# Measuring and mapping citizens' access to rural water supply in Tanzania

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February, 2015

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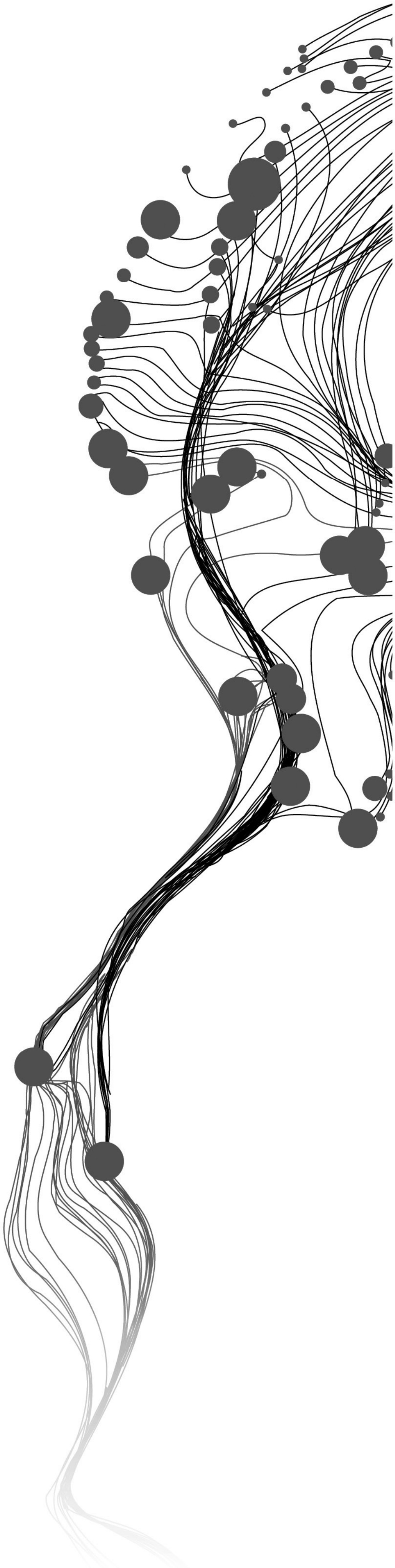

# Measuring and mapping citizens' access to rural water supply in Tanzania


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Thesis submitted to the Faculty of Geo-Information Science and Earth Observation of the University of Twente in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation.

Specialization: Urban Planning and Management



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# ABSTRACT

Water is a mutual common resource fundamental for life. However, measuring water access in Tanzania, like in many other developing countries, has been a controversial subject among water sector stakeholders. The aim of this study was, therefore, to examine the conceptual and practice of water access indicators in measuring citizens' access to water, particularly for rural population. In order to accomplish the aim, Kiromo and Zinga wards in Bagamoyo district, Coast region of Tanzania were selected as a case study. A mixed method research approach was adopted whereby both qualitative and quantitative methods were employed in field data collection and analysis so as to enhance the validity and reliability of the results. Also, water points mapping and spatial analysis of water coverage indicator practice was performed and the pockets of served and underserved areas were highlighted. The findings show that the current practice of water access indicators assess the performance of objective and quantitative access dimensions which gives more focus on service provider's context and ignores citizens' -as service users- value, perception and their access strategies which significantly contribute to sector performance. The evidence revealed that, the current practice does not count for citizens' day-to-day water access informal strategies despite the fact that they have a considerable contribution on the performance of objective access dimensions that are considered by the government and its agencies. These results imply that the official statistics, currently reported, do not reflect the real extent and contents of water access problem facing rural citizens. Thus, it is the proposition of this study that measuring citizens' water access requires targets and indicators that are both quantitative and qualitative as well as framework that recognizes the role played by citizens' access strategies and initiatives. Also, the study discusses the need for mapping to spatially cross-check and validates both quantitative and qualitative water access data from surveys as the approach can be used to visualize and assess rural water access problems as well as evaluating the success of the implemented policy interventions.

Key words: water access, Water Point Mapping and GIS, water access indicators, rural water supply, Tanzania

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| | |
|---|---|
| ADB | African Development Bank |
| BRN | Big Results Now |
| COWSO | Community Water Supply Organization |
| DWE | District Water Engineer |
| EA | Enumeration Area |
| EASTC | Eastern Africa Statistical Training Centre |
| EPI | Expanded Programme of Immunization |
| FWPD | Functional Water Point Density |
| GI | Geographical Information |
| GIS | Geographical Information System |
| GPS | Geographical Positioning System |
| HBS | Household Budget Survey |
| IUCN | International Union for Conservation of Nature and Natural Resources |
| JMP | Joint Monitoring Programme |
| LGA | Local Government Authorities |
| MDG | Millennium Development Goals |
| MoW | The Ministry of Water |
| MoWLD | Ministry of Water and Livestock Development |
| MTSP | Medium Term Strategic Plan |
| NBS | National Bureau of Statistics |
| NPRS | National Poverty Reduction Strategy |
| NSGRP | National Strategy for Growth and Reduction of Poverty |
| RADWQ | Rapid Assessment of Drinking Water Quality |
| RAS | Regional Administrative Secretary |
| RWSP | Rural Water Supply Programme |
| SNV | Netherlands Development Organization |
| SPSS | Statistical Package for Social Science |
| UN | United Nations |
| UNDP | The United Nations Development Programme |
| UNICEF | United Nations International Children's Emergency Fund |
| URT | United Republic of Tanzania |
| WB | The World Bank |
| WHO | World Health Organization |
| WPC | Water Point Coverage |
| WPM | Water Point Mapping |
| WPts | Water points |
| WSDP | Water Sector Development Programme |
| WSP | Water Safety Plans |

# 1. BACKGROUND

This chapter specifically introduces issues concerning measuring and mapping citizens' access to water from the global to developing countries context, Tanzania in particular. It then highlights the justification of this research and outlines the problem, research objectives and questions. It ends by outlining the structure of this thesis.

## 1.1. General introduction

Water is a mutual common resource fundamental to life and in sustaining the environment as well as enhancing the social and economic development of our wellbeing. It is vital for sustainable socio-economic development as a strategic primary input playing a central role in poverty alleviation through enhancing food security, domestic hygienic, hydropower, industrial development, mining, navigation, and the environment for sustenance of ecosystems (MoW, 2005). Availability of adequate water supply, for drinking and other domestic use, of good quality reduces time spent in fetching water, increases health standards by reducing the incidences of debilitating water-borne diseases such as diarrhoea and cholera and thus improve the socio-economic wellbeing of users (UNICEF and WHO, 2006; URT, 2012). Owing to its significance to human life, the United Nations General Assembly and the Human Rights Council explicitly recognised the right to safe and clean drinking water and sanitation as a human right in July 2010 (The UN Special Rapporteur, 2014; UNDP-IUCN, 2004). It contended further that the UN member states have an obligation to move as quickly and effectively as possible towards full realisation of the human right to water using the maximum available resources.

However, defining and measuring water access, as an intangible concept, has been a controversial subject among stakeholders in the water sector from international donor agencies, development partners, national governments, civil society organizations and researchers. The 'one-size-fits-all' water access definitions are likely to fail owing to diverse contexts and conditions among countries and sector-stakeholders. The central concern is nailed in conceptual and methodological challenges between and across sector-stakeholders where several "indicators" have been constructed, adopted and implemented, *as proxies,* to define and measure access to water. The indicators adopted and implemented serve purposes beyond measuring water access as they help to plan and implement sector development interventions or strategies, to monitor and evaluate, as well as to report on sector-development progress. Nonetheless, the identified pitfalls in the design, construction or selection, use and interpretation of some indicators is still a challenge which is associated with variety of costs and risks to sector-stakeholders (Holzapfel, 2014; Wong, 2006).

Therefore, it is the focus of this study to contribute to our understanding of not only development, selection, use and practice of water access indicators but more importantly their impact on measuring citizens' access to water specifically in rural areas. Throughout this particular study it should be clear that the 'improved drinking-water source' is referred to 'improved water point'[1] as defined in the Joint Monitoring Programme (JMP) report and the researcher will use the term 'water point' with similar meaning to the definition by JMP (WHO and UNICEF, 2005). Also the 'public water point' is referred to water source types that provide service to the public.

[1] An improved water point "is one that, by the nature of its construction and when properly used, adequately protects the source from outside contamination, particularly faecal matter". It includes categories as outlined in (WHO and UNICEF, 2005).

## 1.2. Background and justification of the study

The history of using indicators can be traced back to the 1940's when the monthly economic indicators was first published to measure the buoyancy of the US economy. Unfortunately, the initial rapid development of using indicators suffered a setback in the late 1970's due to the failure of researchers to resolve conceptual and methodological difficulties that still remained unresolved (Wong, 2006). For instance Knox's 1978 study (as cited in Wong, 2006, p.2) identified the pitfalls in the design and development of some indicators including the difficulties encountered in the selection, data availability and reliability, the problem of spatial aggregation, and indicators interpretation.

Traditionally, indicators found to be epistemologically associated with empiricism and positivism with the natural assumptions that indicators are quantitative, objective and operational measures. Yet in recent years, researchers have shown an increased interest in another epistemological turn which gives emphasis on value judgement as a yardstick to measure progress and goal achievements of the sector-development (Wong, 2006; Sawicki, 2010). This turn unveil the argument of relativism, and give more emphasis on importance of subjective indicators and interpretation of meaning. In 1992 for instance, David Osborne and Ted Gaebler published Reinventing Government, where they described a process for developing a set of indicators of customers' satisfaction (Sawicki, 2010). In reality, many socio-economic issues, including *access to water*, are not susceptible to quantification only and are inherently difficult to measure as they are either qualitative in nature or the assessment of performance is a matter of opinions, or subjective judgement (Wong, 2006, p. 101). With regard to such stances, some scholars contended for mixed use of both rational or positivist and the value-laden (users' judgement) approach towards indicator development and interpretation. However, the mix of objective measures and normative policy action makes indicators a paradox in social research, and thus more studies need to be carried out to clear the enigma and provide a harmonized concept and methodologies for indicators development and use as argued by Wong (2006).

In determining access to water the most frequently universal indicator definition used to define citizens access to water compares water supply coverage, "in aggregate statistics", within and among countries in order to quantify the global status and progress of international interventions like the Millennium Development Goals (MDGs) (Nganyanyuka, Martinez, Wesselink, Lungo, and Georgiadou, 2014). The indicator used to measure the progress of millennium development goal 7, which targets at halving the proportion of people without sustainable access to safe drinking water by 2015, defines access to water as "the proportion of population using an improved drinking-water source" (WHO and UNICEF, 2012). In the meantime, as most of donor agencies aim to contribute to the MDGs, the indicators and methodologies they often use are of MDGs or linked to them. Holzapfel (2014, p.93-95) listed a number of water access indicators used by international donor agencies. Yet, a number of scholars contend that the MDGs definition is objective-oriented and does not capture the complex nature of water access particularly from the perspective of the users neither does it provide a global consensus on the criteria used to calculate the 'proportion of the population'. For instance, whilst the JMP contends for 'water supply coverage' as the main indicator to measure progress on water access, some scholars (e.g. Zawahri, Sowers, and Weinthal, 2011; Kristof, 2005) introduced additional variables that are important for assessing peoples' access to water including affordability, quality, quantity, reliability and convenience which are partly subject to user's perspective. Meanwhile, other definitions substitute access to water with 'water use' arguing that mere provision of water sources does not necessarily indicate "actual use" by the people (Nganyanyuka et al., 2014; Kayaga et al., 2009). Moreover, the water coverage estimates produced by such indicators for achieving global targets do not give enough information about actual use of water (WHO and UNICEF, 2005) which is the central concern to the citizens as service users.

The problems connected to the definition complexity, choice of indicators with poor data availability and lack of universally agreed methodology to water access are causing uncertainty regarding the figures and statistics that are disseminated worldwide and used by international development agencies (WHO and UNICEF, 2014). With regard to such setbacks and the fact that the MDGs lifespan is approaching to an end, the need to create a universal but adaptable to local contexts, globally legitimate, nationally relevant and coherent action-oriented framework is indispensable for Post-2015 Sustainable Development Goals (SDGs). Taking action to the need, the UN Open Working Group (OWG) on the SDGs is proposing a modification to the MDGs water access indicator definition by going beyond "basic drinking water" as it has been designed to incorporate an assessment of the "quality and safety" of the water people use. According to the proposed SDGs (goal 6, indicator 49) definition, water access is measured by "percentage of population with access to safely managed water services by rural population" where by the term *safely managed* is proposed to include measures for protecting supplies from excreta and other forms of contamination, thus ensuring water is safe to drink (United Nations-SDSN, 2014).

