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A 'CUT' Perspective on 'New' Technologies for Improved Municipal Asset Management in Urban Ethiopia

Tendayi Gondo

(Tendayi Gondo, University of Venda, Department of Urban and Regional Planning, Private Bag X5050, Thohoyandou, 0950, Limpopo Province, South Africa, gondotee@gmail.com OR tendayi.gondo@univen.ac.za)

1 ABSTRACT

In the recent past, there has been a growing realization that effective systems of asset management can strengthen the performance of a local economy and community significantly. Such a governance perspective has been complemented by the development of new and interactive technologies for recording and communicating assets and asset management. Until recently, measuring the uptake of such technologies and subsequently the associated transformation in asset management practice has been difficult. This analysis attempts to appraise the extent to which such new technologies have made and can potentially make a difference in the management of water infrastructure assets of urban Ethiopia. It adopts the Capacity, Utilization and Transformation (CUT) framework proposed by the Economic Commission of Africa. Such a framework was found to be a credible tool in taking stock of technological achievements and deficiencies that characterize any municipal asset management programme. Empirical evidence was gathered from a Delphi study that pooled together expert opinion from 61 officials drawn from Ethiopia's water sector. In addition, case study material from several Ethiopian towns and cities was utilized to complement the analysis. The pooling together of data from such independent samples was achieved through a Comparatives Studies framework that utilized the concept of meta analysis. Results indicate that, Ethiopia's urban water sector has gone through a number of reforms that have not benefited immensely from new and interactive technologies for effective municipal asset management. The current asset management plan that characterize the majority of towns and cities can be dismissed as one of constrained capacity, utilization and transformation. Lack of financial resources, technical expertise and appropriate organizational strategy has constrained the adoption and application of system software for effective asset management in many towns and cities. The analysis also reveals that the relationship between new GIS based asset management technologies and improved asset management is not spontaneous. It needs to be worked out and nutured through the lifecycle of the asset mangement programme. An appropriate organizational strategy that would translate into organizational value and subsequently into the much needed organizational change is indispensible in this respect.

2 INTRODUCTION

2.1 Urban water services in developing countries: an overview

Poor water resource management practices accross the globe have often been blamed for recurring water shortages (Morimoto, 2010). Burgeoning urban populations and increasing weather complexities associated with climate change have compunded the water situation in many cities of the world (Jenerette and Larsen, 2006; Oki and Kanae, 2006; IPCC, 2007). The number of water pipe breaks has increased in recent times. The situation in the developing world is acute where securing water quantity and quality is increasingly becoming a challenge owing to deterioration of water utility assets.

Despite evidence of privatization in countries, more than 90% of urban water supply services in developing countries are provided by public organizations (UDP, 2003; Ndokosho et al, 2007). Such public provision of such services has hovever been described as inherently inefficient. Schwartz, (2008) for instance observes that sub-saharan Africa has a long history of poor performance in its public water utilities. Service coverage has been limited to less than 60 % of the population (WHO / UNICEF, 2006). Other problems that have plagued the sector include high unaccounted for water, often averaging between 40 % and 60 % and overstaffing (Mwanza, 2004). There is also overwhelming evidence to suggest that water service providers in sub-Saharan Africa are often confronted with financial problems due a combination of low tarrifs, poor consumer records, and inefficient billing and collection practices (World Bank, 1994; Foster, 1996; Rothert and Macy, 2001; Mwanza, 2004; Schwartz, 2008). This poor perfomance has not gone unnoticed as the world has witnessed increasing pressure upon utilities to provide services at minimum cost. One much touted area of intevention has been the promotion of effective systems of water infrastructure asset management.

The current heightening interest in municipal asset management is not misplaced as there is a growing realization that Effective systems of asset management can strengthen the performance of a local economy and community significantly (Fernholz and Fernholz, 2006; Gondo, 2010). Requirements for operational efficiency have seen MAM becoming an increasingly important area for decision making for the majority of municipal governments across the globe (Fernholz and Fernholz, 2007). The main benefits of an effective MAM are extensively reviewed in Fernholz and Fernholz, (2007) and Gond, (2010). These include among others;

- Providing local residents with improved services based on municipal asset use.
- Helps boost the revenue base of local governments
- Improves the overall credit rating for the municipal governments
- Attracts more domestic and foreign investors.
- Improves land valuation that make land assets attractive for productive and real estate purposes.
- Enhances the environment and improve the quality of life.

Such a governance perspective has been complemented by the development of new and interactive technologies for recording and communicating assets and asset management.

