A Review of Sector Coordination and ICTs in Multi-Stakeholder Environs of Uganda's Rural Water Sector

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Abstract
In this paper, we review literature related to the current status Uganda's rural water and sanitation sector (RWSS) and then explicate ICT interventions in the sector. For decades, the rural water sector has faced numerous challenges like managing functionalities of water points, limited coordination amongst multiple stakeholders, financial constraints, duplication of projects and fragmentation. Through an in-depth literature analysis of ICT applications, this review seeks to highlight benefits and challenges for increased and sustainable ICT applications in the provision of water sector services. The paper shows that recent years have seen heightened growth of ICT applications in the water sector which are impacting sector governance, transparency, accountability and service delivery challenges; although there is still limited research and discourse on measurable ICT benefits. As part of ongoing research work, the paper presents a decades review of the sector and then presents a gap for researchers to study the impact of ICTs/ Information systems in the water sector of developing countries. Findings indicate that numerous approaches have been implemented to improve sector coordination amongst multiple stakeholders although coordination problems still persist. In addition, the ICT systems implemented have added benefits to the sector but some systems are faced with sustainability issues and failure to scale. Analysis shows that greater attention should be emphasized in studying context relevance of ICT interventions and the underlying casual mechanism of the RWSS challenges.

Keywords
ICT, WASH, Sector Coordination, Stakeholders, Information Systems, Sub Saharan Africa

Introduction

Access to safe drinking water is vital to human life. Access to safe drinking water is still a significant problem worldwide and the majority of countries whose access remained below the MDG target of 2015 are in SSA (O'Meally, 2011; WHO & UNICEF, 2012, 2013, 2014).

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Over 80% of the people who do not have access to safe drinking water in SSA live in rural areas, which comprise the majority of the population (O'Meally, 2011; UN-Water & WHO, 2014; WHO & UNICEF, 2014). There are various challenges to increasing sustainable access to safe drinking water which include: limited financial resources to invest in water supply services; weak sector coordination at national and local levels; capacity constraints around the planning and implementation of activities; the challenge in ensuring the long-term functionality of installed water points; and the need to ensure water needs are met equitably in the face of rapidly growing populations and increased water stress (Abaliwano, Kiyimba, Alowo, & Atuhairwe, 2011; MWE, 2014; O'Meally, 2011; UN-Water & WHO, 2014). According to the United Nations (UN), water is at the core of sustainable development as it is closely linked to a number of key global challenges like health and education (United Nations, 2012; UN-Water, 2014). The UN-Water & WHO (2014) report states that neglect of Water Sanitation and Hygiene (WASH) coupled with the ensuing poor conditions and practices in communities and institutional settings like schools and especially health facilities exacerbated the West African Ebola crisis. WASH is one of five pillars of the global response strategy against the Ebola outbreak. The report also reveals that development aid commitments for water and sanitation increased by 30% to over US$ 10.9 billion in 2012, from US$ 8.3 billion in 2010.

In this paper, we focus on Uganda's Rural Water Supply and Sanitation (RWSS) sector as a case study within Sub-Saharan Africa. The quality and capacity of Uganda's RWSS institutions have improved significantly since the early 1990s (O'Meally, 2011). The institutions responsible for water and sanitation service delivery have undergone reforms with marked improvement of capacity and level of professionalism (Danert, 2010). The sector is now managed by different levels of political and organizational stakeholders, such as the departments of water resources management, rural water supply and sanitation, urban water supply and sanitation (MWE, 2014; O'Meally, 2011).

In the early 1990s, water service delivery in the sector experienced numerous challenges such as relatively weak sector policy framework, limited sector coordination and insufficient institutional capacity (human, financial and technical), particularly at local government level (Flowers & Danert, 2012; O'Meally, 2011; Robinson, 2002) (O'Meally, 2011; WaterAid, 2011). Limited/ weak sector coordination amongst multiple stakeholders resulted in problems like duplication, fragmentation, poor monitoring and evaluation and operation for long-term functionality of installed water points. According to MWE (2014); O'Meally (2011); UN-Water & WHO (2014); WaterAid (2011), coordination amongst different stakeholders and departments in the RWSS sector is a persisting challenge. UN-Water & WHO (2014) reports that coordination of WASH services involves a number of stakeholders including government institutions and nongovernmental organizations. Several countries surveyed in the report have between six to nine ministries and/ or national institutions with responsibilities in sanitation; and the median number of NGOs implementing sanitation and drinking-water projects was 12, with a range from one to 261 NGOs. The report also states that only 51 out of 94 countries surveyed (54%) have a formal coordination mechanism to oversee WASH activities.

According to (MWE, 2011, 2014) reports from Uganda's Ministry of Water and Environment (MWE), there are problems with operation and maintenance (O&M) of rural water facilities. O&M of rural water facilities is largely based on community based

maintenance system (CBMS). The functionality of user committees for CMBS has stagnated at 71% while the average functionality of rural water supplies was 85%, which is 5% points under the target of 90% by 2015. Another key challenge is the establishment of sustainable delivery of WSS services in rural areas given inherent financial and human resources constraints.