Another challenge in measuring water access is disparities in rural and urban water coverage as well as socio-economic discrepancy. According to the MDG progress report the global coverage of people with access to improved drinking water in rural areas is still lagging far behind, particularly in most of sub-Saharan Africa. In 2010 for instance, 96 percent of the global urban population used an improved drinking water source, compared with 84 percent of the global rural population (WHO and UNICEF, 2012). The report pointed further that even in rural areas socio-economic inequality remains a challenge where by poorer people in sub-Saharan Africa are at a disadvantage in access to drinking water. For instance in Tanzania -based on 2002 census report- 42 percent of rural households and 85percent of urban households have access to improved water supply and the gap between the two is widening (Giné and Pérez-Foguet, 2008). Also, it is argued that the socio-economic characteristics of households in a community or neighbourhood influence the provision and distribution of water supply infrastructures (Twaweza, 2014). Local civil society organizations describe many fault lines of discontent and contestation in the level of citizen's access to water in Tanzania and substantiate that the problem is rather mounting (see **figure 1-1**) despite significant investments in water sector in recent years and the fact that water-sector is among the policy priority of the nation.

In 2006 the government with aid from international donor agencies launched a National Rural Water Supply Program (NRWSP) with the target of increasing rural access to water from 53 percent in 2005 to 90 percent by 2025 (United Republic of Tanzania, 2006). To intensify the initiatives, it has recently renewed its efforts through the so called "Big Results Now (BRN)"[2] initiative with the aim to provide access to water to more than 75 percent of the population living in rural areas by 2015 (see **figure 1-1**) which of course will require a dramatic improvement over the current trend (Twaweza, 2014). In trying to address the methodological challenges in determining water access, the government has adopted and is implementing the Water Point Mapping (WPM) system developed by an international organization WaterAid. According to Jiménez and Pérez-Foguet (2008a) WPM methodology allows the definition of more reliable access indicators, in terms of physical coverage, which are centred on water point functionality. With this methodology, access is normally defined by establishing a maximum distance and people served ratios to each water point, for instance the national policies and national water sector strategy in its operational target, define access to water, in rural areas, in terms of physical coverage by establishing a maximum distance of 400 metre to a water point and/or a proportion of rural population that has access within 30 minutes of time spent on collection of water (URT, 2006; United Republic of Tanzania, 2002; NBS, 2011). In the meantime, the Ministry of Water in its operation defines rural water access as one water point serving 250 people within the radius of 400 metre.

[2] "Big Results Now (BRN) initiative aims at adopting new methods of working under specified timeframe for delivery of the change required", with a focus on six priority areas of the economy, including water (http://www.pmoralg.go.tz/quick-menu/brn/)

Another methodology used by WaterAid is Functional Water Points Density (FWPD) which also define coverage as equal to the number of FWP per population expressed in 1000 inhabitants (Stoupy and Sugden, 2003). Based on the Tanzanian standards, a certain area is considered to have an optimal access if its density is at least equal to 4 (i.e. 1 WP per 250 people). In an empirical case of Same rural district in Tanzania Jiménez and Pérez-Foguet (2008a) applied different methodologies and indicators provided by the central government, WaterAid WPM, and FWPD proposal to assess access in terms of physical coverage. As one could expect, the results from among different methodologies and indicators applied show different access coverage across the same area (for more details see table 2 in Jiménez and Pérez-Foguet, 2008a, p.460). So far however, there has been little discussion on the methodological approaches towards the practical operation of those indicators with the central concern on "who accounts for citizens' water access and what and how is it counted". The methodological challenges, as such, might not only contribute to over- or under-estimations of citizens' access to water but also hide their actual condition. Thus, it is the focus of this research to examine the currently used methodological approaches and harmonizing the methods to prevent haphazard results and statistics as claimed by Innes (1990).

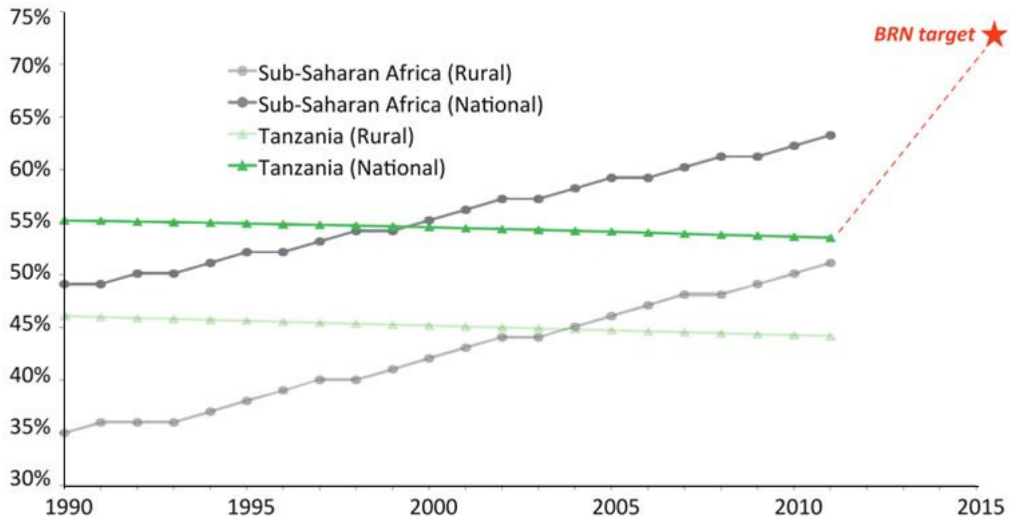


Figure 1-1: Percentage of population with access to water in rural Tanzania from year 1990 to 2015 (adapted from Twaweza, 2014, p.2)

Besides, it is the argument that effective strategic planning and appropriate development and management of water is strongly supported by reliable, accurate, accessible and updated data by which local governments need to make evidence-based decisions (Giné-Garriga, Palencia, and Pérez-Foguet, 2013). Thus, WPM as a methodology with the aid of Geographic Information Science (GIS), remote sensing and advanced information and communication technologies are essential platforms for constructing and operationalising water access indicators (Giné-Garriga, Jiménez-Fernández, and Pérez-Foguet, 2013), as they can integrate data from different sources including surveys, census, and satellites, as well as from different disciplines such as socio-economic and environment data. Also, GIS-based indicators operationalisation can work over different spatial units tailoring to the particular decision problem (Martínez, 2009), the practice which is necessary to minimize the problems of ecologically misleading outcomes. And with the need for visualization, mapping methodology that involves the presentation of water related information in a statistical and spatial context is indispensable. The produced maps are powerful visual tool that can provide local policy makers with strong evidences to inform their planning decisions on equitable water supply service provision.

## 1.3. Research problem

In Tanzania like in other developing countries, measuring citizens' access to water remains a problem despite the development and adoption of several indicators and methodologies to measure the issue at hand. The government through the Ministry of Water (MoW), its agencies such as National Bureau of Statistics (NBS), and donor agencies have been developing and implementing a number of indicators and methodologies to measure water access but still unreliable statistics and under- or over-estimations are usually reported (Satterthwaite, 2003). Meanwhile, the disparities between access to water status as stated by official statistics and the actual access situation from users' point of view is always found (Zérah, 2000) and yet not adequately accredited. However so far, the pitfalls identified are centred on the selection and use of water access indicators in aspects including clarity of water access concept among and within sector-stakeholders, indicators development or selection, and how they are practiced on measuring citizens' access to water. Therefore, this research examines the methodological approach of indicators selection, use and practise on measuring citizens' access to water as accounted for by service providers as well as service users.

Another area of concern is the problems of aggregate statistics in prevalence of socio-economic disparity, among and across users and spaces, where access to improved drinking water sources increases with wealth (UNICEF and WHO, 2011). The aggregate statistics, often characterising greater service coverage, reported and used for planning on water-sector development programmes and projects fail to reflect asymmetries of citizen's modes of access to water (Cheng, 2013), as a consequence hides the actual water-related wellbeing condition of the most marginalized and low-income communities. When indicators are generated at high level of aggregation they can give a misleading idea of the problem they address. In the particular case for instance, the level of physical access or coverage observed is very much a function of spatial scale and not service users' satisfaction. Therefore, the inferences about individuals with aggregate coverage data, such as provided by administrative data, can be misleading and contribute to the problems of *ecological fallacy* (Martínez, 2009).

However, despite the potentials that can be derived from WPM and GIS in constructing and operationalising water access indicators, the methodological approach to that end is still a paradox among researchers and practitioners, particularly in local authorities (Giné-Garriga et al., 2013). Yet, little attention has been paid to examine and document the methods and approaches that accommodate WPM and GIS potentials in measuring citizens' access to water. Therefore, the study also contributes to our understanding, both practitioners and researchers, on the use of WPM methodology with the aid of GIS in water access indicators construction and practice, which in turn can provide input for local policy makers with strong evidences to inform their planning decisions on equitable water supply service provision.

The central problem studied was therefore concerned with the question "who counts what and how" in measuring citizens' access to water particularly for the rural population, using the case of rural Tanzania.

## 1.4. Research objectives and questions

### 1.4.1. General objective

The general objective of this study was to examine the selection, use and practice of water access indicators in measuring citizens' access to water in rural areas of Tanzania.

### 1.4.2. Specific objectives and research questions

In order to achieve the overall research objective, the following specific objectives and research questions as presented in **table 1** were addressed.

Table 1-1: Research objectives and questions

| Specific objectives | Research questions |
|---|---|
| 1. To carry out a systematic review on conceptual and methodological questions in the development and use of water access indicators. | • What are the theoretical definitions of water access?<br>• What is known about the selection, use and practice of indicators used to determine citizens' access to water? |
| 2. To examine the current practice of water access indicators in rural areas of Tanzania. | • How do the government and relevant water sector-related agencies in Tanzania practically determine citizens' access to water?<br>• How do citizens as service users describe their access to water?<br>• What are the similarities and differences between government and citizens perspectives on water access dimensions? |
| 3. To map the spatial distribution of water points' service coverage in Kiromo and Zinga wards and analyse the served, over served and underserved areas. | • What is the service coverage of water points in Kiromo and Zinga wards with respect to different water access indicator practice?<br>• Where are the pockets of underserved and over-served areas? |

## 1.5. Thesis outlines

The organization of this report consists of six main chapters with sub sections and paragraphs building up the chapters. The chapters are structured in the following sequence:

*Chapter 1:* Presents the introduction of this research, the background and laying out the theoretical dimensions of the study. It also provides the justification of conducting the study by highlighting the research problem, objectives, and questions about measuring and mapping citizens' access to water.

*Chapter 2:* A review of literature relating to the concept of water access and methodological approaches to measuring citizens' access to water from the global to developing countries context, Tanzania in particular is presented in this chapter. The chapter also incorporate the conceptual framework of the study.

*Chapter 3:* The tools, materials, methods and other logistics used to accomplish the research are detailed presented in this chapter. It explains all the activities done from pre-field work, fieldwork to post fieldwork phases.

*Chapter 4:* The findings and discussion on "how the government and other water sector-related agencies in Tanzania practically measure citizens' access to water" particularly in the context of rural population is presented in this chapter. It basically discusses the central question of "who counts what and how" through examining the practice and performance of water access indicators by the Ministry of Water, National Bureau of Statistics as well as the role played by development partners.

*Chapter 5:* This chapter presents the findings and discussion on "how citizens as service users of water supply services describe their access to water". It empirically reveals the knowledge, experience and perception, of citizens in the study area, on performance of water access dimensions. The chapter also discusses in details the spatial coverage of water sources while unfolding the pockets of under- and over-served areas, the respective statistics of the population served, and comparative and integrated assessment of all water access indicators. It ends with the discussion on the contrast between the government -as service provider- practice to measuring water access and citizens' -as service user- perceptions on performance water access dimensions.

*Chapter 6:* This chapter gives summary of the results and discussion by referring to the objectives posed in the introduction section. It also presents possible propositions that may be noteworthy and opportune for the post-2015 development agenda discussions. Moreover, the chapter highlights areas for further studies.

