who talk too much." The latter became quiet when they had to acknowledge the hard work.

In five villages, semiskilled workers worked across the village, beyond those parts of the water supply system that served their own homes. However, in Tshakhuma, the initial group that represented all sections appeared too large. When they had to share the amount available for the task, stipends became too meager. After that, workers were organized by section.

The bulk of work was swiftly finalized in three to four months, but the last part or the redesigns took another couple of months or even, as in Phiring, up to 12 months. Ga Mokgotho was the fastest: work was well-organized there, aided by the experience the village had gained with its gravity system for over a decade. In Ga Moela, the less experienced (young) workers also finished the new works swiftly and enthusiastically. In contrast, in Ha Gumbu, many households have private boreholes, and others bought water from their neighbors. These became the only option when the municipal borehole system broke down just before the work started. Here, villagers were lukewarm about the upgrading and extension of the reticulation of the borehole. Works in Tshakhuma took the longest, mainly due to delays in delivery of materials and the many systems that had to be upgraded and one that had to be newly constructed.

Workers appreciated the skills they learned and the stipends they earned. The few complaints were about late payment when other work groups were still to finalize their works and, in some incidental cases, low stipends, lack of protective clothing and hard work. The newly developed local skills and care for the "infrastructure for which we worked hard" bode well for future sustainability.

Flexibility to Adjust Designs

Unforeseen obstacles were encountered during construction, which required adjustment. At some places rocky soils needed steel pipes rather than HDPE pipes. In Ga Moela, the title holder of a preferred site for storage raised an objection; so a new site had to be found. However, new opportunities came up too. Some reticulation lines could be further extended or street taps could be added and moved nearer to households. Future users contributed money for such new pipes, or replaced old pipes, and volunteered to excavate the additional trenches. In Ga Mokgotho, a 100 m shorter route was found for the planned 1,450 m long pipeline from source to reservoir. The big storage tanks were moved closer to the village in Khalavha for security purposes, but by early 2020, the villagers had still not finalized connecting the reticulation from the storage to their yards.

When finalized works were tested, more work appeared to be needed in three villages. In Ga Mokgotho, inflows into the reservoir increased and water was stored for a more reliable rotation. However, the increased volume led to a crack in the masonry. The IA swiftly repaired it. In Phiring, workers had swiftly installed a 2 km long pipe from the Setunyeng stream to a spot below the dam where it was to be connected to the big central irrigation pipe that feeds the irrigation scheme. However, the water pressure in the irrigation pipe appeared too high. The next design was to redirect the pipe directly into the dam, and lengthen the pipe for that purpose. However, the difference in height between the intake in the Setunyeng river and the dam was less than necessary, so water hardly flowed into the dam. The next design was then to move the intake higher up the river. That worked. A second setback in Phiring was the blocked pipeline from the municipal borehole to houses in the Mohlatswengana section. As people had damaged the main line when they made their own connections to the line, blockages were more severe and over a longer stretch of the pipeline than thought initially.

Lastly, in Ga Moela, the steel for the tank stands of the new 40,000-liter reservoir appeared too weak and started bending when the reservoirs were filled for the first time. The supplier of the steel had already been paid, so the IA had to replace it with stronger steel. Also, one of the two municipal boreholes appeared too weak to push the water up through the new main line to the new storage. The IA added an electric booster pump, but raising money from all users to pay for the electricity bill was cumbersome.

This underlines the importance of flexibility to finance such adjustments. Contractors who are only accountable upward to implement fixed designs often lack this flexibility. In the MUS project, the IA and MUS Forums created a flexible reserve fund. In future community-led construction, contingency funds can serve this purpose.

Municipal Boreholes

Although the construction of improved storage and reticulation of four municipal borehole systems went well, it was almost a year before two of the boreholes started working. In Maswie, a section of Tshakhuma, the borehole was constructed in 2015 but had been idle. In Ha Gumbu, the diesel engine broke down in mid-2018 when upgrades of the pump house, storage and reticulation had just started. The municipality promised to replace the diesel engine with an electric one and to provide two complete sets of boreholes, reservoirs and reticulation to the two

new sections. This took till April 2020. In the meantime, rumors emerged that the contractor had disappeared with the money.

The municipal diesel borehole that serves both the Tawaneng and Letlabela sections in Ga Moela had problems too. The borehole broke down in March 2019. In September 2019, the municipality replaced it with a petrol pump, and promised to deliver the fuel, but the process within the municipality took long to win approval for the shift from diesel to petrol. In the meantime, people in the Tawaneng section organized to collect money for the fuel. The pump operator volunteered. In Letlabela, however, users of the new storage and reticulation kept waiting, thinking that if they bought petrol for the pump themselves it would only encourage the municipality to do nothing about it. Promises make people passive; everyone loses.