2.2 New technologies for managing water utility assets

Since the 90’s, new technologies and methods have been developed to improve the water asset management process. Such progreesses have been characterized by a multiplicity of important functions such as the feedback data management, the planning maintenance management, the works management, the probabilistic models of degradation, the lifecycle cost analysis, and the performance levels of supplied services (Michele and Daniela, 2011). New requirements for improved water infrastructure management have seen major developments in the state of art technologies in the infrastructure asset management sector. Traditionally, system software for asset management has dealt largely with methodologies for monitoring, repairing or replacing ageing infrastructure. Such methods have since expanded scope to include methods for deteriorating infrastructure conditions, assessing historical incident data and inherent risk failure, devising replace or repair strategies, enumerating lifecycle costs and the ultimate representation of modelled conditions via geospatial data bases and geographical information systems (Christodoulou et al, 2009). Technological developments for improved water asset management since the early 90’s are largely an expression of a shifting water management paradigm – from a concern with “planning and building” to ‘repair, requalify and replace” (Michelle and Daniela, 2011). A common understanding among modern water management experts is that effective and more efficient decisions on water asset management can be made based on deep engineering and maintenance knowledge as well as on the availability of reliable and updated data (ibid).

Vanier, (2000a) has described some of the major benefits associated with the employment of new technologies in the infrastructure sector through what he refers to as the six “Whats” of asset management. In the water utilities setor for instance, such technologied if embedded in effective systems of asset management would provide useful information to local authorities that would answers to the following;

The *“What do you own?”* questions what is in stock. Many local authorities do not know the extent of their infrastructure portfolio or the percentage desegregation in various disciplines. Having an accurate picture of the extent of the asset base is an initial prerequisite for sound asset management planning (particularly if the planning horizon extends beyond five years).

The *“What is it worth?”* question requires asset owners to assign realistic values to their asset portfolios. Once the actual value of portfolio has been established, then it can be broken into various asset disciplines and maintenance budgets can be assigned accordingly. This information can later be combined with other metrics to establish priorities for decision-making purposes (Lemer, 1998).

The *“What is the deferred maintenance?* Question seeks to establish information that will provide an additional metric for maintenance fund allocation. Having an appreciation of the amount of deferred maintenance provides decision makers with a snippet of the amount of money required to bring the maintenance and repair under control. The output value can later be used in the computation of other metrics for maintenance prioritization such as the Facility Condition Index (FCI) – which is calculated as the amount of deferred maintenance divided by the Current Replacement Value (NACUBO, 1990).

The *"What is its condition?"* question is a simple an extension of the "What is it worth?" and is another tool to prioritize maintenance, repairs and renewal. Given that knowledge of the technical condition metrics is still at infancy, a mix of the FCI and technical condition indices can be used to identify the condition or level of infrastructure (Vanier, 2000a).

The *"What is the remaining service life?"* questions seeks detailed information about the 'technical and / economic service life' of infrastructure that will determine when capital renewal should occur (HAPM, 1995).

Most countries accross the globe have therefore become relentless in employing new technologies for improved management of water utilities assets. Some of the useful system softwares that can be employed in managing water utilities assets are reviewed in Halfawy et al, (2005) and include:

Harfan: a general purpose software that can extent asset life and optimize long term investments

Infrastructure 2000: A GIS based system software that provides capabilities for asset management planning, and is targeted to small to medium size organizations.

RIVA (Real-time Asset Valuation Analysis): A system software (developed by Loki Innovations) that provides capabilities for long-term asset planning in a 10 to 200 year planning horizon.This software supports inventory data collection, valuation, determination of deferred maintenance, condition assessment, estimating remaining service life (RSL) and asset prioritization.

Hansen: A system software developed by Hansen Information Technologies to provide capabilities for managing government operations including asset and property management, utility billing, permits, financial and human resources management. It also assists inventory collection, valuation, and determination of deferred maintenance, condition assessment, estimating remaining service life and prioritizing maintenance and rehabilitation (M&R) options.

While such and other more recent technologies have been extensively employed in most developed countries, their adoption in developing countries has remained a view that that is largely based on anecdote rather than reliable empirical data. Until recently, measuring the uptake of such technologies and subsequently the associated transformation in asset management practice has been difficult. It is therefore not surprising that scholarship in this area has not increased (particularly in the developing world). Using data from Ethiopia's water sector, this analysis seeks to redress this deficit. Specifically, the analysis explores extent to which water authrities in Ethiopia has taken advantage of the benefits associated with such water utilities aseet management technologies. Following this introduction, the analysis gives an overview of methods and materials utilized in this study. It also describes and justify the adopted analytical framework. The results and discussion sections then follow. Finally the analysis winds off by giving some concluding remarks to the subject matter.

2.3 Materials and Methods

Empirical evidence was gathered from a Delphi study that pooled together expert opinion from 61 officials drawn from Ethiopia's water sector. Such officials were largely water and sanitation experts drawn from 21 cities and / or towns found in ethiopia's 8 regional states[1] (refer to figure 1). In addition, case study material from several Ethiopian towns and cities was utilized to complement the analysis. The pooling together of data from such independent samples was achieved through a Comparatives Studies framework that utilized the concept of meta analysis. Further empirical evidence was gathered through a review of government and municipal policy documents.

