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Water Point Mapping in Tanzania: Making the voices of data collectors audible

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Abstract
Any attempt to develop mobile-phone based platforms that allow citizens themselves to report data on near-by rural water points and update the Water Point Mapping System (WPMS) baseline in Tanzania depends on an understanding of reporting practices of water users or their representatives within the local context. The aim of this paper is to describe such reporting practices to official data collectors during the nation-wide baseline data collection for the WPMS project (May 2011 to April 2013). We draw on fieldwork for a five-year action research project (2012-2017) titled *Sensors, Empowerment and Accountability in Tanzania (SEMA)*, and funded by NWO-WOTRO Science for Global Development. Our conclusion is that working with the grain of actual information flows between local institutions may be a clumsy solution to rural water services, but it makes elegant failures less probable.

Introduction
Several studies have compared mobile phone-based ICT platforms for improving water supply in the past few years. Welle et al. (2016) conducted the most recent cross-national comparison, which included eight such platforms, in three continents. Some rely on crowdsourcing—water users or their institutional representatives reporting water service failures. Others rely on either the government provider or NGOs collecting data regularly. These authors saw three related essential building blocks to achieving water service sustainability: (1) successful reporting, (2) successful report processing, and (3) successful service improvements through water scheme repairs. Obviously, steps (2) and (3) are contingent on the success of the first step—the successful reporting of the status of a water point, which is the focus of this paper.

Some authors attribute unsuccessful reporting to citizens' distrust in government (McCall, Martinez and Verplanke 2013) or to the apathy of rural citizens (Daraja 2012). Others attribute the failure to a culture that cannot yet cope with the principle of documentation (Rottenburg 2009), a view frequently echoed in unpublished reports of consultants, who complain that *"there is no monitoring culture"* in the rural water supply sector. But while distrust, apathy or a lack of a monitoring culture may be plausible explanations of unsuccessful reporting, it is not clear how their opposites (trust, citizen engagement and a flourishing monitoring culture) can be created *in a specific context* except by stating the obvious: people will report failures if water officials are responsive to these reports and repair the water points.

One of the eight platforms evaluated by Welle et al (2016) was the human sensor web, implemented in 2010 in Zanzibar by University Twente, the Zanzibar Water Authority, a local mobile telephone company and a local internet service provider. Anyone could report the status of a water point, 'no water' or 'bad water', by sending a coded SMS to the database. Eventually, few people successfully reported and the human sensor web failed to provide continuous data on the quality of service provision in Zanzibar. Since 2012, the University of Dar es Salaam in cooperation with the University Twente are working on a new mobile phone-based platform, called SEMA, which means 'tell me' in Kiswahili. Currently, the SEMA software comprises an Unstructured Supplementary Service Data (USSD) client for standard mobile phones, and an Android client for smart mobile phones. Water users or Community Owned Water Supply Organization (COWSO) leaders with mobile phones may use it in rural Tanzania to report to

local government authorities (LGAs) specific information about their water points. But this time, the design and deployment of the new platform is part of a five year research project (2012-2017), called Sensors, Empowerment and Accountability in Tanzania (SEMA), and funded by NWO-WOTRO Science for Global Development. In our extensive fieldwork, we used the SEMA platform as a research tool that enabled us to collect meaningful information on the reporting behavior of citizens and the responsiveness of water officials to the reports. Additional funding by the Department for International Development (DFID), through the Human Development Innovation Fund (2015-2017), allowed us to scale the SEMA platform to four Tanzanian districts and to about 2000 rural water users and COWSO members, who are currently reporting regularly the status of rural water points in their villages.

In our research project, instead of engaging in cross-national comparisons of platforms which may hide patterns of local variation (Fox 2015), we focused on reporting practices within a single institutional context—rural water supply in Tanzania. Analytically, we distinguish between two related concepts: *'giving a report'* and *'reporting,'* or according to Pritchett (2013), *'giving an account'* and *'accounting.'* Empirically, we collected data on how the *same* individual, whether a rural Tanzanian water user, or a COWSO member, or a ward councilor or a district water official, is 'giving a report' of his actions and how she is 'reporting'. Following Pritchett (2013), we define these two concepts thus: A **report** (or an account) on my duties as a rural Tanzanian water user, or as a COWSO member, or as a ward councilor or as a district water official is a justificatory narrative of my actions that I give to people whose opinion of me I value and whose esteem I seek. These people "*include myself, but also family and kinsmen, friends, co-workers, co-religionists, and people in my profession"* (p. 18). **Reporting** (or accounting) is that small part of my report which includes a few objective facts regarding my actions and communicates them to my hierarchical superior upon demand. As Pritchett argues, for my 'reporting' to be successful, it must converge with my 'report'. The more my 'report' and my 'reporting' diverge, the more fictional are the 'facts' that I communicate in my reporting.