UN-Water & WHO (2014) highlights that most sector decisions are not evidence-based due to the widespread lack of capacity for monitoring, inconsistent or fragmented gathering of data and limited use of information management systems and analysis. There are numerous problems that relate to access to information and communication technologies (ICTs) in rural areas of SSA.

According to (Williams, 2010) access to ICT is now a key factor in the economic and social development of SSA; and many countries see ICT as a necessary foundation for long-term economic development. In addition, African governments have prioritized the ICT sector and are focused on providing affordable ICT services to as many people as possible (Department of Communications, 2014; Furuholt & Orvik, 2006; Gillwald, Moyo, & Stork, 2012; Obot, 2009). The World Bank Group doubled its investment commitment to ICT in Africa to US$2 billion by 2007 whilst other investments came from the European Commission (AfDB, 2013). The World Bank's ICT Sector Unit serves as the focal point to support ICT enabled development across sectors, working in partnership with the other sectors. It also manages stand-alone ICT projects that put in place cross sector foundations, policy and institutional frameworks, and specific programs for ICT enabled transformation (World Bank Group, 2011).

The World Bank has developed several stand-alone ICT projects focused on e-government and other ICT applications to enhance public administration efficiency and service delivery. Some of these ICT applications are having significant social development impact (for example, through e-Health in Africa and Latin America, m-banking in South Africa, or Education in Nigeria and MajiVoice application developed for Nairobi City Water and Sewerage Cooperation in Kenya) (World Bank Group, 2011). ICT applications are now used to transform how sectors operate and how public sector services are delivered for increased development impact.

The WASH sector has seen heightened ICT applications employed to tackle WASH challenges. ICTs are used in rural and urban areas to improve data collection, collect revenue, customer management, water management, reporting technical issues and complaints management (Ball, Rahman, Champanis, Rivett, & Khush, 2013; Champanis, Gool, Rivett, & Chigona, 2013; Champanis & Rivett, 2012; Schaub-Jones, Beilharz, & Nash, 2013). The Ugandan RWSS has also had numerous ICT implementations and this paper highlights some of these systems in the sections below.

Research Method

The methodological approach adopted for the review includes analysis of literature in order to explore the current status of sector coordination mechanisms and the ICT interventions implemented in Uganda's rural water sector. The empirical basis of the paper is data collected from numerous literature and it's important to state that the literature analyzed is

not the primary works of the authors.
Given the underlying challenges facing Uganda's rural water sector as stated in (Abaliwano et al., 2011; MWE, 2014; O'Meally, 2011; UN-Water & WHO, 2014), this review aimed at answering questions like:-

1. What coordination mechanisms exist amongst multiple stakeholders in Uganda's rural water sector
2. What ICT applications are currently used in the rural sector

Based on the methodology, this paper provides a discussion Uganda's rural water sector while also describing sector coordination issues and ICT applications.

Uganda's Water Sector

Uganda is a landlocked country located in East Africa and bordered to the north by Sudan, to the east by Kenya, to the south by Tanzania, to the southwest by Rwanda and to the west by the Democratic Republic of Congo (DRC). Fresh water resources provide a source of livelihood for more than 90% of the population but the geographical distribution coupled with rapid population growth and environmental degradation, is a big challenge to the sustainable development of water resources (MWE, 2009).

The MWE SPR report (2014) states that rural water supply data and projections from the Uganda Bureau of Statistics (UBOS) indicate that the population is estimated at 36.6 million by mid-2014, with 85% living in rural areas. Uganda's population growth of approximately 3% is one of the highest in the world (UNDP, 2014), which puts a considerable strain on public sector service delivery, not just for water and sanitation but also in other areas such as health and education.

In the early 1990's, an estimated 60% of the rural population lacked access to safe drinking water. This period was characterised by fragmented project support and inefficient service delivery (Handley, 2009). Aid in the water sector was also characterised by fragmented donor projects with limited use of domestic systems for service delivery. The projects were managed individually but without sector wide coordination (O'Meally, 2011; Robinson, 2002). Since 2003 many districts have been split up, and the creation of new districts has spread existing capacity, thus hampering progress (O'Meally, 2011). In 2014, 72.8% of the population in urban areas had access to safe water, while the rural population with access to safe water remained stagnated at 64%, which was mainly attributed to the inadequate funding to the district local governments that had the responsibility for water and sanitation service provision (MWE, 2014; Tenywa, 2013).

Between 2013/14, 3,060 new water points were constructed using sector grants. The drilling of boreholes fitted with hand pumps served an estimated 26,000 people in various areas of the country (MWE, 2014). Despite the improved access to safe water, Uganda still remains one of the poorest countries in the world. It is heavily aid-dependent and yet the RWSS is firmly linked to poverty eradication programmes (O'Meally, 2011). Progress in terms of reducing poverty has been made but it remains in the rural areas where there are major logistical and financial challenges associated with serving such areas with water services (O'Meally, 2011; UNDP, 2010).