**Figure 1-2** illustrates the sequence of main phases employed in accomplishing the research where by some phases were done in parallel such as analysis, results and discussion. Also, some phases has feedback (presented by double arrow) for instance, many of the arguments presented in introduction and literature review parts occur again in the discussion or conclusion in somewhat reverse order.

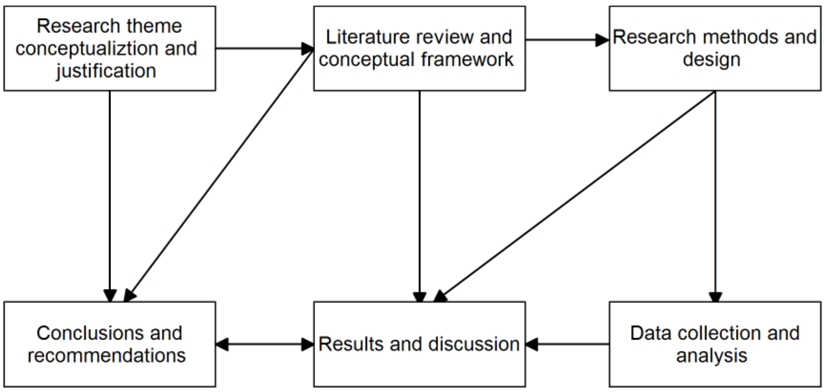


Figure 1-2: Structure of the research (Adopted from Mwamwaja, 2014, p.7)

# 2. CONTEXT AND CONCEPTS OF MEASURING CITIZENS' ACCESS TO WATER

This chapter gives insights on the context of access to water, descriptions of relevant concepts, definitions and methods of measuring water access. It answers the research questions on 'what is known about water access concept and the methodologies used to measure the concept' by presenting a review of literature on the key elements for assessing citizens' access to water in developing countries, particularly in Tanzania and thereby deriving a conceptual framework.

## 2.1. Water access definition and perspectives

### 2.1.1. Water access and coverage definitions

One of the most significant current discussions in water sector, as detailed debated in introduction chapter, is the debate on the appropriate definition of access to water. Stakeholders in the sector particularly donor agencies, national governments, and researchers are in controversy on what is being counted (how access is defined) and how it is being counted. Owing to diverse contexts and conditions in aspects including locality, economy, politics, institutions and others, among different countries, the universal or "one-size-fits-all" solutions are likely to fail (Nganyanyuka et al., 2014). According to the global indicator used to assess the progress of MDG goal 7, water access is measured by the proportion of population with access to adequate amount of safe drinking water from improved sources. However, the diffusion of what constitutes improved access to safe water has reinforced and magnified pre-existing incentives among local governments to hide their deficiencies (Zawahri et al., 2011) as the focus is dominantly on quantifying infrastructure provision.

And according to WHO and UNICEF (2014), the world has met the MDG water target coverage of 88 percent in 2010, while in fact it has only met the indicator, as yet billions of people remains remain without sustainable access to safe and affordable water (Fukuda-Parr, Yamin, and Greenstein, 2014). However, Nganyanyuka et al. (2014) in their conclusion argued that statistics derived from that definition do not count the access to drinking water that counts for citizens. Similarly, different other studies from diverse context (to mention few Kristof, 2005; Kayaga et al., 2009; Zawahri et al., 2011; and Cheng, 2013) have contended against the global definition used to assess progress of the MDGs. Basing on the arguments put forward by those studies, citizens' access to water can be viewed into two main perspectives *supply side* and *demand side*. The supply side is confined to the role of the government, its agencies, and donor institutions that provide water supply service while the demand side is centred on users of the service, the citizens in this case. Amid the supply side, water access is objectively defined in terms of service coverage or physical access whereby the focus is purely on quantifying infrastructure provisions with less attention on the actual use of the provided infrastructures. Owing to such deficiencies, some countries modified their definitions to derive indicators for monitoring national's and the MDGs target on water supply. Distance, time and water quantity have been diversely used to formulate country-specific definition (Kayaga et al., 2009).

On the other hand, citizens as service users define access to water beyond physical access by paying more attention to their satisfaction derived from the actual use of water supply services. Kayaga et al. (2009) in their study stressed further that, where usage can accurately be measured and users get satisfied, this is considered to be better indicator of access since the benefits from water supply can only accrue when water sources are used (Kayaga et al., 2009) the perspective that can be referred to as "actual use". However, the studies presented hitherto provide evidence that these two perspectives logically serve the same purpose and they should be considered simultaneously for effective measure of citizens' access to water. That means, both objective and subjective indicators are important in accounting for citizens' water access while giving more emphasis on aspects such as proximity, water quantity, quality, reliability, and affordability. Stressing further, Fukuda-Parr et al. (2014) argued that water access as a human right requires targets and indicators that are both quantitative and qualitative, as many essential dimensions of water access cannot be reliably quantified.

### 2.1.2. Water access as a human right

Access to water is a human right, as recognised by the UN General Assembly, with the fact that it is in itself essential for life and dignity as well as the foundation for achieving a wealth of other human rights including right to: life, food, education, adequate standard of living, and more decisively right to health (The UN Special Rapporteur, 2014; John, Angela and Nemes, 2004). According to the Handbook of the UN Special Report on the rights to water and sanitation, right to water is defined as "the right of everyone to sufficient, safe, acceptable, affordable and physically accessible for personal and domestic use". It contented further that the international human rights law obliges the UN member States to work towards achieving a universal access to water guided by human rights principles and their defined standards and dimensions indicators including: availability, sufficient, quality and safety, physical accessibility, acceptability, dignity and privacy (The UN Special Rapporteur, 2014). However, human rights to water access like other human rights approaches to development require targets and indicators that are both quantitative and qualitative, since many essential components underpinned on goals and targets of human rights cannot be reliably quantified (Fukuda-Parr et al., 2014). These global developments have led to transformation in the governance of domestic water supply in many countries including Tanzania (Masanyiwa, Niehof and Termeer, 2014).

### 2.1.3. Water governance and service provision

Water governance relates to the range of political, social, economic and administrative systems that control decision making with regard to water resources management and the provision of water services at different levels of a society (Jiménez Fernández de Palencia and Pérez-Foguet, 2010; Batchelor, n.d.). With remunicipalisation ideology that aimed at transferring the role of water service delivery from private companies to municipal authorities (McDonald et al., 2012) and the implication of UN resolution, there is tremendous transformation in domestic water supply governance in many countries, including Tanzania. Such transformation aims at ensuring equity, transparency, participation, accountability, and sustainability of water resources and supply services. For instance, in Tanzania water governance is currently shaped by decentralization process partly due to the failure of centralized government service to provide reliable water service, particularly in rural areas (Masanyiwa et al., 2014). There has been a general shift from an emphasis on state water provision, public service delivery, to neoliberal ideology of market-based service delivery (McDonald et al., 2012), and more recently a multi-stakeholders approach that includes community in water governance. The presence of multi-actors approach not only idealizes a symmetrical triangular interaction between the state, civil society and the market forces but also giving less attention on power differences existing among the actors while the power is the key player to determine who gets access to which water and for what price (Hordijk, Sara and Sutherland, 2014). In such system where different approaches exist in parallel it is not surprising that where public provision fails to reach the poor, both large and small scale private vendors step in, selling drinking water to the poor at prices that can be many times higher than what the public offered the well-off households (Hordijk et al., 2014).

## 2.2. Water access in rural of Tanzania

The government of Tanzania like many other African countries adopts the universal definition of access to water with the aim to quantify and assess the progress of national goals such as of National Strategy for Growth and Reduction of Poverty (NSGRP) as well as of MDGs. The definition adopted describe access as "the percentage of rural population with access to improved sources of water within 400 meters and 30 minutes walking time to fetch water" (United Republic of Tanzania, 2002). The 2002 national water policy recognizes access to clean and safe water as a basic need for all, and aims to provide adequate, affordable and sustainable water supply services to the rural population (Masanyiwa et al., 2014). It specifies the standard levels of service, that are used as proxies to determine water coverage, including; a minimum of 25 litres per person per day for consumers with yard connections to water supply system as well as through public water point., and one public water point to serve a maximum of 250 persons at not more than 400 meter from the furthest user, and within 30 minutes time for a round trip to fetch water.

## 2.3. Review on indicators and approaches to measure water access

In recent years, there has been an increasing interest in measuring citizens' access to water within and across countries in order to quantify the national as well as global status and progress of national and international (like MDGs) water-sector interventions respectively. To monitor progress of the set goals on water access, for instance the MDG goal 7 (as defined in WHO/UNICEF, 2012), different countries have adopted a diverse number of water access dimensions and indicators with regard to the prevailing context and conditions (locality, politics, economy, social and institutional conditions, and others). Nevertheless, keeping in pace with the monitoring the progress of MDGs as well as the legal content of the human rights to water, the common dimensions and indicators used by most countries to monitor progress on citizens' water access include the following:

### 2.3.1. Proximity or physical access to water point

The proximity to water source is normally determined through distance or walking time from user's home to the source. It is the mostly used indicator to measure the level of physical access or coverage. However, with diverse context and conditions, the optimal distance varies across nations as well as between international institutions. For instance, while WHO advocates that water source has to be within 1,000 meters from user's home and collection time should not exceed 30 minutes (United Nations Organization, 2014; The UN Special Rapporteur, 2014) the national water policy in Tanzania set 400 meter as a maximum distance to a water point and not more than 30 minutes collection time -go, wait, collect and return- (URT, 2006; URT, 2002). The contents of human right to water go beyond distance and time by adding the design of facilities to suit older persons, children, person with disabilities, and to be located in safe and sound areas in terms of physical security (The UN Special Rapporteur, 2014).

### 2.3.2. Water quantity

Water quantity entails the sufficient and continuous quantity of water for personal and domestic uses including drinking, personal hygiene, washing of clothes, food preparation, and house sanitation supplied per capita per day (The UN Special Rapporteur, 2014). A person, regardless of being in rural or urban areas, is considered to have optimum access to water in terms of the quantity when he uses between 50 and 100 litres per day (WHO, 2008). In rural areas of Tanzania, a measure of access to water, in terms of quantity, considers an optimal water access when a household is using a minimum of 25 litres of water per capita per day through water points located within 400 meters from the furthest homestead (see **table 2-1**). However, the actual water use ranges from 5 litres per capita per day in acutely water scarce areas to 30 litres per capita per day in other areas (United Republic of Tanzania, 2002).

#### 2.3.3. Affordability

Affordability in water system as a global indicator compares the annual household's water expenditure with total annual income (Hutton, 2012). However, this indicator does not take into account some key household financial recurrent costs such as for water treatment. According to Hutton (2012), affordability criterion is economically expressed by an *affordability index* comparing the household's monthly water cost to its disposable income or expenditure with the implication that the price paid to water services must not limit people's capacity to buy other basic goods and services guaranteed by other human rights (The UN Special Rapporteur, 2014). In simple meaning, households must not be forced to make trade-offs between basic water and other basic needs such as food consumption or medical care costs (Langford and Winkler, 2014). According to Smets' study (as cited in Hutton, 2012) the affordability index used in developed countries is 3 to 4 percent of disposable income of poor households while in Africa the index ranges from 2.8 for median households to 7.5 per cent for poor households. With regard to the index set by international agencies, UNDP use 3 per cent, the World Bank 5 per cent, and African Development Bank (ADB) 5 per cent of expenditure on water services (see **table 2-1**).

#### 2.3.4. Service availability and reliability

Availability and reliability requires that sufficient water is supplied daily to meet people's needs now and in the future. The UN handbook for water as a human right provided further that, water should be available and reliable not only at the household level, but in all places where people spent significant amount of time including; health and educational institutions, workplaces, markets and other public areas (The UN Special Rapporteur, 2014). In Tanzania, the policy directs that water should be available in sufficient amount of at least 25 litres per person daily (United Republic of Tanzania, 2002) although its implementation is still a challenge owing to rapid population growth in relation to existing resources capacity constraints.

#### 2.3.5. Quality and safety

Water required for each personal or domestic use must be of a quality that is safe and free from micro-organisms, chemical substances and radiological hazards that constitute a threat to a person's health (UNDP-IUCN, 2004; The UN Special Rapporteur, 2014). According to UNDP-IUCN (2004) the WHO guidelines for drinking-water quality provide a basis for the development of national standards that, if well implemented, will ensure the safety of drinking water. And with JMP's definition water is considered to be safe only when is collected from an improved source (WHO and UNICEF, 2012). However, this is not always the case as water may become contaminated before it reaches the tap. Yet, due to diverse context and condition across countries, measures to ensure the supply of water quality are usually defined by national or/and local standards depending on the situation of the country. In Tanzania, local service providers at the point of water production are responsible to determine water quality (United Republic of Tanzania, 2013).