[1] Ethiopia is a federal state that is divided into a number of regional states.

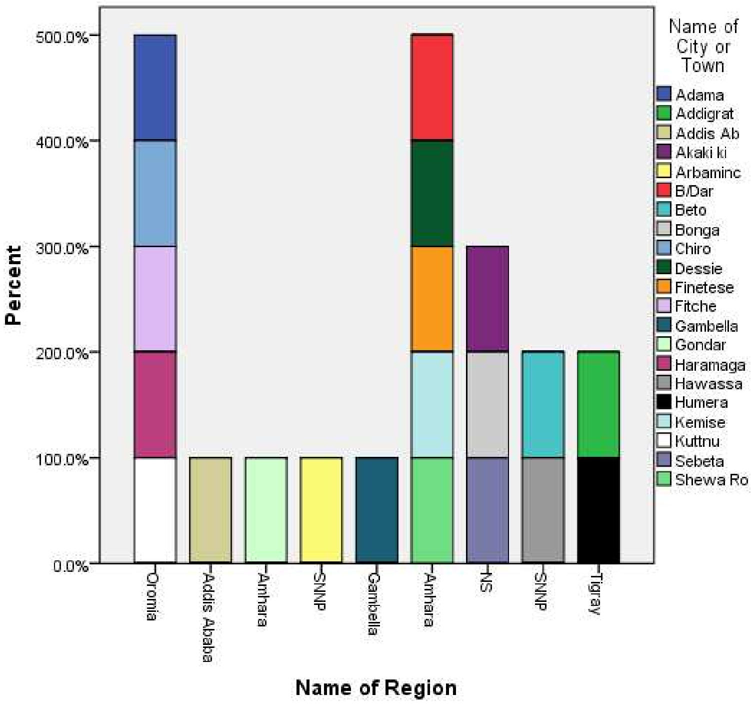

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Fig. 1: sample officials enumerated (n = 61)

2.4 Adopted analytical framework

The study adopted the Capacity, Utilization and Transformation (CUT) framework proposed by the Economic Commission of Africa (UNECA, 2008) to assess the uptake of new technologies for impoved water utilities asset management. Such a framework was found to be a credible tool in taking stock of technological achievements and deficiencies that characterize any municipal asset management programme. In this analysis it permitted the identification of apprpriate capacity, utilization and transformation indicators against which to benchmark the extent of water asset management deployment in Ethiopia's water sector. Capacity dimension seeks to measure the level and extent of the development and deployment of new asset management technologies and other resources. Utilization (usage) indicators are aimed assessing and measuring the extent of usage of capacity and related resources by local authority employees. Transformation or impact indicators are targeted at measuring the impact of the deployment and usage of water asset management technologies. In the absence of a previous similar study, the analysis employed a host of indicators often mentioned in water utilities literature and other related disciplines to guage capacity, usage and transformation.

Finacial resources are indispensible in boosting the local authority's capacity to acquire new technologies. Challenges often mention in water utilities literature include finacial constraints, poor tarrifs, poor consumer records and inefficient billing and collection practices (World Bank, 1994; Foster, 1996; Mwanza, 2004; Schwartz, 2008). Other capacity related isssues include planning and management indices such as funding (to procure necessary computer hardware and software resources), and manpower (Uchegbu, 2009) and training. Utilization indicator such as employees experience, knowledge and skills (Armstrong and Sambamurthy, 1999; Byrd and Turner, 2000; Finkand Neumann, 2007), existence of financial support and commitment from govenmenrt authorities (Mwoga, 2004; UN-WATER, 2006; Schwartz, 2008) technology acceptance by users (Carlsson and Turban, 2002; Westphal et al, 2003) and benchmarking tendencies (Donahue, 1989; Osborne and Gaebler, 1992; Halachmi and Holzer, 1993; Nickson, 1997). Transformative indicators used include among others service coverage (WHO / UNICEF, 2006; Schwartz, 200), unaccounted for water losses (Mwanza, 2005, Jafar et al, 2010), level of autonomy in the water utilities sector (Batley, 1999; Cullivan et al., 1988;Hoffer, 1995; Islam, 1993; Schwartz, 2006), pipe breakages and water quality. Figure 2 summarises the elements of the CUT model employed in this study.