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Institutions responsible for service delivery in the WSS have improved capacity with local governments to deliver water services (Danert, 2010; MWE, 2011; O'Meally, 2011). Government agencies have taken more lead in the sector with little consultancy support provided (O'Meally, 2011). Training officials has also strengthened M&E and sector reporting (Fisher, Thomson, Okuni, & Sansom, 2005). MWE has now shifted focus from implementing projects to supporting local governments and establishing regional Technical Support Units (TSU) to support planning and delivery (MWE, 2014).

Sector Coordination

In the early 1990s, the Uganda water sector had limited coordination and dialogue across ministries and national sector actors, and development partners. This resulted in duplication, high transaction costs and fragmented monitoring and reporting (Handley, 2009). There were steps taken by the MWE to improve on the coordination between the stakeholders involved in Uganda's RWSS sector. Progress had been driven by the change in aid approach and greater donor coordination, with harmonisation with government at the national level, often using a sector wide approach (SWAp) (O'Meally, 2011). The shift in aid approach enabled building of domestic capacity with donors providing budget support, and Ugandan national and local government institutions playing leading roles (Iyer, Evans, Cardosi, & Hicks, 2005; Rukare, 2009). Aid to the water sector shifted from being conventional project aid in 1998 to more than 40% of aid being provided in the form of budget support by 2008 (Williamson et al., 2008).

Danert (2010) states that the sector has undergone notable progress which include: - reform of the policy framework, improved service delivery, capacity building, decentralised service models, increased sector-wide coordination and consultation, new aid approaches and sector budget support (SBS), increased budgetary allocation and an improved flow of resources and information to local governments. O'Meally (2011) and MWE (2014) describe the different steps taken to heighten sector coordination and increase harmonisation, and these include: -

Sector working groups (SWG)	The sector working groups (SWGs) where introduced to strengthen resource allocation for the budget process and to discuss issues arising out of implementation. It was designed to bring government actors and donors together (MWE, 2014).
Joint Sector Review	Joint Sector Review (JSR) is a formal review process that is held annually and attended by sector ministries, civil and political leaders, local government staff and donor representatives. It is a forum to discuss sector performance, identify problems and solutions and agree on undertakings to address priority issues (Robinson, 2002).
Performance Measurement Framework	The performance measurement framework was developed around 11 Golden Indicators as key conditions for effective water service delivery. Joint technical and financial reviews are carried out and the output of the review is the annual SPR, which assesses performance on targets and progress against MDGs (Iyer et al., 2005; MWE, 2014).
Sector Wide Approach (SWAp)	SWAP is a mechanism whereby Government of Uganda (GoU), civil society and Development Partners support a single policy, development plan and expenditure programme, which is under Government leadership and follows a common approach (Handley, 2009; MWE, 2014). SWAp is thought to have reduced fragmentation and duplication in the sector by enabling a degree of coordination and information sharing (O'Meally, 2011).

The Water Policy Committee (WPC)	WPC was established under the Water Act in 1998 to assist and advise MWE and to promote inter-ministerial and inter-sectorial coordination (MWE 2014).
District Water and Sanitation Coordination Committees (DWSCCs)	DWSCCs consists of administrative and political leaders, technocrats and non-governmental/community-based organisation (NGO/CBO) representatives at district level. The role of the DWSCC is to oversee the implementation of WSS programmes (MWE, 2014).

Table1: Showing Existing Sector Coordination Approaches

Sector Coordination Challenges

Despite the steps taken to mitigate coordination challenges as shown in the *Table1* above, several challenges still remain. Fragmentation due to project interests continues, with different projects and actors having different approaches to service delivery. The enforcement of policy and regulatory guidelines has been hampered because of this. (MWE, 2009; OPM, 2008). The wide array of water service providers added the complexity of coordinating overall sector targets (O'Meally, 2011). The un-budgeted resources like those channeled through NGOs make it difficult for GoU to track expenditures and to link the outputs to the strategic goals (MWE, 2010).

Another challenge is that the MWE is not to consistently follow up on key performance criteria in a timely manner. The field visits by the MWE to monitor district local governments remains fairly fragmented and the findings are not always reflected in the sector performance reports (Danert, 2010; Kimanzi, 2004; O'Meally, 2011). Reliable information on key indicators at local level often lacks (Welle, 2010).

O'Meally (2011) states that the impact of the reforms on sector performance has not been assessed systematically. Stakeholders in the government acknowledged that SWAps do enable negotiation, but donors have had an upper hand and were sometimes over-insistent or ignored the views of GoU officials. SWAp has contributed to a reduction in innovative approaches, reduced financial flows to the sector and slowed procurement. SWAp did also not address the overall sector coordination or service sustainability (IRC, 2010).