#### 2.3.6. Acceptability

Acceptability is crucial in determining citizens' access to water since water supply facilities might not be used if they fail to meet the social or cultural standards of the people they are meant to serve. That means all water supply facilities must be socio-culturally appropriate and sensitive to gender. For instance, gender appropriateness of water sources may be about technological design of the source or other access dimensions such as insecure location of the source and others (Masanyiwa et al., 2014). Also, water must be of an acceptable odour, taste and colour to meet all personal and domestic uses (The UN Special Rapporteur, 2014; John et al., 2004).

**Table 2-1** highlights dimensions and standards used by different institutions, particularly in Tanzania and in global context, to determine and measure the progress of citizens' access to water.

Table 2-1: List of institutional indicators and standards for optimal citizens' access to water

| Indicators/dimensions | Standards | Institution |
|---|---|---|
| Physical accessibility | 0-1,000 m and not more than 30 minutes | WHO/UNICEF |
| | 0-400 metres or within 30 minutes<br>0-500 metres or within 30 minutes | URT<br>NBS |
| | Location with physical security | UN (Human rights) |
| Functional WP Density | 1 water point per 250 people | URT |
| Quantity of water | 50-100 litres per day/person | WHO |
| | >= 25 litres per day/person | URT |
| Reliability | 24 hours per day | WHO/URT |
| Affordability | 5% of disposable income | World Bank/ADB |
| | 3% of disposable income | UNDP |
| Quality and safety | WHO standards<br>Acceptable odour, taste and colour | WHO, IUCN, UNDP |
| Acceptability | Locality social or cultural standards | UN (Human rights) |

## 2.4. Approaches to measure water access

One of the current discussions in measuring water access, as an intangible concept, is on methodological approaches used across countries and among stakeholders. However, it is obvious that the measurement of water access as a concept depends on the explicitness and precision of its definition, thus selection and development of indicators for measuring the concept is indispensable. Nevertheless, the precision, validity and reliability of indicators adopted to measure water access is directly linked to the availability of accessible, accurate, reliable and routinely collected and updated data (Ricard Giné-Garriga, de Palencia, and Pérez-Foguet, 2013). That means, the approaches towards measuring water access is centrally connected to available data types, collection tools and methods, and scale of measurement.

### 2.4.1. Data for indicator development, selection and use

The development and use of indicators certainly links to the availability of data. Without the basic ingredient of good-quality datasets with proper scale of measurement, it is simply not possible to produce reliable and robust indicators, though in some cases innovative methodology and analytical techniques can help to ameliorate and overcome some of the problems (Wong, 2006). Tanzania in particular, lack of quality and reliable data that are routinely collected, disseminated, and updated on rural water supply was mentioned as one amongst the biggest challenges in water sector (Mwamwaja, 2014). However, a number of studies have been carried out and outline a number of different techniques and tools in order to address data challenges including issue of unavailability, unreliability, and of outdated data (Ricard Giné-Garriga et al., 2013; Wong, 2006; Mwamwaja, 2014). Example of outlined tools and techniques include Water Point Mapping (WPM), the Rapid Assessment of Drinking Water Quality (RADWQ), and the Water Safety Plans (WSP). In terms of data sources, the studies advocate the use of data from household survey as well as census data since reliance on improved methods and survey data generally produce a more accurate picture than counting the number of constructed facilities (Langford and Winkler, 2014).

### 2.4.2. Indicators development and selection

The measurement of many abstract concepts, for instance measuring access to water, is not underpinned by theoretically sound or policy-focused frameworks (Sawicki, 2010), thus it is becoming increasingly difficult to ignore the question marks over the choice of indicators in measuring citizens' access to water. The methodological criteria behind the 2001 MDGs framework for instance, focus on simplicity, measurability, and achievability in setting goals and targets, on statistical criteria for selecting indicators. However, the criteria were criticized being insufficient and that they are applied unevenly in practice (Fukuda-Parr et al., 2014; Langford and Winkler, 2014). In recognizing some criticism of the MDGs, and setting out new criteria for targets and indicators, the "Lessons Learned" report (as deduced in Fukuda-Parr et al., 2014) suggests that targets should among other criteria include both absolute and relative changes, be quantifiable and time-bound, be ambitious but achievable, and be set in consultation with country teams. The report contends further that "outcome-based indicators" are preferred to "process indicators" that means the goals should focus on ends, not means. And the effective indicators are those that are amenable to disaggregation to reveal inter-group disparities and the possible presence of discrimination, measurement of fluctuations that can capture vulnerability and insecurity, and the potential to advance data creation and collection (Fukuda-Parr et al., 2014). On the move towards Post-2015 SDGs, the UN OWG on SDGs (United Nations-SDSN, 2014) proposed that a robust indicator should, among other things, be: clear and straightforward, consensus based in line with international standards, constructed from well-established data sources, disaggregated, universal, outcome-based (but only if possible), and managed by a designated organization. However, the use of indicator criteria, such as data availability and measurability, as a "veto" over goal and target selection is more likely to exclude many human rights and human development concerns (Langford's 2012 as cited in Fukuda-Parr et al., 2014).

### 2.4.3. Scale of measurement and up-to-date spatial data

The choice of a spatial scale appropriate to the problem is very critical and is constrained by the existing statistical data. There is always a trade-off between the amounts of data available and the use of more appropriately defined spatial units (Wong, 2006). For instance, administrative boundaries are often used as a framework for data compilation, but they may not correspond to the ideal spatial scale of measurement for the concern at hand. In order to minimize the problems of ecologically misleading outcomes, the use of small-area units and low levels of aggregation is suggested. For instance, in Malawi WaterAid practical experience three spatial units of population were used including the census Enumeration Area (EA with population of 500-2,000 people), the Traditional Authority Area (TA comprising an average of 19 EAs), and District Area (comprising of 10 TAs) (Stoupy and Sugden, 2003).

## 2.5. Water access indicators practice

Indicators practice in this case entails the operationalisation of indicators to measuring citizens' access to water. The operation of coverage indicators, on the WPM and Geographic Information (GI) Systems platforms, has impacts on citizens' access to water. The coverage indicator and WP density indicator use data from WPM system to provide useful information for planning, management and reporting on sector-development interventions across the country (Stoupy and Sugden, 2003). In order to ensure, not only the policy usefulness of indicators, but also their effectiveness several researchers have advocated the need to *institutionalise indicators* (Innes, 1990; Wong, 2006). According to Innes (1990, p.232), institutionalisation refers to the setting up of routine procedures and practice to enhance the continuing existence of an indicator and to legitimise the method and concept of the measure. Wong (2006) stressed further that regularising or "standardising" the methods and concepts of measurements prevent haphazard adjustment or manipulation of data (Witten, Exeter, and Field, 2003; Barifashe, 2014).

### 2.5.1. Water point mapping

Water point mapping as explained in the earlier sections is the tool for collecting accurate data on water point functionality whereby the geographical positions of all water points in a particular location are gathered with their respective technical and demographical information. This information is collected using GPS and a relevant questionnaire located at each water point. The data is entered in GIS package and then linked with available demographic, administrative and physical data. Then the functionality coverage information for each water point is displayed through digital maps for further actions including planning purpose and as input to inform sector-decision making. This methodology can be used to determine 'physical' access indicators constructed from the lowest geographical level using the available data (Jiménez and Pérez-Foguet, 2008b) and be useful for monitoring the distribution and status of water points.

### 2.5.2. Water points functionality

Functionality of the service is a very broad and complex concept. With respect to water system and the scope of this study, the definition adopted describes water point functionality 'in terms of distribution and coverage' of public water points to provide reliable and adequate water supply services in the long term (Jiménez and Pérez-Foguet, 2008b). Other studies consider a water point to be functional if it yields good quality water or has no technical problems even if water is seasonally available, on the contrary water point is not functional if does not provide water for more than six months of the year (Mwamwaja, 2014).

### 2.5.3. Water point coverage (WPC)

With regard to this indicator, citizens' access to water is usually defined as the ratio between the number of people served by each water point and the maximum distance travelled by users to reach it for the service. In Tanzania, this ratio means 250 persons per outlet within a distance radius of 400m from the furthest homestead (United Republic of Tanzania, 2006) and within 30 minutes of time spent on collection of water. This implies that a citizen is considered to have an optimal access to water, only if is within a distance of 400 m from the water point or spends 30 minutes of time to fetch water. In analysing the practice of WPC indicator, different methods have been used by different authors. For instance, Barifashe (2014) used proximity-distance analysis while other studies such as of Witten et al. (2003) used network analysis to examine accessibility of community resources to users (Witten et al., 2003). The later method is more appropriate where the network of roads and access ways are well defined to enhance the analysis.

### 2.5.4. Functional water point density (FWPD)

The indicator under this particular method measures water access in terms of "density or distribution of only functioning water points per population". It basically computes water access as the number of water points in a particular area divided by population (within that area) expressed in number of water points per 1000 people (for an empirical case example see Stoupy and Sugden, 2003). Basing on this method, in Tanzania for instance, an area is considered to have optimal access to water if its density is at least 4 WP per 1,000 people (United Republic of Tanzania, 2002). This approach helps to compare and reveal the difference in the distribution of water points between different levels of geographical units of measurement. For example, in Malawi case study the indicator was used to compare water point densities between EAs within the traditional authorities, and EAs within the district (Stoupy and Sugden, 2003).

## 2.6. Conceptual framework of the study

The selection of indicators not only certainly links to available data and policy objectives, but also incorporate both objective and subjective attributes in development and interpretation (Wong, 2006). Various contemporary studies (e.g. Jimenez and Perez-Foguet, 2008; Giné-Garriga et al., 2013) contend that the effective indicators operation, particularly for planning and reporting, is centred on WPM system which provides reliable and updated information on water points functionality status. Such indicators practice enables the monitoring and improvement of water supply services which is considered as the central realm for measuring citizens' access to water. **Figure 2-1** presents the framework that shows the main concepts and elements (as detailed explained in earlier sections) on selection, use and practice of indicators to measuring citizens' access to water and it highlights the relationship between them.

However, it is contended that the actual level of access to water is determined through both the physical access or service coverage as well as actual use of supplied water were satisfaction on provided service in terms of water quantity, reliability and affordability is derived (Nganyanyuka et al., 2014; Barifashe, 2014; and Kayaga et al., 2009). That means the consideration on citizens' satisfaction to water access in terms of both proximity and actual use is of great significance. Nevertheless, such relationships as possible explanations need to be examined to develop empirical findings to see whether the framework provides a useful organization of ideas to enhance our understanding about measuring citizens' access to water.