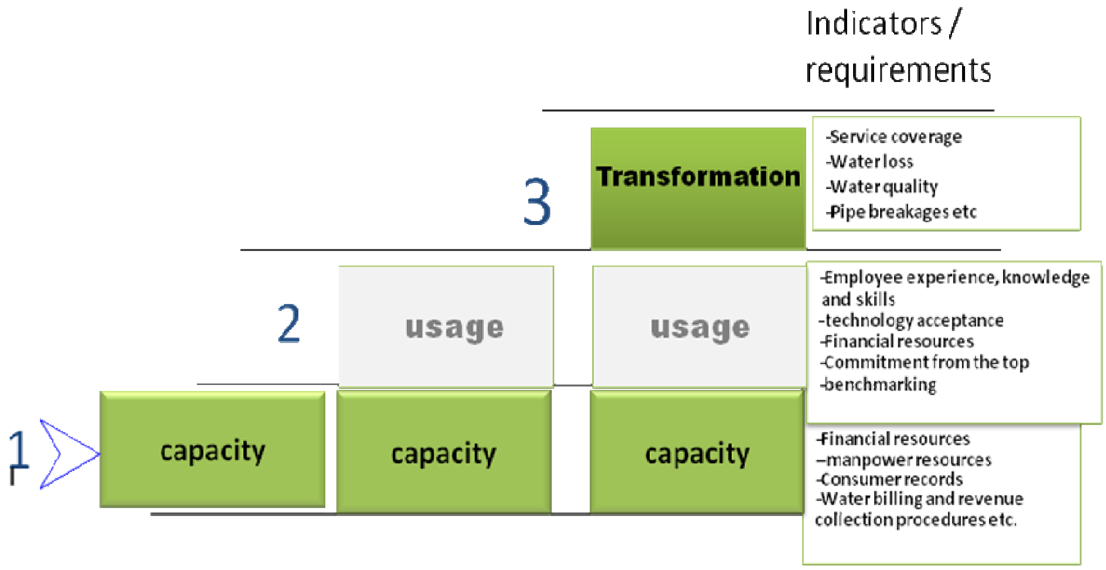

Fig. 2: Adopted analytical framework

3 RESULTS

3.1 Water infrastructure issues in Ethiopia

Ethiopia has a relatively low water resource development infrastructure (Seleshi, 2006). The Ethiopian nation has a population of about 77 million people. On average Ethiopians walk about 4km to get water and are consuming 15 litres of water per day. It is argued that Ethiopia needs about £300 million pounds to meet MDG targets on water and sanitation (DFID-Ethiopia, 2007). There are glaring global inequalities in the supply of water infrastructure and services. One indication is water storage: the United States and Australia have 100 times more storage per head than Ethiopia (Winpenny, 2003). Approximately one-third of Ethiopia's water supply systems are non-functional at any given time (MoWR, 2007). There is overwhelming empirical evidence to suggest that a combination of factors such as technical capacity, lack of spare parts, a weak water governance system and lack of support from water sector offices have rendered Ethiopia's water sector ineffective (Deneke and Abebe, 2008).

3.2 An overview of water policy interventions

The Ethiopian government launched the Universal Access Plan (UAP) – a big ambitious plan which seeks to ensure access to safe water and sanitation for all by 2012. The UAP was last reviewed and reaffirmed by the government in 2008. Capital investment in the water sector has doubled over the past four years (MoWR, 2008). The Ethiopian government's national Water, Sanitation and Hygiene (WASH) programme is supported by external donors including the World Bank, the African Development Bank, UNICEF and various NGOs. In 2007, DFID committed financial resources worth £75 million pounds into a 5 year WASH project through a number of initiatives, including the improvement of water infrastructure for 37 small towns of Ethiopia. Such initiatives have resulted in increased water expansion coverage in some towns and cities of the country. More however still need to be done to improve on water storage and utility efficiency (AICD, 2009). The European Delegation to Ethiopia invested €56 million in Support of water supply and sanitation projects (ECDE,..). Combined efforts and support from DFID and other donors in recent years have been instrumental in helping put Ethiopiaon course achieving the MDG target of water by 2015, even though it still remains a fallacy to halve the proportion of the population without access to improved sanitation (DFID, 2009).

3.3 Water utility asset management

Ethiopia's water utility reforms have barely touched the water utility asset sector. The majority of sampled water and sanitation seperts concurred that many ethiopian cities and / or towns lacked credible systems of Municipal Infrastructure management (refer to table 1). Table 1. perceived status of asset managemnt in the water sector

Does the LA have an Asset Management Plan?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	8	13.1	13.1	13.1
	Yes, but	22	36.1	36.1	49.2
	No, not at all	21	34.4	34.4	83.6
	No, but plans underway	4	6.6	6.6	90.2
	Dont know	6	9.8	9.8	100.0
	Total	61	100.0	100.0	

Table 1. Perceived status of asset management plan in various towns and / or cities.

The water and sanitation experts agreed that the water utility reforms that had taken place in Ethiopia over the years had resulted in the acquision of substantial amounts of water utility assets to match up to urbanization induced water demand. Effective operation and maintenace of such assets was yet to see the light of the day. The majority of such experts felt that the performance of the overall asset management approach when measured by Vaneer's six Whats scoreboard was discouraging (refer to table 2).