ICTs in the Water Sector

For several years, ICTs have been positioned as a core component for development strategies employed by governments, multilateral agencies, NGOs and academia.While there is still much discussion on the impacts ICTs have on development, ICTs continue to be deployed in developed and developing countries to achieve social and economic change (Bailey, 2009). The increasing use of ICTs in the public and private sectors of agriculture, health, education, telecommunication, governance, finance and others are reported to have a positive impact with some countries like South Africa and Kenya showing that ICTs have played an important role in their economies (Heeks & Molla, 2009). The potential that ICTs hold in helping to boost economic growth and reduce poverty is attributed to how ICTs have been incorporated. Expectations are that harnessing ICT can bring about radical improvements in the way that health, education and other sectors function (Schaub-Jones et al., 2013). The World Bank Group doubled its

investment commitment to ICT in Africa to US$2 billion by 2007 (AfDB, 2013; Enock Yonazi, Kelly, Halewood, & Blackman, 2012).

There has been a significant shift in recent years towards improving the service delivery capability of governments as a driver for e-applications (AfDB, 2013). About half of all projects approved in the 2000s contain some form of ICT component, more than double the proportion experienced during the 1990s. The World Bank has financed a large portfolio of ICT applications across a wide range of sectors, with the largest amounts having taken place in public administration, education, health, WASH, urban and rural development. Several of these Information technologies (IT)/ Information systems (IS) have been implemented in public institutions through e-government policies with in developing countries (Avgerou, 2008; Furuholt & Orvik, 2006; Heeks, 2002a).

Governments in Africa have implemented supporting policies and frameworks to act as enablers for ICT implementations. South Africa's ICT Vision 2014 describes an inclusive information society, one in which the use of ICTs will be harnessed to ensure that everyone has fast, reliable and affordable access to information and knowledge that will enable them to participate meaningfully in the community and economy (Department of Communications, 2014; Department of Telecommunication & Postal Services, 2014).

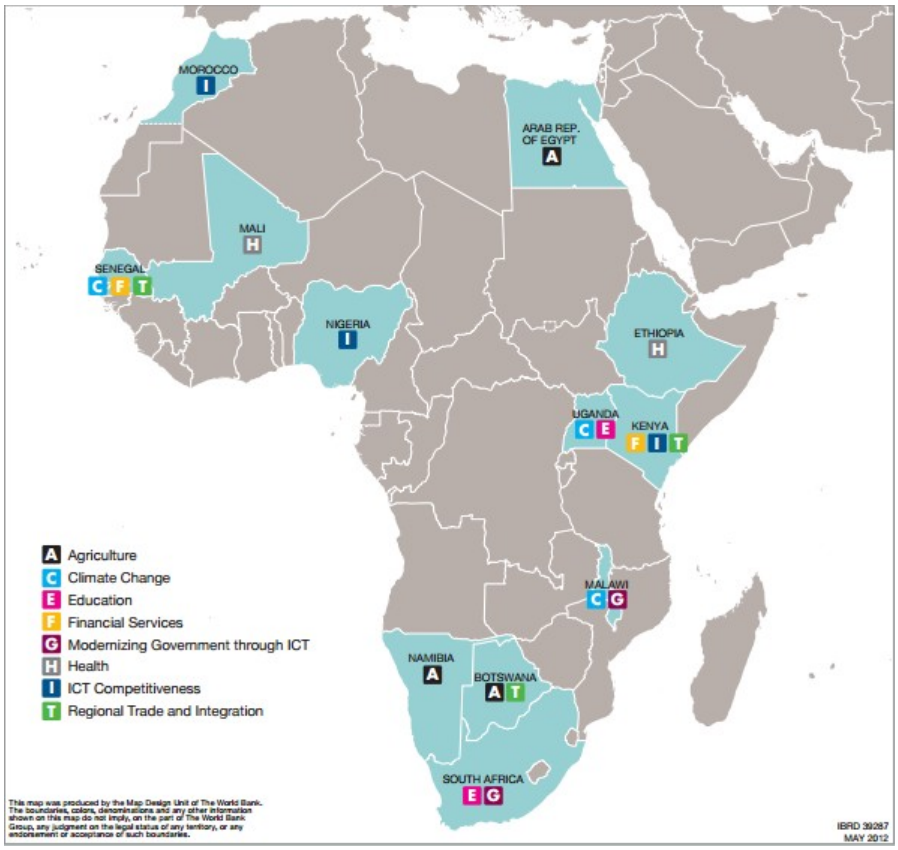

Figure 1: Showing World Bank ICTs priorities Implementations in Africa (Source: (Enock Yonazi et al., 2012)*)*

Within the WASH sector, ICTs in Africa are being used in rural and urban settings to streamline and improve the collection of field data, planning, monitoring and management, strengthening revenue collection, managing assets more productively, customer relationship management, measure and report on technical performance and regulation of the water sector (Borralho, 2013; Schaub-Jones et al., 2013). The expectations are that harnessing ICT intelligently can bring about radical improvements in the way sectors function, particularly in developing countries (Schaub-Jones et al., 2013; Sheffield et al., 2014).