These two concepts allow us to reduce the problem of creating trust, or citizen engagement or a flourishing monitoring culture to the empirically-grounded problem of how to make *'giving a report'* and *'reporting'* by the *same* individual converge. During our fieldwork in rural Tanzania we collected 'reports' of water users, COWSO members, district water officials and ward councilors in focus group discussions, interviews and participant observation in the village market, on the street and in citizen assemblies as they interacted with each other. We found substantial evidence in rural Tanzania of a rich culture of 'giving a report', as defined above, and we documented it elsewhere (Nganyanyuka et al 2016a,b, c).

In this paper, we examine 'reporting' practices of village leaders to official collectors of rural water point data. The empirical setting is the nation-wide data collection for the Water Point Mapping System (WPMS), a massive and unprecedented project in Tanzania, and for all we know, in sub-Saharan Africa. The lessons learnt are essential when designing mobile-phone based platforms that allow water users or their representatives to act as data collectors and update the baseline data *themselves* (Georgiadou et al 2011, 2014).

Description of the Case Study & Approach

The WPMS is an innovative web-based information system that aims to make rural water point data accessible to the public and easily updateable by local government authorities (LGAs). It provides in digital form the status of all rural water points in the country to inform national planning and budgeting. The blueprint for the WPMS was negotiated between the financier (World Bank) and the recipient (Ministry of Water) and carried out by the project implementer (a local company) in the period 2010-2013. Implementation included four activities: (1) nation-wide baseline data collection of all rural water point data, (2) development of the web-based Water Point Mapping System (WPMS), (3) provision of recommendations for the integration of WPMS into the monitoring systems and practices of LGAs, (4) support capacity building on the use and updating of the WPMS. Table 1 summarises the water point data collected during the nation-wide survey. At the time of writing, setting up a cost-effective updating platform still remains a significant challenge, while the WPMS baseline is constantly evolving.

	WPMS baseline data
Baseline data describing the status at time T	**Capturing the Water Point status** (1) Local time, (2) GPS time, (3) Functionality of Water Point (WP) in 7 STATUS classes, (4) Aggregation of STATUS in 2 classes, (5) Water quantity of WP, (6) Water Quality of WP, (7) Type of WP hardware problem, (8) Reason for hardware problem, (9) General comment, (10) Whether and when payment is received for water, (11) Amount of payment received for water use, (12) Whether a public meeting was held in the village about WP management
Data describing the collective user	**Collective User ID** (1) LGA name, (2) Ward name, (3) Village name, (4) Sub-village name, (5) Village population, (6) Population served by WP, (7) Village registration nr, (8) Village photo ID (9) Who is responsible for water scheme, (10) Who is responsible for WP
Data describing the physical water point	**Rural Water Point ID** (1) GPS location, (2) Water point code, (3) WP photo ID number, (4) Water scheme name, (5) Water permit issued for scheme from catchment, (6) Name of catchment, (7) WP local name, (8) Description of water source, (9) Type of extraction, (10) Type of WP technology, (11) Name of WP funder, (12) Name WP Installer, (13) Year of WP construction, (14) Year of WP breakdown, (15) Description of water source, (16) Type of extraction, (17) Type of WP technology

Table 1: WPMS Baseline data collected in the nation-wide survey **(May 2011- April 2013)**

At first sight, the idea of an *'evolving baseline'* is puzzling. Even the total number of water points— the most basic aggregate fact of the baseline data—has been evolving since May 2013, as the baseline is being reviewed, verified, corrected, by the ministry and a series of consultants (Table 2).