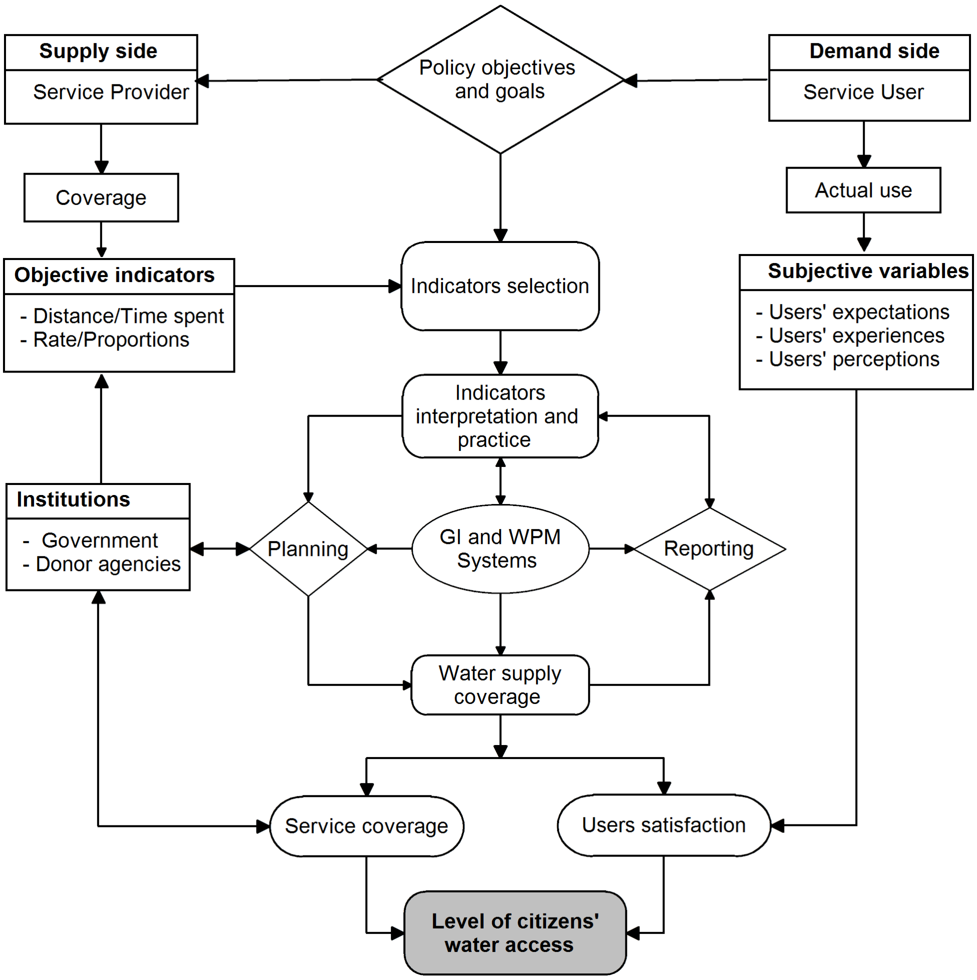


Figure 2-1: Conceptual framework for measuring citizens' access to water

# 3. METHODOLOGY

## 3.1. Introduction

This chapter describes the approaches, methods, techniques and tools used to conduct this research. The research employed a case study design where Kiromo and Zinga wards in Bagamoyo district were selected for study. The strategy to operationalize research questions adopted a mixed methods approach whereby both qualitative and quantitative methods were employed in data collection and analysis to enhance the validity and reliability of the results. The application of mixed approach in this study was justified by the nature of research questions and on triangulation argument that qualitative and quantitative research might be combined to cross-check findings in order that they may be mutually corroborated as argued by Bryman (2012). It also presents the methods used to collect both primary and secondary data in order to acquire a deeper understanding on the selection and use of indicators in measuring citizens' water access.

## 3.2. Description of study area

### 3.2.1. Location and administrative structure of the study area

Bagamoyo is one of the six districts of Coast region one among the 30 regions in Tanzania sharing border with Indian Ocean in the East, Dar es Salaam region (Kinondoni district) and Kibaha district in the South, Morogoro and Tanga regions in West and North respectively (see **figure 3-1 'A'**). It lies between latitude 38 to 39 degrees South and longitude 6 to 7 degrees East. The district has a tropical climate with temperature ranging from 13 to 30 degrees of centigrade and annual rainfall ranges 800mm to 1200mm. It covers an area of 9842 square kilometres of which 8.7 percent (855 square km) is covered by water (ocean and rivers) and the remaining 91.3 percent (8987 square km) is dry land. According to 2012 National Population and Housing Census, the district had 311,740 inhabitants with an estimated annual growth rate of 3 percent. The district is divided into 16 administrative wards including Kiromo and Zinga wards where the study was undertaken (**figure 3-1 'B'** and **'C'**) (NBS, 2014b).

### 3.2.2. Selection of sub-areas for study

The household survey was conducted in four selected sub-villages in Kiromo ward and one sub-village in Zinga ward as representative of the whole area. Therefore, household survey was conducted in a total of five selected sub-villages including Kiromo 'A', Kiromo 'B', Chaga 'A', and Mbuyuni in Kiromo and Mandawe sub-village in Zinga. The selected study areas were chosen purposively, for addressing my research questions, based on the following factors:

- In a particular case, the selected sub-study areas are representatives of rural areas where the main infrastructure of public service and utilities, such as the main Dar es Salaam Water Supply and Sewerage Corporation (DAWASCO) water pipe, are passing through them and thus citizens get service from the infrastructures.
- They are archetypal and epitomize a broader category of rural-setting served by the National Rural Water Supply Programme (NRWSP), market oriented water agencies (DAWASCO) as well as civil societies but with relatively different physical and socio-demographic features.
- The existing variability in physical and socio-demographic characteristics between the study areas. For instance, Kiromo 'A' and 'B' are sub-villages along the main Bagamoyo road where the centre

of Kiromo ward is located and thus sheltered by a number of socio-economic activities. On the other hand, Mbuyuni, Chaga and Mandawe sub-villages are relatively further away from the main road as well as village centres and thus relatively less covered by socio-economic activities.

- Easy accessibility to and within the study areas by different modes of transport since the main Bagamoyo road from Dar es Salaam to Bagamoyo town is passing through them.

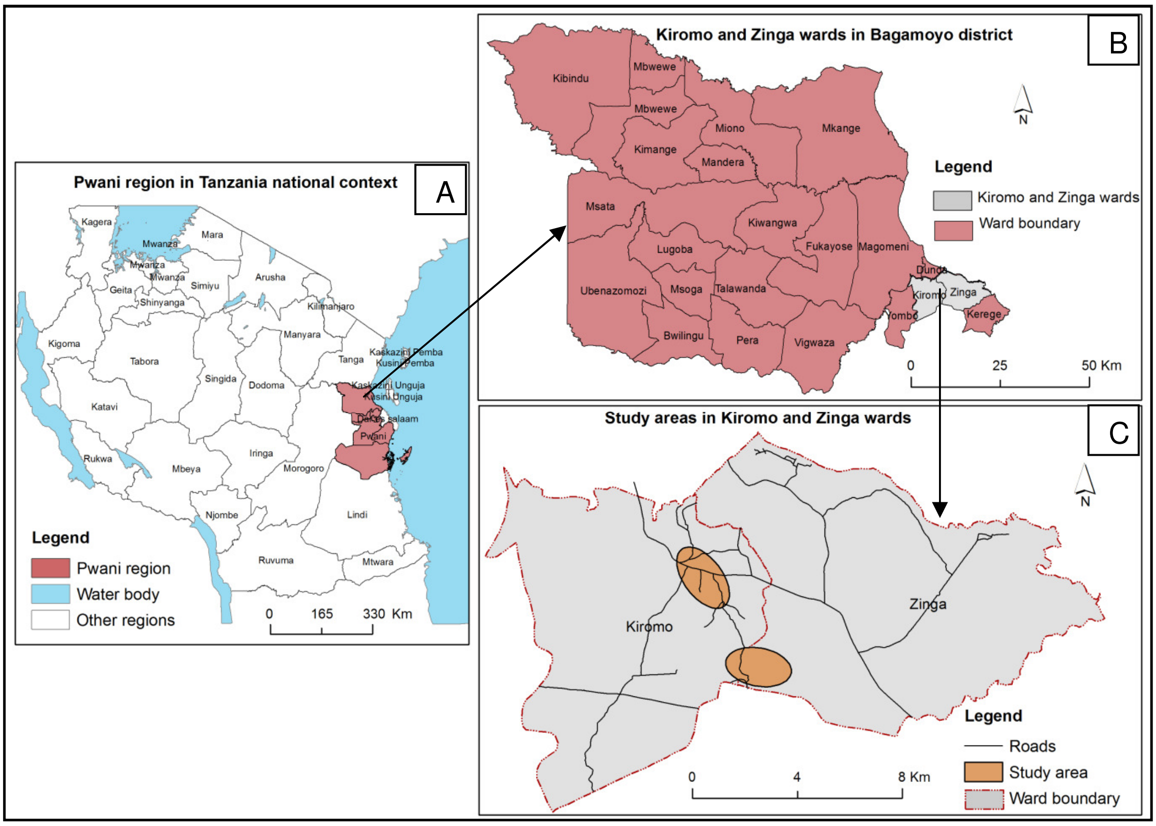


Figure 3-1: Location maps of study areas in the country (A), district (B) and ward context (C).

### 3.2.3. Housing conditions

The common main buildings used by households for dwelling are of two major categories, modern and local houses based on building materials used in construction of walls, floor and roof (**figure 3-2**). Whereas, majority of modern houses were walled by cement bricks, roofed by iron sheets and the floor covered by cement, the local houses were constructed by poles and mud, roofed by grasses and the floor covered by earth, mud or sand.


Figure 3-2: Traditional (A) and modern (B) housing typology as found in Kiromo villages (October, 2014)

#### 3.2.4. Physical infrastructure and services

Kiromo and Zinga wards are covered by different infrastructure and utilities such as roads, water supply, electricity, telecommunications as well as services including schools, health centres, and others. The area is passed by the main Bagamoyo road which connects Bagamoyo district to Dar es Salaam region. It also covered by a number of unclassified roads and footpaths which connect to the main road, particularly where the village centres are located. In terms of water supply infrastructure, the main DAWASCO water pipe that transport water from the source, Ruvu River, to Dar es Salaam region is passing through the area, and thus area is provided with piped water connections as well as public water points.

#### 3.2.5. Population characteristics

Kiromo ward has four villages and according to 2012 census report the ward had a total population of 7,279 inhabitants and 1,944 households while Zinga ward had a total number of 11,189 inhabitants and 2,829 households. They both had an average household size of 3.7 with annual growth rate of 3 percent (NBS, 2014b).

### 3.3. Field data collection

Primary and secondary data were collected to search out a deeper understanding on issues pertaining to citizens' water access in Tanzania, particularly in rural areas. Whilst primary data involved households questionnaires, interviews with key informants, observation and mapping, secondary data was collected through documentary review of academic publications, government reports and archives such as census materials, national policies, and other relevant case reports. Data was collected on two levels namely the district and the sub-village levels within 17 days duration (i.e. from September 29 to October 15, 2014).

#### 3.3.1. Sampling design

Prior to field data collection the design of sampling strategy to determine the target population for survey in the study area was on hand where points indicating representative sample for households surveyed were generated on satellite image base map as sample frame, then simple random sampling was done. However, the implementation of that strategy, particularly maintaining the households list on the ground appeared not feasible to researcher owing to factors including time and resources (funds and equipment) limitation for field data collection as some samples found to be very far apart. Therefore, alternative household sampling method commonly known as EPI (Expanded Programme of Immunization) sampling method, which does not require detailed sample frame, was opted for. The EPI method has been used in situation where representative samples in household surveys are often difficult to obtain or implement, particularly in low-income countries (Bostoen and Chalabi, 2006). By means of EPI method and the aid of ArcGIS collector, an application installed in an Android tablet, a number of clusters (sub-villages) were chosen with a probability proportionate to their size, population wise, (although the administrative boundaries were fuzzy) and then an equal number of selected households were surveyed in each of the selected clusters (sub-villages). Using the digital prepared uploaded Bagamoyo satellite image base map overlaid by existing water points, a location near the centre of each sub-village was selected then a random direction and a random household along the chosen direction pointing outwards from the centre to the boundary of the sub-village were subject to the survey. The survey was systematically conducted after every five households from the preceding surveyed household. The steps were carried out iteratively until the required number of households was surveyed (see *Appendix 1*). The study population in this case were households living in study areas, while a sampling unit was an individual household. A total of 40 households were surveyed in four sub-villages through the prepared questionnaire.

#### 3.3.2. Construction of questionnaires and guide for semi-structured interviews

The questionnaires for households' survey aimed at primarily exploring the socio-demographic situation of selected households in Kiromo and Zinga and their experience and perceptions on access to water supply service. Owing to time limitation and easiness in processing (Bryman, 2012), most of the questions involved were of closed type question with exception of some few open questions (see *Appendix 2*). On the other hand, the guide questions for semi-structured interviews with official responsible for rural water supply and statistics in the Water Ministry, Bagamoyo District Water Engineer (DWE) and the National Bureau of Statistics (NBS) aimed at collecting information on water access indicators practice (see *Appendix 3*). The interaction with local leaders aimed at getting more insight on different issues about community initiatives and strategies towards Kiromo and Zinga citizens' access to water. **Table 3-1** gives an overview of main types of questions used for household survey and key informants. Despite that water quality is necessary to ensure that water-borne disease transmission is minimized or eliminated, it was not included in my questionnaires with the reason that it requires laboratory assessment or someone with the appropriate skills and experience. However, the issue of water quality was raised by a number of respondents during survey and thus considered and presented in highlights.