ICT projects in WASH sector are geared towards the welfare of the community. There is a general perception that ICT has transformational abilities of addressing some of the water related issues in Africa. This has led to a variety of ICT implementations over the years for example reporting/ complaints management, billing and revenue systems, customer management, citizen engagement, water testing systems etc. (Champanis et al., 2013; Champanis & Rivett, 2012; R Hope et al., 2011; Rob Hope, Foster, Krolikowski, & Cohen, 2011; Narasimhan & Leblois, 2012) Literature on ICTs and the water sector acknowledge the potential of leveraging them as tools to solve monitoring, planning and management challenges. Although there are high rates of ICT failures, some WASH experts claim that their potential has not been fully realized. It is also suggested that through improved communication the experience of greater transparency and accountability for all stakeholders will increase (Jacobs, Rivett, & Chemisto, 2015).

The GoU has been implementing a series of policies to integrate ICTs into their development agenda as well as into a variety of areas of social life. The proliferation of affordable ICTs, in the form of mobile phones, has presented opportunities to address information gaps by transforming the way information is generated and shared amongst stakeholders (Obot, 2009). Obot (2009) highlights that work is ongoing on interconnectivity for the entire country by laying 1,500 kilometers of optic fiber to all major towns in Uganda.

ICTs have been implemented in the Ugandan WASH sector to improve service delivery in both rural and urban areas. ICT development is supported by a national ICT policy (2003), which was developed with the goal of promoting the development and effective utilisation of ICT, including timely access to information. ICT growth and adoption in the water and sanitation sector is changing the landscape and with the support and infrastructure development, ICTs are being used to improve the lives of communities. The government hopes that, by improving services, citizens will increase their participation and control over public affairs (Obot, 2009). However, the MWE does not have a framework or specific policy that addresses and regulates the use of ICTs in the WASH sector. The current IT internal policy only covers email use, telephone use, connection of equipment to the ministry network, back-up of information and naming convention.

Uganda reported efforts to improve the functionality of water sources and the reduction of response time in cases of breakdown by using mobile phones to monitor system status (AfDB, 2013). Flowers & Danert (2012) ascertain that with the advances in IT, people in the rural sector should have their demands and requests transparently available in the public domain. Examples of the ICT systems include: - E-water Payments with Mobile phones, Water Point Mapper (WPM), Field Level Operations Watch (FLOW), Mobiles 4 Water (M4W), WSDB for the MWE etc. (Hellström & Jacobson, 2014; Rob Hope et al.,

2011; Mirembe, 2014; MWE, 2014; WaterAid, 2014; Welle, 2010). Despite the ICT contribution to the sector, these numerous ICTs store information that is collected and managed by different organizations. Data integrity concerns arise when organisations collect public information in different systems without a common framework on data formats or centralized storage.

ICT Applications in Uganda

The water sector in Uganda has undergone several ICT interventions geared towards improving governance and transparency. Lessons learnt from literature about these interventions can be used for new developments. Some selected applications implemented for the rural water sector are describe below: -

Water Supply Database (WSDB)

The WSDB was initially set up to store information that was collected during a WATSUP Project (Water Atlas Update Project). Uganda's MWE is responsible for the operation and maintenance of the Water WSDB (MWE, 2014). The WSDB contains geo-referenced information on point and piped water supplies in rural and urban areas. A mapping tool allows users to generate maps for the areas of their interest. The tool can also be used to plot the location of the sources either on a Google Earth satellite map or in Google Maps. Data in the WSDB is updated by District Water Office staff in the whole country who are trained on the use and operations of the WSDB and data update procedures. Submission of data from the entire country in 2014 was at 96%, which was up from 65% in 2013 (MWE, 2014).