WPMS Baseline	May 2013	August 2014	October 2014	September 2015
Total number of water points	75777	74250	58514	84945
Online and official sources	WSSR 2013 (GoT)	MoW - WPM Technical Workshop	Annual Review, 2015 DFID	Annual Review, 2015 DFID

Table 2: Evolution of the total number of water points in the WPMS baseline after May 2013

The WPMS baseline must represent the status of the WP infrastructure at time T0 and is a list of all mapped water points (e.g. 100,000 WPs) with their attributes. At a later time, T1, the list may feature 105,000 WPs either because 5,000 new WPs were constructed, or because 5,000 old (unmapped) WPs were "discovered." But this is not a new baseline at time T1. It is the status of the WP infrastructure at time T1. Having a baseline at T0 allows us to make a credible claim at T1 that the WP infrastructure has improved or deteriorated during the period T1-T0.

What the approach is trying to achieve

First, there is a need to halt the "evolution" of the WPMS baseline and agree on what will constitute a single, authoritative baseline for all future comparisons. This matters because of the tight coupling between the WPMS and the Payment-by-Results (PbR) pilot proposed by DFID in Tanzania in 2013. The PbR pilot is a £78million incentive to central and local government to maintain and expand access to rural water points within each one of the 50 pilot districts. £1,500 will be paid for each functioning water point but not for new ones. Thus local government will have a strong incentive *"to maintain existing water*

points in a sustainable manner and to fix broken water points instead of simply building new ones […] Payments will be made upon an independent verification of results, building on the existing Water Point Mapping System." (Janus and Keijzer 2015, p. 12).

Second, there is a need to make audible the voices of actors—like data collectors—that are normally silenced in the literature of development cooperation. Data collectors have been central figures only in high literature so far, and then only as hapless victims of village bureaucrats. For instance *K*, the land surveyor and protagonist in Franz Kafka's *The Castle* (1926) was lectured thus by the village mayor when he expressed his wish to collect data in the village: **"***As you have noticed, Mr Land Surveyor, I knew all about this affair […] But now that you have been kind enough to come and see me yourself, I have to tell you the whole, if unwelcome, truth. You have been engaged, you say, as a land surveyor, but unfortunately we don't need a land surveyor. There wouldn't be any work for you here at all. The boundary markings of our little farms are all established, everything has been duly recorded. Property hardly ever changes hands, and we settle any little arguments about the boundaries ourselves. So why would we need a land surveyor?"(p.55).* Silencing data collectors' voices is unfortunate at a time when the so-called "crowd" is supposed to be the ultimate source of any online data and work, from tedious micro-tasks performed by large, paid crowds (e.g. Amazon Mechanical Turk) to developing common goods (e.g. Wikipedia), to reporting potholes to government (e.g. FixMyStreet).

How the work was undertaken – Four concepts

Elementary data: Ideally, baseline data collected in the field should be *elementary*. Elementary data are either facts or figures for which a consensus between the data collector and the villagers can be easily established on the ground, in the real world. Elementary *facts* have an indisputable referent in the field. Examples are: *"the users of this water point refer to it as Kwa Juma Popo*", *"this water point is a shallow well*". For villagers, the local name *Kwa Juma Popo* means that the water point is next to the house of Juma Popo, or next to his farm, or within his farm. Elementary *figures* are numbers that refer to a countable reality in the field. An example of an elementary figure could be *"the water quantity at local time T at this water point is the amount of time it takes to fill a 20-litre bucket as witnessed by the data collector and the villagers*."

Elementary administrative procedures: A set of elementary data collected in the field constitutes a valid baseline for a country when *elementary administrative procedures* are in place to link the collected data with their administrative representations at the local government authority (LGA) office and the Ministry of Water. An example of such a procedure is the mapping between *Kwa Juma Popo* and a unique identifier generated by the National Bureau of Statistics, e.g. 05023043181WP50 meaning (05 – Region code, 02 – District code, 3043 – LGA code, 181 – Ward code, and WP50 – water point number). The elementary administrative procedure creates a solid link between the local name of the water point (*Kwa Juma Popo),* which has a meaning for the villagers, and its administrative representation—the unique water point identifier 05023043181WP50—at the LGA office. A water engineer at the local government authority (LGA) office or the ministry of water would experience the solid link between *Kwa Juma Popo* and 05023043181WP50 as two entries next to each other in a row of an excel sheet that contains all the elementary data of the water point.