To what extent do you know about the following about water utility assets in your town / city?	Proportion of sample officials (n = 61)				
	To a very lesser extent	To a lesser extent	To a large extent	To a very large extent	Not sure
What do you own?	45.9	27.9	9.8	9.8	6.6
What is it worth?	45.9	23.0	24.6	-	6.6
What is the deferred maintenance?	53.2	37.7	3.3	-	6.6
What is its condition?	41.0	29.5	3.3	13.1	13.1
What is the remaining service life?	54.1	29.5	3.3	-	13.1
What doyou fix first?	52.5	31.1	6.6	-	9.8

Table 2. Perceived level of knowledge on water utility assets as measured by Vaneer's six Whats asset management model.

3.4 State of the art technology for managing water assets; A CUT perspective

The bulk of urban water authorities in Ethiopia have not taken advantage of new technologies for improved asset management. The current situation can be dismissed as one of constrained capacity, utilization and transformation. Capacity challenges range from absence of a credible planning and management framework for asset management through to lack of appropriate resources to acquire and utilize the requisite infrastructure hardware and software and the general lack of a sound revenue genration mechanisms to sustain all munipal activities. Shortage of funding that in most cases result from poor billing and revenue generation systems has seen most local authorities losing the much needed water tarrifs to finance and sustain water operations. Most local authorities have therefore failed to procure the necessary computer hardware and late alone train their employees with appropriate skills of handling such technologies (Figure 3). In a few cities such as addis Ababa, Adama and Mikkele, where some elements of asset management can be traced, the respective local authorities have often lacked a credible organizational strategy that would steer the much needed organizational change in the water utility asset sector.

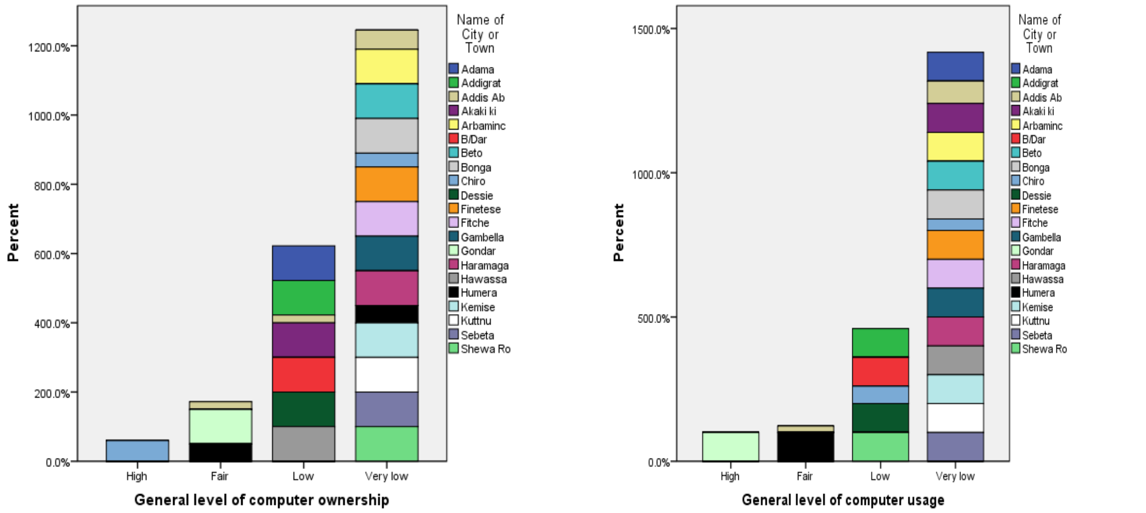

Fig. 3: Perceived levels of computer ownership and usage in a sample of Ethiopian towns and / or cities.

While evidence of asset management use is evident on other sectors such as the airline industry and the telecommunications sector and land administration exist, the analysis found no evidence of use of related technologies for managing water assets. The only exception is the billing component of some major cities such as Addis Ababa, Adama, bahir dar and Mikkele where it has gone electronic. Despite exposure by some officials to new developments in the state of art technology for water asset management, their widespread adoption and isage has been influanced by many other factors. Usage challenges discerned include lack of the much needed experience, knowledge and / or skills to implement such innovations. It was argued that the sophisticated nature of the bulk of such technological innovations given a generally less educated workforce was stiffling their uptake. The application of GIS based technologies in other infrastrcuture sectors offers an invaluable opportunity for water authorities in Ethiopia to benchmark performance. Several studies elsewher have reveald that benchmarking water asset management with other similar sectors will increase the chances of innovation diffusion (Donahue, 1989; Osborne and Gaebler, 1992; Halachmi and Holzer, 1993; Nickson, 1997). Unfortunately evidence of such bechmarking does not seem to exist. Figure 4 presents a snipper of other challenges affecting a sample of specific cities and or towns.