For all municipal boreholes, even minor breakdowns took long to repair. In principle, all users interviewed were ready to take charge of small repairs themselves, leaving the big repairs in the hands of the municipality. New co-management arrangements can advance such a win-win division of roles and responsibilities between communities and municipalities.

Costs of Facilitation, Training and Supervision of Construction

Table 7 gives the required staff time (in days) and total staff time and travel costs per village for the IA's facilitation of community-led construction from the recruitment process onward. This includes advice, indoor and on-the-job training, supervision and quality control of works. Table 7 shows that costs to the IA amounted to 36% of the total capital costs. The national Cost Benchmark Guide estimates that the proportional costs of secure storing, construction supervision fees and training and capacity building fees range from 10% to 22%, depending on the size of the project. As noted in the section *Cost and Time Comparison* above, it is unclear how local contractor costs are calculated—a role that the IA implicitly took up as well.

Table 7. Costs to the implementing agent (IA) for facilitation, training and supervision of construction.

	Total days (facilitator)	Total days (technologist)	Total days (engineer)	Total staff time and travel costs (ZAR)
Ga Mokgotho	43.5	10	8	113,307
Ga Moela	53.5	31	6	199,222
Phiring	35.5	21	6	141,729
Khalavha	46	7	3	104,544
Ha Gumbu	33	6	3	95,752
Tshakhuma	149	16.5	10	283,667
Total days of facilitation/supervision	360.5	91.5	36	
Total staff and travel costs				938,221
IA's contractor insurance				24,000
SDM and VDM office rental (ZAR 1,000/month per office)				16,000
Indoor training (5 days with 69 participants @ ZAR 100)				34,500
Subtotal				1,012,721
Overheads (12%)				121,527
Total				**1,134,248**
Total capital costs (see section *Cost and Time Comparison)*		3,153,746		
IA facilitation and supervision costs for construction as a percentage of total capital costs		36%		

Employment Created

Community-led construction generated a total of 3,550 semiskilled person days of employment, which was 72% of the total employment generated, the rest being skilled jobs. Table 8 gives an overview of the number of workers, the total person days of employment created for semiskilled workers at a daily rate of ZAR 90, the total worker remuneration and the proportion of it earned by semiskilled workers. The total labor cost of ZAR 446,690 was 14% of the total capital cost of ZAR 3,153,746.

Table 8. Number of workers, total remuneration paid to all workers and proportion of payment and person days of work generated for semiskilled workers.

Village	Number of skilled and semiskilled workers	Total payment (ZAR) to skilled and semiskilled	Person days of workers semiskilled employment @ZAR 90/day	Total payment (ZAR) to semiskilled workers	Payment to semiskilled labor (%)
Ga Mokgotho	58	61,500	485	43,631	71
Ga Moela	38	123,890	1,025	92,284	74
Phiring	50	81,350	556	50,084	62
Khalavha	22	62,500	611	55,000	88
Ha Gumbu	31	53,150	487	43,840	82
Tshakhuma	77	64,300	386	34,700	54
Total/average	276	446,690	3,550	319,539	72

Preparing for Handover

In preparation for Step 6, the use phase, the IA organized a five-day training session on operational skills for the three villages in Vhembe district in December 2018 (20 participants) and for the three villages in Sekhukhune district in January 2019 (15 participants). The topics included: knowledge of environmental health and community hygiene practices, water quality (especially the quality of the 3-5 liters per person per day used for drinking and cooking; for example, the use of a teaspoon of bleach in 20 liters of water, and wait for 30 minutes before drinking), climate change adaptation, operation and maintenance, gender equality and women's empowerment to raise awareness and promote change, and basic bookkeeping. In February 2019, a training session was held on homestead irrigation in which seeds were provided as well. Officials of the municipality visited the schemes toward the end of 2019, preparing for an official move to the use phase without the IA. However, the Covid-19 crisis in early 2020 delayed this process.

Conclusions

These generic guidelines derived from the lived experience of the project show how a community-led approach implements step-wise planning, design and construction of water infrastructure by placing the future users in the driver's seat. This experience also confirms that community-led MUS is **relevant** wherever the maintenance backlog of public infrastructure is growing and/or self supply is expanding. In cases of municipal boreholes, communities appeared willing to take up responsibility for swift small repairs to the reticulation in forms of co-management in which municipalities continue to ensure reliable O&M of boreholes.

In addition to normal financial support for materials and labor, as in any infrastructure project, community-led MUS **requires** an IA with a—still quite rare—combination of facilitation skills and technical and engineering skills relating to small-scale technologies. The IA and other project partners need to ensure due diligence, transparent budgeting and spending, technical quality control and appropriate contractual structures and arrangements. If these conditions are met, community-led MUS has eight generic strengths.