Transaction-intensiveness: The collection of baseline data is a transaction-intensive activity. It requires a large number of interactions, always involving face-to-face contact, between the data collectors and informants: the local water technician, the village executive officer, the traditional village chief, members of the village water committee, individual villagers and other non-resident water users such as pastoralists. 70% per cent of the Tanzanian population of 44 million is settled in thousands of villages, and population increases by 1.2 million people annually, one of the fastest growth rates in the world (UNDP 2014). The country covers an area almost twice as large as France, variation in rainfall and water resources is considerable, and transportation is often slow, unreliable and costly. The daily schedule of a data collector can be excruciating. Data collection commences early in the morning and terminates at sunset. During the rainy season, reaching villages even with a four-wheel drive vehicle is impossible and a canoe or a motor bike must be used instead. Walking on foot for up to eight hours in order to reach a WP and collect data is common.

Discretion: The collection of baseline data is also a discretionary activity because the data collector must make decisions on the basis of information supplied by informants that *"is important but inherently imperfectly specified and incomplete, and entails extensive professional or informal context-specific knowledge"* (Prichett and Woolcock, 2004, p. 194). The data collector depends on the ward executive officer for village populations of villages and registration numbers. He depends on the village executive officer (VEO) to walk him to each existing water point. He depends on the village water technician, the water committee and water users for answers to questions such as the type of water extraction, the status (functional, non-functional, needs repair) of the water point, specific hardware problems and (seasonal) water quantity. Only water committee members, the technician and users may remember the year and technical reasons for breakdown as well as non-technical reasons (e.g. theft) for a non-functional pump. Finally, only water committee members and residents know which amount a citizen pays as service fee when he/she draws water.

Main results - Capturing WPMS baseline data from villagers

The local company contracted by the Ministry of Water captured the rural water point data from May 2011 to April 2013. It trained data collectors in digital techniques of data capture, including GPS equipment, tablets, and digital cameras. Each data collector capturing a water point in a village had to position the water point with GPS coordinates, photograph it and inscribe on it the official code described earlier, using a special pen with indelible ink. The idea was to establish a *solid physical link* between the local name of the water point (e.g. *Kwa Juma Popo*) and its administrative representation—the unique water point identifier 05023043181WP50—at the LGA office. The data collector was accompanied by the district water engineer (DWE) or his representative. He depended on the local knowledge and willingness of village leaders to be interviewed and to provide him with a host of other data—functionality of the water point, the perceived quality and quantity of water, time of latest breakdown, name of original constructor, among many others (see Table 1) that would uniquely identify the condition and infrastructural history of each water point. Last but not least, the data collector depended on the willingness of village leaders (either indigenous local chiefs, or local appointees of the district government) to walk him to each water point. Our in-depth interviews with one of the data collectors (here referred to as M[1]) and the inspection of the May 2013 WP baseline revealed a number of issues, of which we list four:

Only a few of the collected data were elementary (e.g. *"the village name is Fukwe"*, *"the users of this water point refer to it as Kwa Juma Popo*"). Other data (e.g. the population served by the water point) were *aggregated* estimates either guessed or extracted from paper records often of dubious quality. Yet other data (e.g. water point functionality) were not only discretionary in terms of how the collector and the village leader perceive the water point status, but also fluctuating over time due to fluctuating official definitions of functionality, different methods to aggregate functionality, as well as due to changes of official names of administrative units during the period of data collection. The official ID—the string of digits and numbers derived from the administrative hierarchy region/district/ward/village/sub-village and an arbitrary integer— assigned to each water point by the data collector, was particularly vulnerable, as villages ended up in newly formed wards and districts with different names. As a result, the solid link between the 'field' and office representation of the WP was broken for those villages and wards.

The WP database consumed itself from the inside, a phenomenon called autophagy[2]. To capture the water point functionality in the field, the data collector assigned a 'status' to each water point by choosing one out of several predefined status categories of 'functionality'. These categories ranged from 'functional' to 'needs repair', to 'service interruptions for less than 3 months' up to 'more than six months', and finally 'non-functional'. During data processing the original 'status' was aggregated into a 'status II', by combing all service interruptions of more than three months into the category 'non-

[1]We call the data collector *M* due to the eerie similarity of his experience to that of *K*, Franz Kafka's land surveyor in *The Castle* (1926).