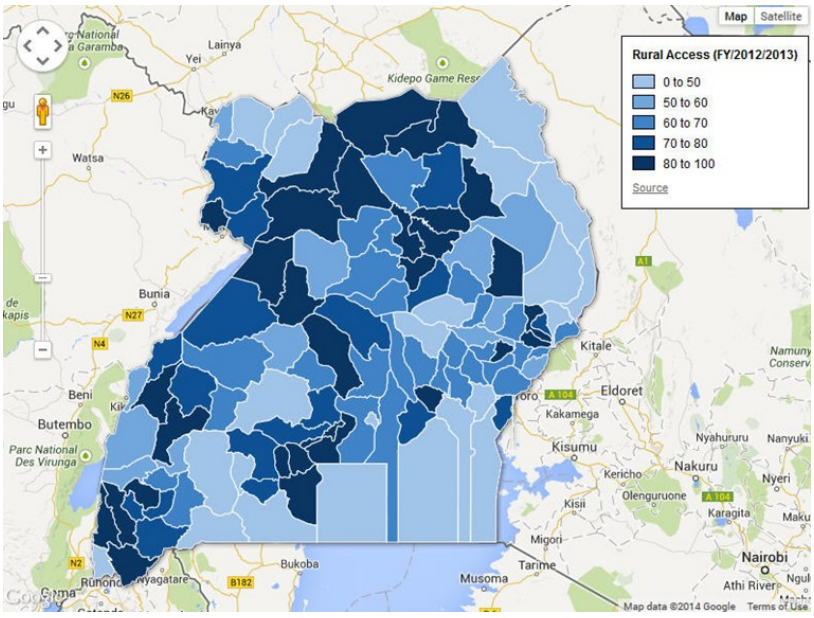

Figure 2: Showing WSDB rural access to safe water maps (Source: (MWE, 2014))

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Challenges

According to (MWE, 2014), the following challenges are faced with WSDB: -

- The quarterly and annual district reports are not submitted in a timely manner and do not include all required information to update the WSDB
- The monitoring of the online access to the WSDB shows that only very few staff in MWE and in districts make use of the WSDB
- Some water sources in the districts have been nonfunctional for more than five years and there is need to design and implement a decommissioning exercise to improve data quality.

WSDB and Data Warehouse

The Water and Environment Sector Liaison Department (WESLD) has been working on an initial design for a data warehouse. The data warehouse will allow MWE staff to obtain up to date summary management information in report formats from the various databases in the ministry including WSDB. The warehouse will also have a document repository where water sector and project documents can be downloaded (MWE, 2014).

Mobiles 4 Water (M4W)

Mobile Phones for Improved Water Access (M4W) is a rural water monitoring and reporting software application developed with the aim of improving water monitoring, functionality, operational maintenance, reducing the response time to reported problems and appropriate service delivery of rural water points (Mirembe, 2014) (Triple-S, 2013). M4W was implemented in seven districts (Arua, Kasese, Kyenjojo, Kabarole, Masindi, Amuria, and Lira) by Makerere University in collaboration with WaterAid, SNV and Triple-S (Triple-S is a project of IRC in Uganda) (SNV & IRC/Triple-S, 2012). M4W is a web based system and it utilizes mobile technologies to collect data, and then display real time information on performance of rural water services.

According to (Hellström & Jacobson, 2014; Triple-S, 2013), M4W is used by Hand Pump Mechanics (HPM) to collect data on water points using mobile phones. Data collected includes location, current status, repairs, and service history of water points. The data can be collected even when phones are offline or when the network is down. Users also use M4W to report water point problems by sending an SMS to a specific short code. The SMS is sent to the district and to the MWE after which a notification is sent to the HPM responsible for that specific water point. M4W gives a 48hr window for any problem to be assessed (Mirembe, 2014).

M4W is also linked to the Ministry Water Supply Database and it has been used to identify water sources that are not in the Ugandan Ministry of Water and Environment's (MWE) database. Over 15,000 water points are monitored and these include shallow wells, deep boreholes, protected springs and public taps.

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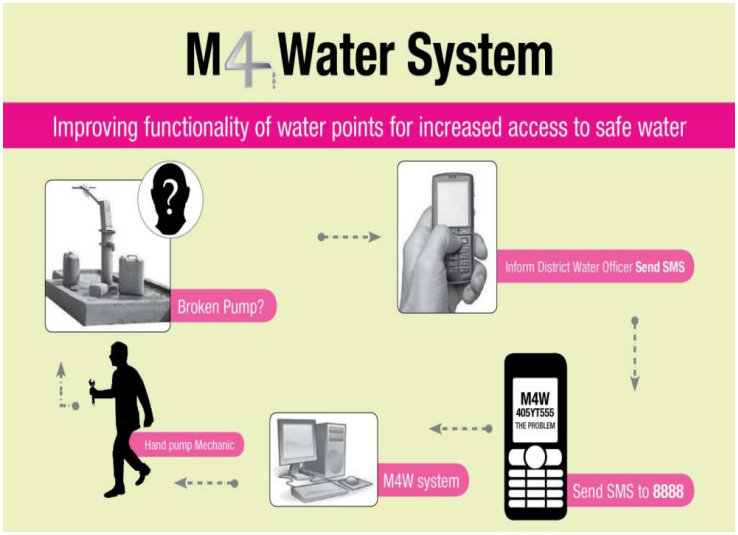

Figure 2: A poster explaining how the M4W System works

(Source: Mobile phone technology to improve functionality of rural water source*s, 2012)*

Successes

M4W has enabled collection of up-to-date data and access to real-time information on water problems in the community (Hellström & Jacobson, 2014). The data from M4W has supported the updating of District and National Information Systems like the WATSUP (Water Atlas Update Project) database which has real time information on the status of water sources in the country (SNV & IRC/Triple-S, 2012).