Table 3-1: Main aspects in households' survey questions and semi structured interviews

| For household survey | For key informants interview |
|---|---|
| Household's socio-economic status | Key aspects in determining water coverage |
| Main and alternative source of water | Types of data they collect |
| Proximity to water source (time spent) | The use of collected data |
| Water supply reliability and convenience | Methods and techniques used |
| Quantity of water used | Citizens involvement |
| Affordability | Their opinions on sector performance |
| Perception on level of water access | |

#### 3.3.3. Primary data collection

The field primary data were collected in two levels namely case level through household survey and district to national level through key informant interviews. And different steps, methods and tools were employed as explained below.

**i. Training of survey assistants and questionnaire testing**

After being authorized by Bagamoyo District Council to conduct my research in Kiromo and Zinga ward, one field assistant was trained on how to administer questionnaires in Swahili language as well as mapping and survey testing run. Through that process weaknesses in some questions particularly in language translation (English to Swahili) were identified and reformulated so as to enhance their effectiveness as well as reduce loopholes for non-response cases.

**ii. Household survey**

The questionnaire based household survey was done through the prepared questions. A total of 40 households were surveyed where by 65 percent of respondents were females. Out of 40 surveyed households, 9 households were from Mandawe sub-village, 11 Kiromo 'A', 10 Kiromo 'B', 6 from Chaga, and 4 households from Mbuyuni sub-village (see *Appendix 1*) depending on a probability proportionate to their size as explained in earlier section and diversity in richness of features to be explored including the installed public water points. The interviews were recorded by digital audio recorder for responses cross-checking as well as widening the probability of capturing information beyond the asked closed questions.

The household survey focused on getting information particularly on socio-demographic characteristics of the households, and exploring citizens' perception and attitudes towards the practice of water access indicators, and service satisfaction.

**iii. Observation and mapping**

Observation and mapping of houses interviewed and water sources, both main and alternative, used by the respective household was carried out. Non-participant observation, photo and note taking were used throughout the field data collection period to ascertain availability and use of water sources and other relevant information on subject matter. In mapping exercise both 'ArcGIS collector software' and handheld GPS were used to pick coordinates of the respective mapped features including the houses surveyed and coordinates for water sources mentioned by respondent as main source as well as their alternative sources. In addition, some physical features such as physical housing condition were observed in the field as proxies for socio-economic status of the respective household interviewed.

**iv. Key informants interviews**

Semi-structured interviews with officials from different relevant institutions were conducted on different dates. The interviews involved the Principal Civil Technician and WPM Trainer of Trainers from the Ministry of Water-division of Rural Water Supply, Environment and Statistics Analysis Manager from the National Bureau of Statistics, and Principal Water Technician (by-then acting District Water Engineer) from Bagamoyo District Council. The main aim was to acquire a thorough understanding on how water access indicators are practically operated, reported and whether subjective attributes, including users' perspectives on water access are taken into consideration during data collection on water coverage. Having conducted some household interviews and get some ground facts, a number of questions in key informants guide questions were fine-tuning accordingly. The questions were left to officials and appointments for interview arranged on other days so that to provide them space for interview preparation except for NBS official where interview was conducted on the same day of the first meeting.

### 3.3.4. Secondary data collection

Given the scope, time and resource constraint for primary data collection, secondary information are of great value as they can solve the mentioned limitations, be useful to supplement or cross-check primary data, and sometimes reanalysis of them may offer new interpretation although control over data quality is always questionable (Bryman, 2012). Secondary data was acquired though systematic literature review, case study documents review as well as from digital sources such as WPM database.

**i. Systematic review**

Systematic literature review is a replicable, scientific and transparent literature review focused on a research question that tries to identify, appraise, select and synthesize all high quality research evidences relevant to that question (Bryman, 2012; Wikipedia, n.d.). In this study systematic review was carried out to get an overview that summarize the balance of evidence on theoretical definitions and methodological questions regarding water access indicators development or selection, use and practice in determining citizens' access to water. The approach comprised the following sequence of steps;

- Define the purpose and scope of the review; the purpose was to get an overview on water access theoretical definitions and methodological approach in water access indicator practice within developing countries.
- Develop a set of inclusion and exclusion criteria with a search strategy; only journal papers on developing countries context, Tanzania policy reports, online published materials, grey literature and other unpublished reports about water access indicators in developing countries were considered for review.

- Select studies for review; relevant studies to the scope and purpose of the review were selected.
- Analyze each study and synthesize the results; selected studies were analyzed and synthesized as presented in chapter 1 and 2.

**ii. Documents review and digital sources**

Secondary data about the case study and water access matters was obtained particularly from Bagamoyo district council water projects reports. From the Ministry of Water booklet on ‘water policy in simple language through cartoons’ (as translated by author from Swahili language *“Sera ya maji katika lugha nyepesi kwa njia ya katuni”*) and other documents on subject matter were obtained. Other acquired data from visited offices included Household Based Survey (HBS) dataset (*.csv format*) of 2011/12 for Coast region and Tanzania wards shape files were acquired from NBS office and website in digital format respectively. Also WPM database of 2011 was acquired from the Ministry of Water official website. Although we highly demanded 2012 socio-economic census dataset and Enumeration Areas (EAs) administrative boundaries shape files from NBS but we failed to get them because they were yet to be officially published and NBS officials were still working on them. Also, the author actively participated (by asking questions) in online Rural Water Supply Network (RWSN) Webinar workshop of November 18, 2014 which was about "Water Point Mapping in Tanzania: a reality check", from this workshop the author acquired more insight on the context of WPM in Tanzania.

## 3.4. Data preparation and analysis

### 3.4.1. Data processing

Prior to analysis the collected data were processed and transformed into feasible formats for further computer-based analysis. The phase involved tasks including audio transcription, data entry in different software packages and coordinates transformation. In data entry, the household questionnaires responses were firstly coded, and then the variables names and types from each question was identified and entered in the Statistical Package for Social Science (SPSS). Next to it, the coded value for each response of the respective question was entered in SPSS to create a dataset. The audio-recorded key informant interviews were transcribed into text using Express Scribe Transcription software (v 5.69). Then, the transcribed interviews, particularly from household survey, were visualised through Wardle- a web-based application- to get an insight into the transcribed opinions. Also, the coordinates picked by ArcGIS collector software was manually extracted (after the failure of application to synchronize picked coordinates) and entered in Ms. Excel sheet. Since, the coordinates picked by handheld GPS were in ARC1960 while those picked by collector app were in WGS 1984 then coordinates transformation to one system was done through ArcGIS to avoid shifting of points. The system opted for was WGS 1984 so that base map such as satellite image, topographic or open street maps can be used for updating and visualization.

### 3.4.2. Data analysis techniques and tools

The collected data was analysed through two main approaches namely statistical analysis using SPSS and Ms. Excel, and Spatial analysis using ArcGIS.

**i. Statistical analysis**

The main statistical techniques used for analysis, depending on the type of variable, fall under univariate (analysis of one variable at a time) and bivariate (analysis of two variables at a time) analysis (Bryman, 2012). I used the former to describe the basic features of my data in a case study by producing simple summaries or descriptive statistics about the sample in terms of frequency tables, graphs and charts, measures of central tendency (e.g. mean, median and mode), and measures of dispersion for ratio data such as range and standard deviation. Bivariate analysis was used to find out whether two variables of interest among the variables were related. Under that analysis approach, cross tabulation was used to simultaneously analyse relationship between pair of variables for instance, water source types and water uses. And Chi-square (X2) test was applied to contingency tables to establish how confident the relationship between the two variables in the population can be. In line with the contingency table and Chi square test, Phi (Φ) and Cramer's V statistics were used for the analysis of the relationship between two dichotomous variables (for example gender) and of nominal variables respectively. One-way Analysis of Variance (ANOVA) was also performed to compare means on variables including distance and quantity of water consumed. A multiple linear regression was run to identify the variables associated with water users' satisfaction.

**ii. Spatial analysis**

The processed data were exported to ArcGIS for spatial analysis and visualization. The main analysis done based on proximity and density type of analysis. However, some of intended spatial analysis was not undertaken due to delay and lack of data from the institutions concerned. For instance, lack of road network shape files for network analysis from the Ministry of Infrastructure as well as delay of population census data (EA-level shape files) from the NBS (the office is still working on them) for population density analysis. Though, instead of population data, housing units were digitized from the satellite image and used as proxy for population. In terms of water points distribution density, the densities of functioning water points across the area were analysed through point density analyst tool, where by the geo-referenced water points in WPM dataset where used as input features and served population as field of analysis. Then water point distribution density was visualized using the new added field (WP density) to see the distribution pattern across the study area.

To analyse the served, underserved and over-served areas, the spatial distribution of water points service coverage in the study areas was mapped and a benchmark of 400 meter distance was used for analysis. The used standard of 400 meter, as a maximum distance from a particular water point to the furthest household, is the national benchmark to determine the service coverage of each water point. Proximity analysis, vector analysis in particular, was done to find out the distance from functional public water points to users dwellings. To facilitate the analysis, buffer and near tools were both used to find out how many households were served by a particular water point within a radius of 400 meter which is the service coverage of that particular water point. Also, Euclidean distance under raster spatial analyst tools was applied to visualize the spatial pattern of areas covered within a distance of 400 meter from the water points and thus analyse the under-served areas. From the spatial analysis, joins and overlays between different layers were done for comparison, and then the pockets of underserved and over-served areas across study area were identified.

## 3.5. Remark

Although the study is based on a small sample of respondents, the current empirical findings add to a growing body of literature on citizens' water access, particularly in rural areas where multi-water supply service providers operate in parallel. That means, with the context of the study area caution must be applied as the findings, from that particular study, might not be extrapolated to other rural areas of Tanzania where the public is the sole provider of water supply services through communal water schemes. Nonetheless, the findings from this study may be transferable to rural areas with similar characteristics and features to Kiromo and Zinga wards where the so referred to as 'triangular interaction' between the state, civil society and market forces in water supply service provision exist in parallel.

# 4. THE CONTEXT AND PRACTICE OF MEASURING WATER ACCESS IN RURAL TANZANIA

This chapter presents findings and discussion on 'how the government and other water sector-related agencies in Tanzania measure citizens' access to water' particularly in the context of rural population. It discusses the central question of "who counts what and how" through examining the practice and performance of water access indicators by the Ministry of Water, National Bureau of Statistics as well as the role played by development partners.

## 4.1. National rural water supply

In 2006, the government of Tanzania adopted the National Rural Water Supply Program (NRWSP) for the period of 2006-2025 so as to meet the national goals and MDG target 7 and beyond. The overall goal of NRWSP in Tanzania is to improve health and alleviate poverty of the rural population through the provision and sustainable use of water to achieve the Ministry's Medium Term Strategic Plan (MTSP), National Poverty Reduction Strategy (NPRS), the MDGs as well as the Tanzania Development Vision (TDV) 2025 targets (United Republic of Tanzania, 2013). The target behind the goal is to provide a cost effective and efficient service that meet specified levels of service corresponding to the protection of public health, the ability to pay for the service and equity considerations. The strategies adopted to reach the targets, as stipulated in the United Republic of Tanzania (2006), included the following;

- To provide a daily minimum of 25 litres per person per day for consumers with yard or pipe connection or connection within house compound.
- To provide at least 25 litres per person per day through water points, public taps or water kiosk within 30 minutes time for a round trip.
- To ensure that any water point can be used by a maximum of 250 persons at not more than 400m from the furthest user, and within 30 minutes time for a round trip to collect water.

However, although the government of Tanzania is highly responsible for provision of water services in rural areas but the sector is heavily dependent on external donors. Nevertheless, the traditional and formal water supply services in rural areas are provided by Community Owned Water Supply Organizations (COWSOs) as they are entitled by the government to manage public rural water schemes. The role of COWSOs is to operate and maintain rural water supply systems on behalf of the community while expected to meet all the costs of operating and maintaining (O&M) their water supply systems through charges levied on water consumers -on the basis of cost recovery mechanism- (United Republic of Tanzania, 2006). Yet, the current practice shows that in many cases both formal and informal water supply services operate in parallel and have a noticeable contribution towards the sector performance (Nganyanyuka et al., 2014).

In order to improve the provision of water and ensuring water is available for productive activities through integrated water resource management for socio-economic development the government instituted the Water Sector Development Programme (WSDP) in 2007. The WSDP based upon the NRWSP, but the former include also urban water supply and water resources management and is currently the biggest program in the sector.