[2]Rottenburg (2009) defines autophagy (from the Greek *auto*, "self" and *phagein*, "to eat") as the phenomenon in which paper lists, databases and maps consume each other (through inconsistency) and themselves from the inside (through invalidity) and attributes it to a culture "*that cannot yet cope with the principle of [bureaucratic] documentation."* (p. 108).

functional.' All water points that had less than 3 months of interruption or required simple repairs were labelled 'functional'. Apparently, there was an informal agreement between the local water committees and the DWEs that *"small repairs usually take up to three months to fix"* and therefore labelling such water points as 'non-functional' was not expedient. However, when the first version of the rural WMS was published in 2013, the database was full of water points that were recorded more than three years earlier and no updates were made to see whether the points needing repair had been actually in the meantime. In order to correct for this, elementary data had to be consistently linked to the IDs inscribed on the water points. But the official ID changed when villages ended up in newly formed wards and districts with different names, and the written ID labels themselves disappeared. On top of this about 5% of the recorded water points in the rural WMS displayed inconsistencies with regards to their numbering (unique identifiers that were not unique) or location. This meant that many water points would be impossible to update, because it is impossible to link them to the database unless the full records are available to the village water committee and cooperation from the village leaders is guaranteed. All these records therefore technically became outdated and irreparable, consuming themselves from inside.

Water points were occluded and therefore not captured because of the outright refusal of the village leader to cooperate. We quote a characteristic example of a dialogue between our data collector and a village leader:
"We arrived at the village in the evening and were immediately confronted by the village leader. He was a traditional chief elected by the villagers according to ancient traditions. To his question about the purpose of our visit I answered:
M: We come from the [national water authority] and want to map the water points in your village.
Village Chief: What is the benefit of your work for us?
M: All we want to do is take the inventory of the water points, because the government wants to construct water points in every village.
Village Chief: Others like you came here with the same stories in the past and they did nothing. Go away!
I explained that this time was different. And my proof was the DWE's presence. Unfortunately this made things even worse.
Village Chief: What are you talking about? We have not seen a DWE here since the construction of the water well [many years ago]. The DWE is paid to help us and he and the government have abandoned us. I don't believe you. Go away!"

In other instances, *M* was met with (what he perceived as acts of) wilful *deception* by village leaders, for example*: "The village leaders [appointees of the district] often lied to me when I asked where the water points are. They reported having fewer water points than they actually did. They did not report water points that could be reached only by walking many hours. They also hoped that by lying about existing water points (especially those far away) I would construct more water points closer to them. Obviously, they over-estimated my powers. I am only a data collector."*

Beliefs in magic were common in the western world from classical times to the enlightenment, especially in times of rapid change and urbanization, and are still widespread in Tanzania (Pew Research Centre 2010). Beliefs in magic and witchcraft should not be dismissed as irrational attitudes that need to be eradicated but as means for resolving conflicts and defining and affirming social boundaries in communities (Douglas 1970). We quote a characteristic excerpt from an interview with M, the data collector, on such beliefs in rural water supply: "*Some of the elders of the villagers (e.g. traditional chiefs) do not want their water point to be mapped and marked because they believe that once I map and mark the water point the water may disappear or dry up. In one village the leader walked us to the water point where several pastoralists were fetching water. I told the people that I wanted to take a picture of the water point. Some fled, and some hid their faces. I took the photo nevertheless, and when the time came to write the official ID of the water with the special pen they protested vehemently: 'The water will disappear if you write on the water point.'*"

Early in 2014, DFID hired a consultant to formally assess whether the WPMS baseline was good enough for the Payment by Results pilot. The consultant discovered that the baseline data of May 2013 "*was far worse than the GoT and donors had expected. This was an unexpected challenge to both GoT improving delivery of functional water points, and GoT and DFID monitoring outcomes to make PbR payments."* (DFID Annual Review, 2015). About 75% of the official IDs inscribed on the water points had disappeared, although the special pen inscription was designed to last. It is difficult to tell whether the inscriptions are worn off due to

exposure to the sun and rain or whether they were intentionally removed after the data collector's departure to remove the magic spell. The consequence is the same. The physical link between the water point on the ground and the corresponding entry in the WPMS baseline has been severed. The consultant made the sensible recommendation to update the baseline with new rigorous procedures rather than to repeat the whole data collection from scratch. In August 2014, the World Bank and the Ministry of Water invited all stakeholders to a technical workshop in which *"technical people should have technical discussions, share our experiences in rural water management systems and agree on a way forward"* (senior ministry official). The baseline has been evolving ever since and setting up an updating platform remains a significant challenge.