Challenges

- Low literacy levels amongst HPMs has been a challenge. Some HPMs had difficulties using English in reading and writing the required reports (SNV & IRC/Triple-S, 2012).
- The poor transportation network in rural areas affects the movement of HPMs to the remotely located water-source problem sites (SNV & IRC/Triple-S, 2012).

Water Point Mapper (WPM)

WPM was designed by WaterAid and has been used in Uganda and other countries like Malawi, Swaziland, Ethiopia, Ghana, Kenya, and Tanzania (Welle, 2010). WPM is an application for producing maps that shows water supply services with an area or location; and it creates high quality maps to act as information source for water supply programs in the developing world. With regular update and reporting of data through continual usage, WPM can be used to monitor the distribution and status of water supply in terms of coverage and functionality. WPM is aimed at water, sanitation, hygiene practitioners as well as local governments working at district and sub-district levels in Sub-Saharan Africa (Welle, 2010). WPM helps to visualize the spatial distribution of water supply coverage and can thereby be used to highlight equity issues and management-related aspects of water points. WPM has can be used for planning of investments to improve water supply coverage, allocate resources to deliver basic services where they are most needed, promote increased investments in the sector and measure progress and performance (WaterAid, 2014).

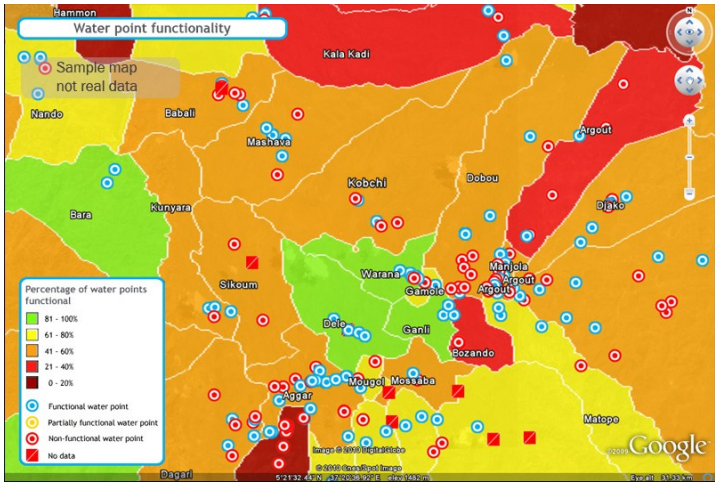

Figure 4: A map generated by WPM (source: http://www.waterpointmapper.org/)

Challenges

WaterAid has faced operational challenges in terms of having WPM entrenched in the local and national governments (Welle, 2010).

Field Level Operations Watch (FLOW)

FLOW is an open source mapping software application used for collecting data and monitoring the functionality of water access points (Goodier, 2011). Since 2012, the Akvo Foundation has taken control of continued development of FLOW, although it was developed by Water for People (WfP). FLOW runs on Android platforms (smartphone), and allows users to take GPS coordinates, fill out text, take pictures and videos, and fill out questionnaires. This information is then translated to Google Earth data and put on online maps. FLOW can be used in areas where there is no internet connectivity. However, when there is internet connectivity the software automatically transmits the data to the central database and uploads it to Google Earth (Hellström & Jacobson, 2014).

FLOW is used by Uganda's Ministry of Water and Environment to compile data into a central database where it is used for advocacy and planning within the district. District Local Governments can also use the data to plan for future investments, and assess service and sustainability levels (Hellström & Jacobson, 2014). Other than Uganda, FLOW has been implemented in a number of countries i.e. Malawi, Rwanda, Congo, India, Dominican Republic, Honduras, Guatemala, Nicaragua, Ecuador, Bolivia, Peru, Liberia, Nepal, Burkina Faso and Mozambique.