### 4.2. Rural water supply coverage and access

The adoption of WSDP has led to a significant increase of financial resources to the sector. Through its "quick-win subprojects", an additional of 8, 285 water points have been installed providing water supply to over 1.89 million additional beneficiaries and thus water supply coverage[3] in rural areas increased from around 55 percent in 2007 to 57 percent in 2012 (**figure 4-1**). And number of people with access to water supply service increased from about 21.5 million in 2007 to 22.4 million in the year 2012. That means in order to meet the national target, under NPRS II (MKUKUTA in Swahili), of reaching 65 percent by June 2015 as well as MDG target of 74 percent by 2015 much effort were needed to cover the remaining 8 and 17 percent of people without access to water service respectively. However, though too ambitious, if the BRN initiatives, with the target of covering about 15.4 million people, were to be implemented in 2013/2014 then the NPRS II and MDG target would have been met by 2015 (United Republic of Tanzania, 2013). Nonetheless, the decline in coverage from 58.7 percent in 2009 to 57.8 percent 2010 was observed and the likely reasons being rapid increase in population far above the amount of new installed water points, breaking down of water points, and the discontinuation of quick-win sub-projects. On the other hand, the coverage statistics, as estimated from survey data compiled by the National Bureau of Statistics (NBS), showed an increase in coverage from around 40 percent in 2008 to 47.9 percent in 2011 (United Republic of Tanzania, 2012), which is less than the coverage (57 percent) of the same year provided by the Ministry of Water (MoW). Such variation in coverage statistics provided by MoW and NBS, as can be deduced from **figure 4-1**, might be due to existing discrepancies in the data collection approaches adopted by the concerned institutions as will be discussed in the coming sub-sections.

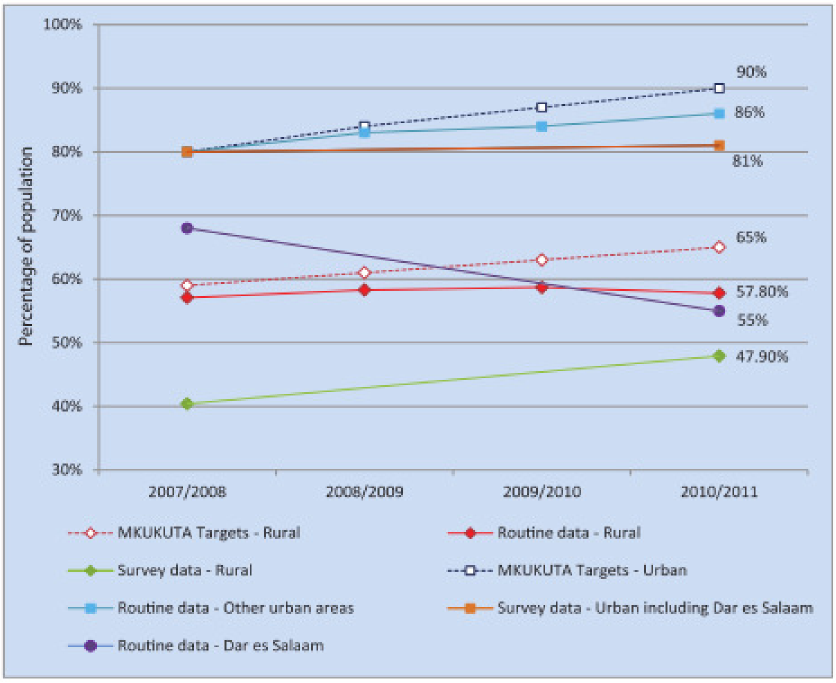


Figure 4-1: Proportion of population with access to public water supply in Tanzania and MKUKUTA (NPRS) targets by year 2007-2011 (adapted from United Republic of Tanzania, 2012, p.73)

### 4.3. The role of civil society and development partners in rural water access

The civil society organizations and international donor agencies also have a remarkable contribution to the performance of water sector, rural water supply in particular. In 2008, civil society organizations,

[3] Water supply coverage as estimated by Functional WP Density method where by coverage is calculated as the standard number of people served per water point (250 people as defined in national water policy) multiplied by the number of functional water points, regardless of distance from dwellings to the water point and expressed in percentage.

particularly donor agencies, established a national network known as Tanzania Water and Sanitation Network (TaWaSa.Net) to strengthen their capacity working with all other stakeholders within water sector in Tanzania and securing that policies are implemented in an equitable way and good practice in the water sector is promoted (TaWaSa.Net, n.d.). Among the active Non Government Organizations (NGOs) in the water sector are the WaterAid, the Netherlands Development Organization (SNV), Concern Worldwide, Plan International, and the World Wide Fund (WWF). The government receives financial and technological external support from several donor agencies through the Development Partners Group (DPG). For instance, the WSDP is co-financed by the government of Tanzania, the ADB, World Bank, Dutch government, and other financiers, and it valued at a total cost of about USD 2,891.7 million to be invested over 2005-2025 time frame, wherein around USD 1,832.0 is from external financing (MoW, 2006). Also, the Dutch government through the SNV in collaboration with WaterAid provide support in improving the functionality of existing rural public water points through Water Point Mapping system (MoW, 2013).

## 4.4. The current practice for measuring rural water access

The current practice shows that the government of Tanzania uses multiple data sources and methodological approaches for measuring the goals (both national and global) progress and impacts of rural water supply interventions on citizens' water access. Principally, data for monitoring water access are collected by the MoW and NBS. However, in some circumstances data from commissioned organizations such as research and academic institutions also contribute to the monitoring of the national goals and targets as well as of the MDGs. The methodological approaches adopted by the two institutions are as explained in the following sub-sections.

### 4.4.1. Data sources, types and collection approaches

The estimates of water access are derived from data collected through two primary systems namely routine or administrative records and household based surveys system. In practice, administrative data are routinely collected, analysed and published by the MoW while the NBS, as a government agency, is entitled to collect, analyse, compile and publish data generated from national household-based surveys such as Household Budget Survey (HBS), the Demographic and Health Survey (DHS), and the Population and Housing Census (United Republic of Tanzania, 2012). Thus far, however, the two institutions share data, for instance the MoW uses demographic data and geographical boundaries (shape files) prepared by the NBS whereas the NBS uses data from the ministry as the basis for sector performance assessment as well as for cross-checking.

**i. Routine or administrative data by the Ministry of Water (MoW)**

The MoW collects data on water supply coverage through the District Water Engineer (DWE) office in the respective Local Government Authorities (LGA) throughout the country. The DWE office collects data in water scheme level routinely after every three months (a year quarterly basis). The appraisal collects data about all existing water points including domestic points such as hand pumps or bore-holes, rain water harvesting tanks and improved springs. However, the types of data collected focused mainly on water points' functionality, management, technical specifications, and quality and quantity of the water supplied by each outlet (MoW, 2013). From the collected data, the estimate of overall water supply coverage is computed by the proportions between the existing functional water points and the available population expressed in number of water points per 1,000 people. Moreover, to determine the percentage of coverage the number of functional water points are multiplied by the proportion between 250 people and the total population and the results are expressed in percentage, as the formula can be seen in **table 4-1**. The population data used by the MoW to estimate water access is obtained from the NBS and the benchmark used to determine access is "one water point per 250 people or 4 water points per 1,000 people within 400 meter from the furthest user". However, the observations made during the interview with the acting DEW, revealed that the specified benchmark was not fully applied on the ground instead the water access coverage estimates based mainly on functional water points per served population, while ignoring the issue of distance.

The coverage estimates prepared by the DWE are reported to the MoW where they are compiled in the WPM database, in national level aggregate, ready for publication and use for different purposes by the district, regional, central government as well as development partners (see **figure 4-2**). Among the uses, as mentioned during interview with an official from MoW, includes serving as a basis to measure the progress in the provision of clean water as well as inputs for sector decision making. Although the administrative data are more likely to offer the advantage of more regular monitoring of water points distribution and the functionality status which is necessary for water supply service sustainability, they focus more on service provider's or "supply side" interests over actual use of provided water supply facilities. Yet, despite the adoption of WPM system with the aim of collecting and establish the baseline information as a basis for reliable and robust water access indicators (Jiménez and Pérez-Foguet, 2008a), the quality and reliability of administrative data might be questionable because the underlying data can easily be manipulated in order to meet performance targets established by the central government. For instance, the findings in Bagamoyo district council showed that, the DW office was not aware of WPM database nor using the adopted tools for data handling instead data were manually collected, processed and reported. The main highlighted reason was limited resource capacity by the district council.

Table 4-1: Formula used by MoW to calculate different aspects of water point functionality (MoW, 2013)

| S/N | Description | Formula |
|---|---|---|
| **1.** | Total coverage | (Total Wpts / Population) * 1000 |
| **2.** | Percentage of functionality | (Functional Wpts / Total Wpts) * 100 |
| **3.** | Functional coverage | (Functional Wpts / Population) * 1000 |
| **4.** | Percentage of full coverage | (Functional Wpts * 250 /Population)* 100 |
| **5.** | Non functional coverage | (Non Functional Wpts / Population) *1000 |

Note: The asterisk (*) means *multiply*

### ii. National surveys data by the National Bureau of Statistics (NBS)

As introduced earlier, water access is assessed as part of periodic national household-based surveys through national population census, HBS, and DHS. Whereas the HBS collect data on key socio-economic characteristics of households and seeking to measure human behaviours and attitudinal change particularly on sector interventions, the DHS surveys collect data on key health and nutrition issues. Conversely, the national population census collects data about the demographic features of the population, education level, health of the populace, economic status, housing conditions and other aspects of the population (MoWLD, WaterAid, EASTC, and NBS, 2002). Although the household based surveys are generally more flexible and measure the actual use of water supply infrastructure -by asking questions and compiling responses from users or *"demand side"*- but the findings showed that the current nature and contents of survey questions (see *Appendix 4 and 5)* give more attention to official quantitative and objective dimensions, *service provider's side*, and not adequately capturing the complex nature of citizens water access which is subjective.

However, despite the flexibility advantage of surveys, the findings showed that variations on survey frameworks and contents on access dimensions, as well as in sample designs between surveys over time exist. The variations observed are for instance, while national census survey is conducted once in the whole country at the same time every time years, the HBS and DHS are carried out to only sampled households in the selected domains or areas of the country such as Dar es Salaam, urban and rural domains. Moreover, the key dimensions on water access assessed by the national surveys varied from one survey to another over time in terms of questions wording, categories or formats which in turn hinders comparisons over time and places. For example, the key water access dimensions collected through the HBS include water source types, affordability, proximity in terms of distance, and household's water collection frequency (see *Appendix 4*) while by DHS approach the main access aspects included main source for drinking water and time spent to collect water for a round trip (NBS, 2014a; MoWLD et al., 2002). Within the 2012 census, only one question about the main source of drinking water for the household was included (see *Appendix 5*). Such variations are likely to cause estimate inconsistence and bring difficulties in comparing progress of water access interventions as well as performance of water-related poverty reduction measures over time and across places. Alongside the surveys inconsistency setback is the problem connected to long time-lags between data collection, analysis and publication of results which may cause data to be useless for real-time management and monitoring process as argued by United Nations-IEAG (2014). The revealed discrepancies amid surveys methodologies and the involved long time-lags in data handling is a challenge that is likely to contribute to unreliable and less timely statistics about citizens' access to water, even for the same geographical area and time period.

#### 4.4.2. Geographical scale of measurement on water access indicators practice

The choice of a spatial scale appropriate to a particular problem is very critical and is constrained by the existing statistical data (Wong, 2006). The current water access indicator practice in Tanzania showed that, although data are routinely collected in water-scheme or project level with regard to administrative boundary units such as wards and village level but the compilation and reporting of water access estimates is done at the national level aggregate by the MoW. However, the unit of analysis used is a water point (MoW, 2013). Then again, as introduced in earlier sections, despite the fact that the survey-based data are collected at household level but water access estimates are reported at national level aggregate, as it was confirmed by the statement from the Environment and Statistics Analysis Manager in the NBS office during interview. The manager was quoted saying:-

*"....the household budget surveys have questions on distance to access water but the analysis is done at the national level and not village or ward level even with national health survey and demographic periodic surveys. All those have common questions asking about social services...We go to the selected households ask them questions, they answered, we see their responds whether they get water inside or outside the house compound, how many minutes they spend to fetch water etc. But when it comes to analysis, it is done at the national level because we only go to three or four selected regions so we have the data but not disaggregated, rather they are at national level aggregate".*

However, the findings revealed further that the two systems of collecting information also differ in their classifications of urban and rural areas. The MoW defines rural areas as areas within the service area of national administrative boundaries under local government authority while urban areas are those within service area of urban water and sewerage utility. Conversely, national surveys, HBS and DHS in particular, defines only three domains namely Dar es Salaam, rural, and urban areas and the service area boundaries by the MoW do not utterly correspond with the urban-rural boundaries used by surveys.