In this section, we examined characteristic 'reporting' practices of village leaders to official collectors of rural water point data. The divergence between these 'reporting' practices and 'reports' (Nganyanyuka 2016b, c) can be explained by the long history of mutual by-passing of villagers and the state. On the one hand, the donors and the state have chronically by-passed local institutions and villagers in the shaping of rural water schemes (Therkildsen 1988). On the other hand, the peasants have persistently resisted being 'captured' by the state (Hyden 1980), ever since the Ujamaa period, which promised peasants ambitious rural water supply schemes if they resettled in new villages. The peasant ethic of mutuality and reciprocity eventually saved the peasants from the heaviest burdens of forced resettlement, which was eventually abandoned, while the water schemes rapidly deteriorated. The peasants' uncanny ability to opt out of resettlement via covert resistance (e.g. foot-dragging) and their tenacity in preserving their way of life prevailed. Their resilience to forceful state interventions "*comes as no surprise if one bears in mind that the institutional order in Tanzania and its colonial and postcolonial legacy never really demonstrated their superiority in providing justice and prosperity*." (Rottenburg 2009, p. 141). The occlusion of water points, the (perceived) acts of deception and even the beliefs in magic in rural water supply may be seen under the light of a continuing covert peasant resistance to the state and its data collectors.

Lessons learned

An adaptive approach is needed to design a mobile-phone based updating platform that *"goes with the grain"* (Kelsall 2008) of local culture. It should include: **(1)** mapping of the actual tasks and information flow between the LGA and rural citizens (see e.g. Figure 1), **(2)** clustering the tasks into major steps (e.g. detecting, reporting, diagnosing, mobilising funds, purchasing, fixing) and depending on whether these unfold outside or inside local (village and district) institutions, **(3)** classifying the micro tasks based on degrees of discretion and, finally, **(4)** digitising steps incrementally and based on the priorities in Table 3. See Nganyanyuka et al (2016b) for further details.

Tasks outside the village and district institutions: These are tasks in steps I (detecting), II (reporting), III (diagnosing the water point breakdown), V (purchasing spare parts) and VI (fixing) and have a mix of low and medium discretion. Tasks in steps I (detecting) and II (reporting) are low-discretion, and easily amenable to digitization, but only if a village official, willing to be assimilated in the hierarchical monitoring process, carries them out. Tasks in step III (diagnosis) require the physical presence of a skilled individual at the village and can be transformed by non-technological solutions e.g. by building the capacity of COWSOs to effectively monitor and repair broken water points without depending on the district council. Tasks in steps V and VI are amenable to digital transformation. Information about breakdowns and possible solutions that is available transparently and in a timely fashion may provide external market parties with the opportunity to stockpile spare parts efficiently and dispatch technicians to the right locations. A social enterprise could probably provide this service under a business model that would benefit a network of warehouses and technicians down to village level.

Table 3: Digitizing task and information flows (Nganyanyuka et al 2016b)

Steps	Low Discretion # tasks	Medium Discretion # tasks	High Discretion #tasks	Amenability to digital transformation	Priorities
I: Detection & reporting at village	2			High	**1st priority** - Mobile phone based updating platform – SEMA platform
II: Reporting to the district	1				
III: Problem diagnosis		4		Medium	**2nd priority** - Social enterprise
V: Purchase of spare parts		2			
VI: Fixing	2	2			
IV–A: Village mobilizes funds by withdrawal	9	3	1	Low	**3rd priority** - Simplifying rules and procedures in collaboration with actors, then digitizing
IV-B: Village mobilizes funds by collecting contributions	11	2	3		
IV-C: Village mobilizes funds at district council	33	10	3		

Tasks inside village and district institutions: Tasks in step IV-A (mobilize funds at village level through withdrawing money from bank), IV-B (mobilize funds at village level through contributions), and IV-C (seek financial assistance from the district) include a mix of all three levels of discretion-low, medium and high. Medium discretion tasks in step IV-A, IV-B and IV-C include attendance to meetings, travelling to carry letters to the district council and withdrawing funds from the bank. High discretion tasks include approval of the COWSO steering committee to request funds from the DED or the district treasurer. All these tasks unfold within local (COWSO and village government) and district institutions and are infused with an incredible amount of rules and procedures, both formal and informal. While some of these procedures may appear to be absurdly complex to an outsider, they reflect a deeply embedded bureaucratic culture that should not be dislodged with technological means. Thus while non-discretionary tasks in step IV-A, IV-B and IV-C might seem to be easy candidates for digitization we strongly recommend to refrain from expediting them with technology, before new rules and procedures are deliberated upon and agreed by all concerned actors.