Because of cosntrained capacity and utilization, the much needed transformation in the water sector has been difficult to realize. Most of the sampled cities and towns in the study for example still have less than perfect water network that caters for the water needs of many. While a good 76% to 94% of city inhabitants have access to ether private and public tapwater, the water supply sector is constantly marred by unexpecteed interruptions in supply. One such highly affected town is Arbaminch where water interruption of more than 5

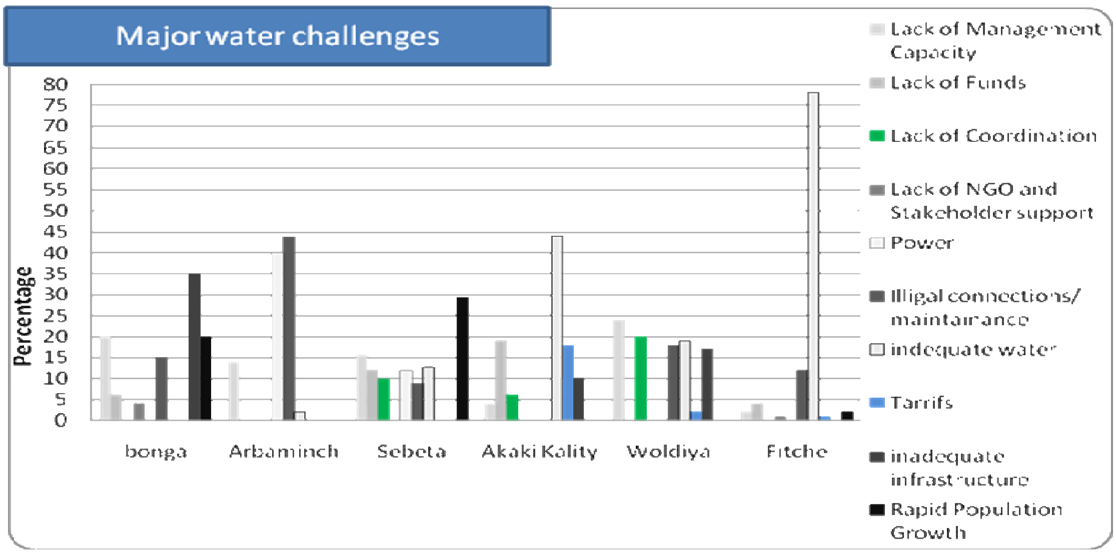

Fig. 4. Water challenges in selected towns

hours are experienced by at least 98% of the population. Other towns affected include Fitche, Woldiya and Sebeta (Figure 5). It must be noted that although Bonga town and Akaki kality city do incur the interruptions, they are in a better situation with more than 50% of the populations having a more or less regular supply of water. Irregularity of water supply does have its unpleasant outcomes as people will be forced to compromise on sanitation.