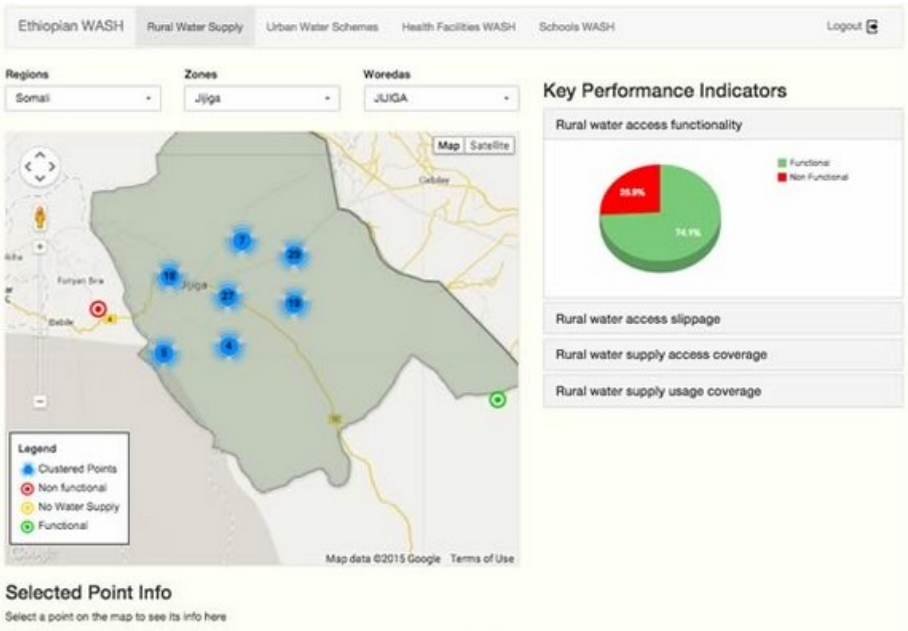

Figure 5: Showing Akvo FLOW Dashboard with clustered water points (Source: http://akvo.org/blog/government-of-ethiopia-and-unicef-compile-national-water-sanitation-inventory/)

Challenges

One of the challenge associated with FLOW is data management. As a result of the excessive data generated, it can be difficult to discern the actionable data from the rest of the data.

General ICT Failures and Lessons

The poor sustainability rate of ICT interventions combined with the high frequency of failure in scaling applications beyond the pilot phase remains a substantial concern. Heeks (2002c) classifies ICT failures in two different ways; first, there is the total failure of an initiative never implemented or in which a new system was implemented but immediately abandoned. A second possible outcome is the partial failure of an initiative, in which major goals are unattained or in which there are significant undesirable outcomes. Heeks (2002c) further states that sustainability is a key issue that affects ICT failures in developing countries.

Garriga, de Palencia, & Foguet (2015) elucidate that lack of data updating mechanisms, or poor interaction between academics and practitioners during the design phase are common reasons that hamper an adequate appropriation and continued use of the developed tools in the WASH sector. They further claim that studies involving the design of ICT systems should first consider the local authority as the principal stakeholder, and specifically engage in various stages of the process with those government bodies with competences in WASH.

Several literature on contextual studies and implementations from Avgerou & Walsham (2000); Avgerou (2008); Furuholt & Orvik (2006); Heeks (2002b); Higgo (2003);

Macome(2008) deal with general use of ICT in African contexts; with all these studies pointing to the importance of taking local context and cultural environments into account when implementing ICTs in developing countries. Furuholt & Orvik (2006) state that the implementations of Information Technologies /Information Systems is not only about putting a particular technology or IT innovation to use but also substantial contribution of literature based on identifying factors influencing design, implementation, management, resources, infrastructure requirements and organization structures affecting the technology.

Avgerou and Madon (2004) propose an approach to studying context that is capable of accounting for the diverse social settings of IS innovation. They describe various stakeholders of the implementation processes while showing how each of these groups are driven by their own rationality and that the rationality of the apparently irrational behaviour needs to be uncovered for each group. Heeks (2002c) argues that IS initiatives that do not experience significant undesirable outcomes (success) are those in which most stakeholder groups have their major goals attained. Other than Heeks (2002c), studies on stakeholder involvement in IS implementations from (Kroczek, van Stam, & Mweetwa, 2013) (Pouloudi, 1999) (Sjöström & Goldkuhl, 2010) (Mishra & Mishra, 2013) (Flak & Rose, 2005) are able to show that incorporating various relevant stakeholders not only contributes in addressing organizational and cultural issues of information systems projects but also impacts the project progress and developers being able to build usable systems. Mishra & Mishra (2013) citing works from Lyytinen and Hirschheim (1987, 1988) counter argue that failure is conditional on the capability of information system to meet the expectations of different stakeholders. They state that some systems may be considered successful by some stakeholders but a failure by other stakeholders because the concept of stakeholder represents a progression from developer and user centered problems to organization-wide and inter organizational.

Conclusion

This paper provides a literature review of the rural water sector Uganda highlighting the coordination mechanisms and ICT applications. Despite the rural sector still being below the MDG goals of 2015 of 70% access to improved water access, the sector has shown progress of the last decades. Reforms in the administrative departments, political leadership, laws and the implementation of ICTs has had significant impacts on the sector. The literature shows that the water sector has been going through reforms over the last decades, although many of the associated challenges like coordination, duplication and fragmentation have largely persisted. ICTs described in this paper have particularly contributed to information accessibility, monitoring, reporting, maintenance and an overall improved service delivery, transparency and accountability.

Despite, continuous ICT/ IT investments, the impacts of the ICTs have not been studied sufficiently with very little academic literature being available.

Future Work

This paper is part of ongoing research work comprising of a multi-method study to design and implement an artefact (information systems) to support sector coordination in multi-

stakeholder environments of Uganda's RWSS. The artefact implementation aims to increase collaboration, coordination and information sharing amongst multiple stakeholders; thereby contributing to finding suitable solutions for coordination problems. The study also aims to identify appropriate factors that can elucidate successful design, implementation and evaluation of artefacts in the water and sanitation sector.

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