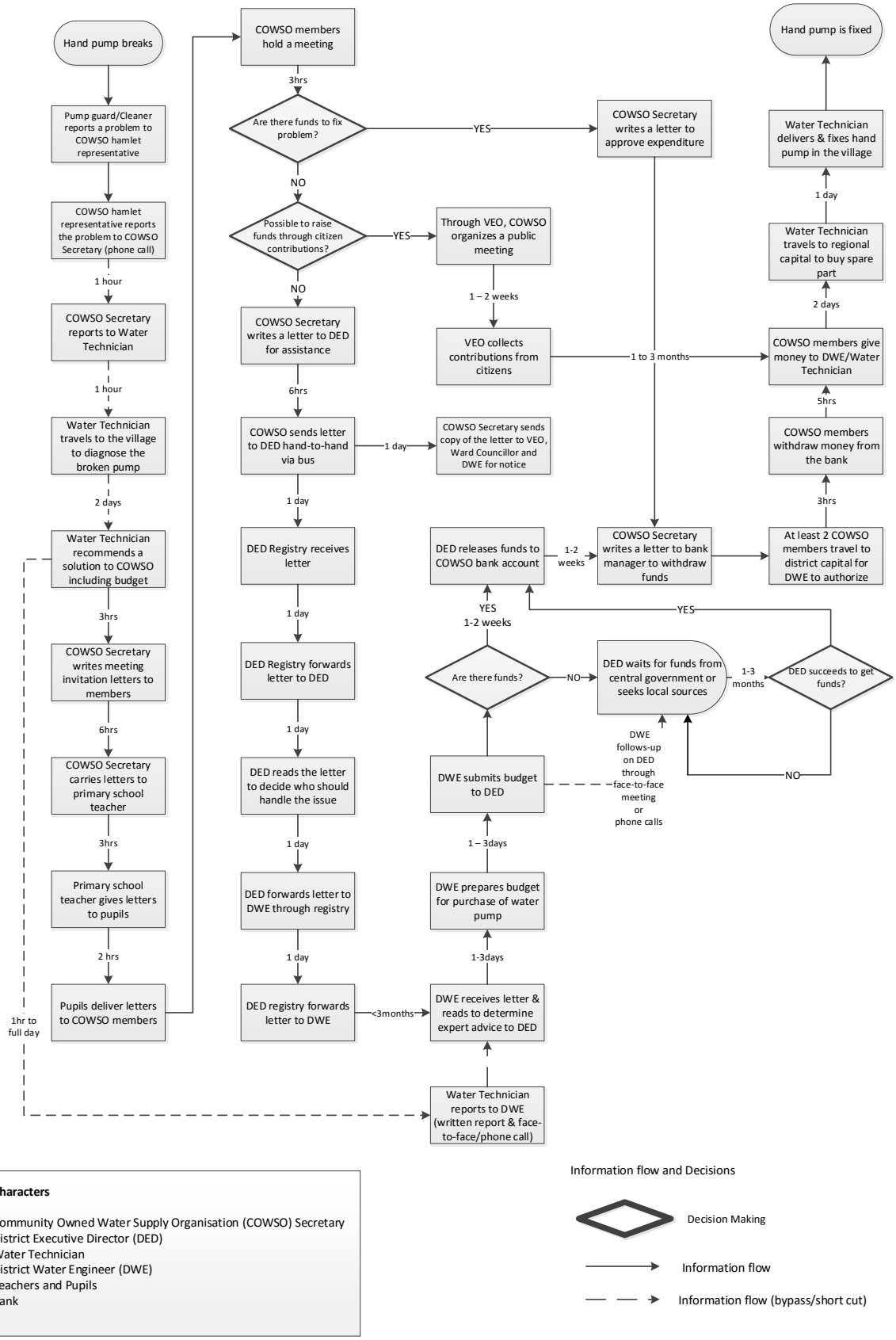

Figure 1: Typical task and information flow of the monitoring and repairing a rural water point - Nganyanyuka et (2016b)

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