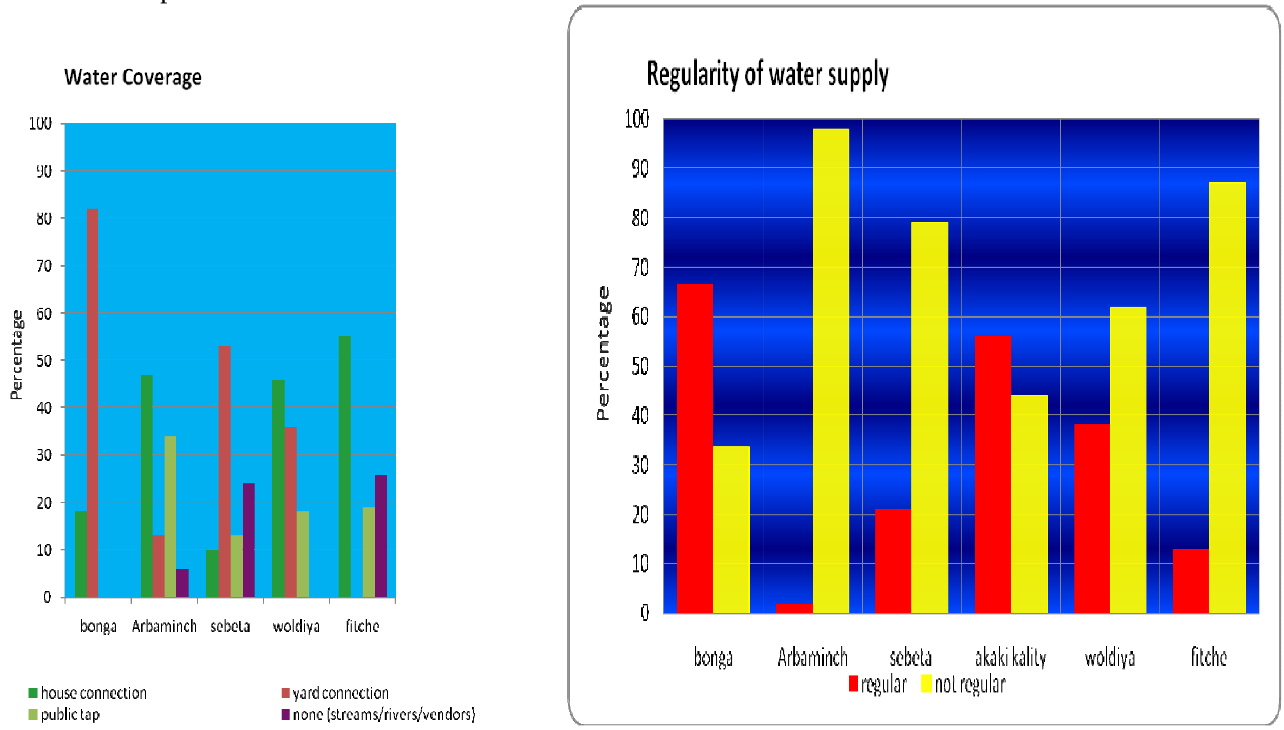

Fig. 5. Water coverage and Regularity of supply in a sample of towns.

Un-accounted for water has also remained relatively high in the three towns of Woldia, Fitche and Bonga. A situation that has compounded the already poor water supply challenge(figure 4). A combination of water loss induced water shortages and other power water quality issues has compromised the overall health of households in several towns of ethiopia among other social and economic impacts (refer to figure 4)

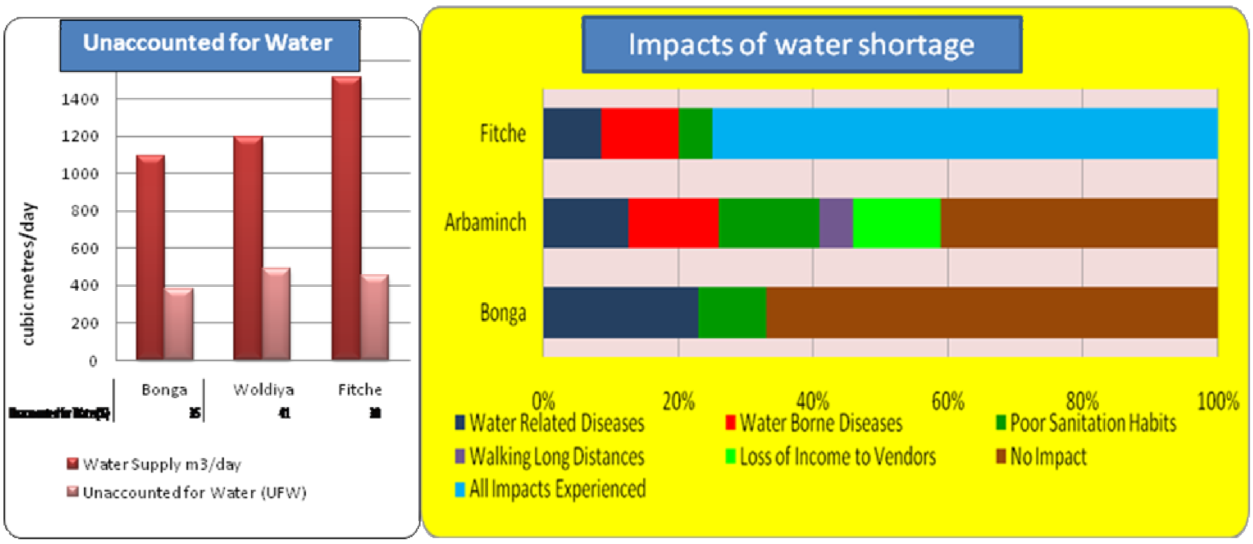

Fig. 6. Water loss and household perceptions on impacts of water shertages in sample towns

4 DISCUSSIONS

Water utility reforms in Ethiopia and elsewhere have done well in increasing the much needed stock of water utility assets (Urquhart and Busch, 1999; Kaganova *et al*, 1999; Kaganova and Stone, 2000). Such a move has not been misplaced given the complex demand that cuurent populations are puting water resources. Complexity has been in part resulted from the growing intensity and scale of climate change related challenges and burgeoning urban populations (Jenerette and Larsen, 2006; Oki and Kanae, 2006; IPCC, 2007). Such an asset building move has however remained unmatched with the extistence of credible asset management plans that would see the operations of water utility assets managed in a sustainable basis. Empirical evidence presented has shown that water authities in Ethiopa barely know what and how much stock of water utulity assets they own. It is also currently difficult to discern the asset life of such assets, and knowing when repairs are needed. Having ready answers to these and other related questions would have gone a longway in improving the quality of water service offered. As a result water utility operations in Ethiopia have remained constrained. Like many other countries in Africa, Ethiopia's water sector has been plagued by limited service coverage Statistices on water service coverage in other african countries are reported to be averaging less than 60 % (WHO / UNICEF, 2006). Mwanza, 2005 has observed that un accounted for water in sub-Saharan africa averages 40 % and 60 %. Other daunting challenges include financial constraints due to a combination of low tarrifs, poor consumer records and inefficient billing and collection practices (World Bank, 1994; Foster, 1996; Mwanza, 2004; Schwartz, 2008).