1. Community-led MUS **improves livelihoods** by supplying more water more reliably and nearer home to alleviate the burdens of domestic chores and livestock watering, and to enable irrigation or reuse of more water for trees and crops, brickmaking and other such enterprise. Measures such as point-of-use treatment or filter boxes ensure water quality of at least 3-5 liters per person per day for drinking and cooking.

2. Community-led MUS **creates jobs** when villagers are remunerated for their work, as is widely applied in employment generation programs.

3. Community-led MUS is **inclusive**. Open invitations to attend mass meetings reach everybody and give voice to everyone in the process to nominate representative community structure. Inclusiveness is further fostered by encouraging and monitoring so that no one is left behind in designs and that women and youth are included and trained, including in skilled technical works.

4. Community-led MUS is **cost-effective** in the sense that it harnesses communities' existing knowledge, skills and investments in cash and kind in water infrastructure for self supply, and welcomes the cost-effectiveness of multipurpose infrastructure. Local procurement of materials can further reduce costs compared to centralized procurement. In addition, the costs incurred by the IA seem comparable to fees normally charged in water infrastructure projects. However, further research is needed on costing modalities, including costing of supervision of contractors, size of projects, and required levels of engineering expertise.

5. Community-led MUS is **performance-oriented in the common interest**. Where communities can allocate fixed amounts, they seek to spend cost-effectively for the common good. Serious, hard work in community spirit is rewarded.

6. Community-led MUS is **swift**. Communities do need time to discuss and agree on issues, but they can act also beyond office hours and partly voluntarily. Some remuneration for works accelerates construction. Indeed, administrative tasks, such as formalization and contracting, tendering or procurement, appeared more time-consuming.

7. Community-led MUS is the only service modality to **support self supply** and the mix of self supply and public infrastructure as is most common nowadays. Moreover, by anticipating unplanned, if not illegal forms of 'partial self supply', such as yard connections, these aspirations and investments can be anticipated in the design phase so that damage and conflicts can be prevented.

8. Last but not least, community-led MUS strengthens **sustainability** by starting with the *localized* technical and managerial problems in the mix of public infrastructure and self supply; following people's priorities in identifying *localized* solutions; (potentially) procuring locally; recruiting local semiskilled and skilled workers for construction and developing their technical and managerial capacities; strengthening community structures to lead the process from the onset and for the future both technically and managerially; and initiating and strengthening contacts with government agencies and suppliers (especially in case of local procurement) throughout the process. This respects the communities' voice in the spirit of 'nothing about us without us'.

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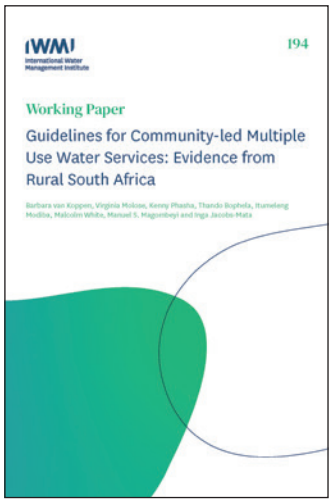

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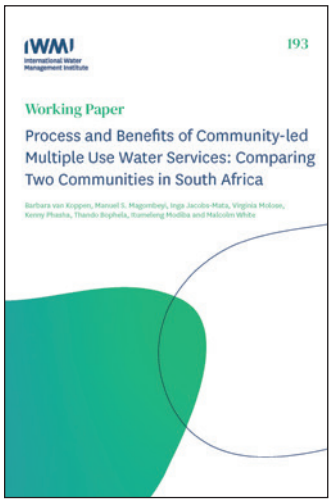

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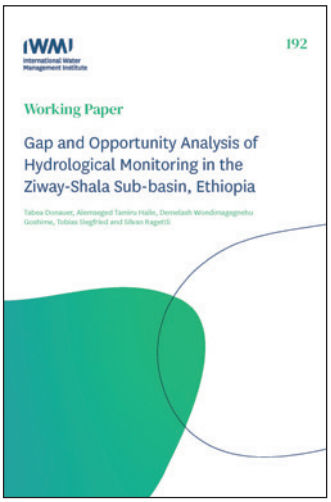

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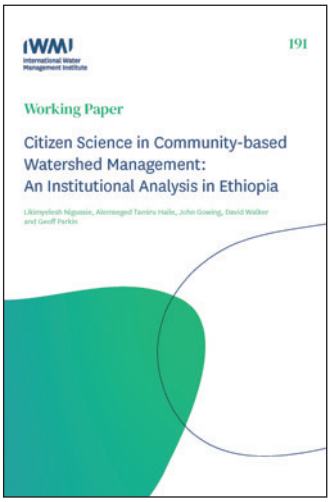

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