The water situation is further compounded by the non adoption of new technologies for managing water utility assets. Evidence to this technological void has been presented within the context of the CUT framework. Most water authorities in Ethiopia lack capacity to acquire and utilize the much needed infrastructure asset management technologies. Capacity challenges include limited financial resources, absence of skilled personel and the generally weak water billing and tarrif collection practices – factors that have traditionally constrained many other countries in sub Saharan Africa in the last decade or so (Mwanza, 2004; Schwartz, 2008). Utilization of the asset management technologies has also been constrained by a myriad of other factors that have traditionally characterised most water services accros the globe. These include among others lack of manpower resources (Uchegbu, 2009), lack of benchmarking and a the absence of required levels of financial committment and government will. Empirical evidence drawn from elsewhere have discerned a positive association bettween the extension of appropriate levels of financial committment, government support and improvements in the water sector (Mwoga, 2004; UN-WATER, 2006; Schwartz, 2008). The argument is that such factors help to create a certain level of autonomy that will foster a conducivive evironment for the adoption and implementation of innovations (Worls bank, 1992). Such an observation has been supported by several other independent studies whose results reveal that opportunities for improved performance in the utilities sector increase with the level of autonomy, particularly financial autonomy (Batley, 1999; Cullivan et al., 1988;Hoffer, 1995; Islam, 1993; Schwartz, 2006). Benchmarking tendencices, particularly under a highly competitive environment are known to increase the chances of adopting innovations in the water sector (Donahue, 1989; Osborne and Gaebler, 1992; Halachmi and Holzer, 1993; Nickson, 1997). Most water authorities in Ethiopia are still far from privatizing their water and sanitation sectors. The complexity associated with water asset managementnt technologies in an environment where education statistics are not good has also contributed towards their non-use by water authority employees. Other studies have shown that policy makers usually portray a conservative attitude towards complexity. They prefer simple constraints and flexible negotiations to complex assessment and decision-aid methodologies (Starkl et al, 2009).

As a result of these challenges, the analysis can conclude that technoldies for managing water utility assets have not been able to foster the much needed transformation in Ethiopia's urban water services sector. Water coverage has continued to be low, water losses throgh pipe breakages and pilfirage among other factor have constrined service coverage and quality. Overally, this has had dire health, social and economic consequences. Widespread adoption of water asset management in Ethiopia can be effected only if these challenges are addressed. More funding should be extended or mobilized for technology acquisition. Adequate funding as been indispensible to the success stories of other water infrastructure related projects. A strong commitment from government as what happened in Uganda's water utility sector can go a longway in overcoming some of the financial hurdles (UN-WATER, 2006). It is reported that between 1997 and 2000, Government financial support to Uganda's water utility sector increased from US$2 million to US$20 million (WSP, 2002). Water services were accordingly boosted. Many other countries have also successfully supported public infrastructures for water systems (OECD, 2004; ASCE, 2005; Tsagarakis, 2005; Mohr, 2006)

Handling coplexities associated with asset management technologies would require skills development and training programs. Research in Information Technology (IT) and Information Systems Development (ISD) has shown that experience, knowledge and skill are critical in converting IT components into valuable services (Armstrong and Sambamurthy, 1999; Byrd and Turner, 2000; Finkand Neumann, 2007). Carlsson and Turban, (2002) further note that most of the problems are not technology related but are rather people and / or organizational problems. Proper planning and management initiatives are central to the provision of adequate servies. Planning and management in public water supply systems often determine the quality of service the water supply authorities can render (Uchegbu, 2009). To this end credible asset management plans that are guided by a known orrganizational stategy are required. Such a strategy would then lead to the much needed organational value that will inturn steer the much needed asset reforms in the water sector. These requirements need to be fulfilled as the relationship between water asset management technologies and changes required in the respective water sector is not spontaneous.

5 CONCLUSION

Thi analysis has revealed that the water asset management plan that currently characterize the majority of towns and cities can be dismissed as one of constrained capacity, utilization and transformation. Lack of financial resources, technical expertise and appropriate organizational strategy among other factors has constrained the adoption and application of system software for effective asset management in many towns and cities. The analysis also reveals that the relationship between new water asset management technologies and improved asset management is not spontaneous. It needs to be worked out and nutured through the lifecycle of the asset mangement programme. An appropriate organizational strategy that would translate into organizational value and subsequently into the much needed organizational change is indispensible in this respect.

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