In general, the observation justified that although water access data are collected at low-level of geographic units but the estimates and reported data from both approaches are generated at high levels of aggregation. However, in the presence of diverse context and conditions such as socio-economic characteristics, the aggregated data are more likely to provide a misleading idea of the extent of water access problem they address and quantify (Martínez, 2009). The aggregate data often characterising greater service coverage but fails to reflect asymmetries of citizen's modes of access to water (Cheng, 2013), and thus hide the actual water-related wellbeing condition of the marginalized households. Also the inferences about individuals with aggregate data, such as the used census data, if not well refined, can contribute to the problems of ecological fallacy as argued by Martínez (2009). Though still, the MoW has potentials of using the WPM and GIS systems that can address the issue of ecological fallacy.

Figure 4-2 illustrates the institutional flow of data and information on water access indicators performance from community level to the national level. It also shows categories of data suppliers and users, the contribution of civil societies, government and non-government agencies, and research and academic institutions to the monitoring of water access national goals and targets as well as MDGs.

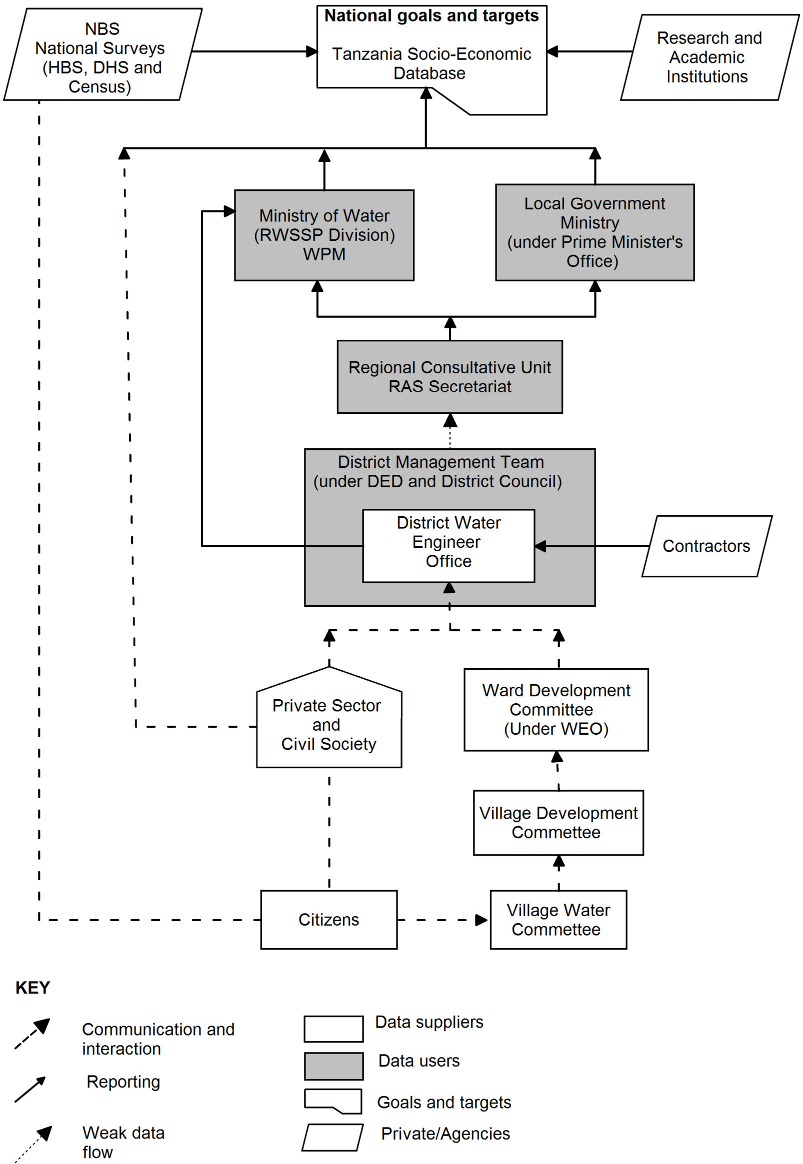


Figure 4-2: Data and information flow on water access indicators performance in water sector (adopted from MoWLD, WaterAid, EASTC, and NBS, 2002, p.61)

#### 4.4.3. Water access indicators practice

As discussed previously, the findings on operationalisation of water access indicators showed that discrepancy exists between indicators measured by the MoW and those assessed by the NBS. Whilst indicators used by the former measured progress on access to water services resulting from investment made in water infrastructure throughout the country, the indicators used by the NBS seek to assess the actual use and impact of water infrastructure to the intended users. However, the nature of the questions and the implication of approach used by the NBS in data collection might suggests that the reported water access estimates, from surveys, are based on users' satisfaction and perception on water supply services provided by the government or the donor agencies. On the other hand, the framework contents and approach used by the MoW to collect data are basically focus more on service coverage, water points functionality, management and technical aspects so as to justify the investment made on public water provision (value-for-money) to the central government and donor agencies. The findings from conducted interviews with the MoW and NBS officials as well as observation made from WPM data entry form (see *Appendix 6*) and survey questionnaire (see Appendices 3 and 4) reveal the following indicator dimensions that are actually used to measure rural water access:

**i. Source type**

The findings showed that both the MoW and NBS are using water source type, as proxy indicator, to determine the quality of source in terms of whether the source is improved or unimproved. And in assessing water supply coverage, only improved water sources, as per the definition adopted from JMP for water supply and sanitation (WHO and UNICEF, 2005), are accounted for and mapped by the MoW in WPM database. The included sources are piped water into dwelling, yard or plot, public tap or standpipe, boreholes, protected dug wells, and rain water collection. However, it is the argument that the source being improved may not necessary indicates the quality and safety of water from the facility as it was observed in Kiromo and Zinga wards where some of public water points were in deteriorated conditions, thus rendering to the risk of water contamination.

**ii. Water quantity supplied**

Despite that the national policy describe the water quantity indicator in terms of quantity of water used by respective households from a particular water point and is usually expressed in litres of water available per person per day, the MoW determine the quantity of water supplied regardless of whether they are proportionally used. The MoW determine the quantity of water supplied per day from a specific water point using population data of a specific area from NBS by multiplying the total served population via that particular outlet by 25 litres needed per person per day. And in order to estimate and assess the coverage in terms of amount of water used by households, they take total expected amount of supplied water by an outlet per day in litres divide by 25 litres expressed in percentage (MoW, 2013). However, according to the interviews with the DWE of Bagamoyo, determining the actual quantity supplied by the source was pointed out as a challenge particularly when the source is bore hole and users get water through mechanical way such as pumping, in contrast to boreholes with storage tanks, like the situation in Kiromo and Zinga wards.

**iii. Water quality**

When assessing water quality the focus is on the condition of water relative to the requirements of human needs and purposes. The common objective quality parameters for domestic consumption may fall under physical, chemical and microbiological dimensions. The control of drinking water quality in Tanzania fall under the responsibility of local service providers at the point of water production or supply (United Republic of Tanzania, 2013), under supervision of the MoW. The findings showed that the district council through water engineer office determine the quality of water from public water points through testing variables including; taste, odour, colour, and fluoride contents and fill in the WPM data sheet (see *Appendix 6*). However, although water quality is usually sampled and analyzed at laboratories but the observation showed that in many cases assessment on water quality are made on-site, by the reason that water exists in equilibrium with its surroundings. And this indicator is only considered by the MoW and not by the NBS.

**iv. Water point functionality status**

The functionality indicator is used by the MoW to notify the status of a particular water point on whether it supplies water or not. The findings showed that water supply coverage is estimated from only functional public water points. And a water point is considered to be functional if it yields good quality water during the survey or it had no technical problems even if water is seasonally available. On the contrary a water point is considered not functional if it did not supply water for more than 6 months of the year consecutively (MoW, 2013). However, knowing water point functionality status only is not enough for sustainable water supply, rather it may be more effective to set up, implement and monitoring the Operation and Maintenance (O&M) frameworks while assessing functionality status.

**v. Functional Water Point Density (FWPD)**

This is the most common indicator practically used to determine the water supply coverage and distribution. The MoW uses it as a basis for the design of all proposed new water points investments. Although distance threshold, 400 meter from the furthest user as specified in the national policy, is necessary in determining service coverage but the findings showed that the current practice by the MoW does not fully take it into account. Instead, with that indicator, percentage of full coverage is determined by only taking the number of functioning water points times 250 divide by the available population size of a particular area expressed in percentage (MoW, 2013). The population data, in ward level, used in computing the service coverage is often acquired from census data collected by the NBS.

**Table 4-2** highlights the variation in water access indicators used by the Ministry of Water (MoW), as service provider, and the National Bureau of Statistics (NBS) as government agency for measuring and reporting on achievement of water sectors development interventions (NBS, 2008).

Table 4-2: Variation in water access dimensions and indicators as considered by MoW and NBS

| Water access dimension | Indicator descriptions | MoW | NBS |
|---|---|---|---|
| Physical accessibility | Percentage of population with access to safe drinking water within 400m from an outlet | ● | ● |
| Time taken to fetch water | Percentage of population who spent a maximum of 30 minutes to collect water from the source | | ● |
| Quantity of water | Percentage of population/households with access to at least 25 litres of water per capita per day | ● | |
| Water quality | Percentage or proportion of population/households with access to safe drinking water | ● | ● |
| Water supply reliability | Percentage of population/households with access to adequate water 24 hours a day | ● | |
| Affordability | Percentage of population contributing to water services | | ● |
| Acceptability | Consideration of social and cultural factors of local area | ● | |
| Management of water supply | The supply is managed by private individual, or company, or community | ● | |
| Type of water source | Type of water source as proxy to determine whether improved or unimproved source | ● | ● |

The overall significant difference that exists in determining water access between the MoW and NBS is basically centred on the conceptual and methodological approach employed to measure citizens' water access. However, both systems focused more on quantitative information which may be taken as indicative rather than on ground truth-revealing. This is likely due to factors such as errors in surveys design, implementation and analysis, as well as the fact that they both miss dimensions which are not easily quantifiable. Also, their aggregation nature, in compilation and reporting, fails to capture the prevailing intra-district, -ward, as well as intra-village differences (MoWLD et al., 2002). **Table 4-3** summarizes the main differences in conceptual and methods approaches employed by the two key-player institutions in determining citizens' water access in Tanzania, particularly for rural population.

Table 4-3: Different aspects and approaches for measuring citizens' water access as considered by the MoW and NBS of Tanzania

| Approach | Ministry of Water | National Bureau of Statistics |
|---|---|---|
| Purpose | For administrative purpose to justify investment done by government on water provision projects | To assess the impacts of water projects, implemented by government and donors, on intended users welfare |
| Water access interpretation | Percentage of population covered with respect to objective set of standards. | Users' experience and perceptions on water supply services |
| Data collection | Routine data collection system from administrative sources | Household based surveys conducted in |
| Frequency of data updating | After every three months of a year - a year quarterly basis | After every 10 years for national census and 5 years for other national surveys |
| Spatial scale and unit of analysis | Water point at water scheme level throughout the country | Household at EA level throughout the country (for census) and sampled areas for HBS and DHS |
| Water access dimensions | Water point functionality, management, service coverage, technical specification<br>- Quality and quantity | - Proximity, time spent, quality, affordability<br>- Measures of drinking water treatment |

## 4.5. Water point mapping methodology

Water Point Mapping (WPM) is considered as a planning and monitoring tool used to locate water infrastructures and collecting related information using any available technology. The collected information is thereafter used in planning, managing and decision making for sustainability of water supply services. The adoption of WPM was an initiative of the government of Tanzania through MoW to collect and establish the baseline information for all existing water points, being a basis of better service delivery. However, the central objectives of WPM is to inform the planning of investments to improve water supply coverage, to determine lost water investments, to measure progress and performance against strategies, projects and expenditures, and to address the issue of equity in terms of resource allocation for service delivery. And as a system, it is more useful in showing the geographical distribution of water points, functional and non-functional water points, and water points that need repair in each locality. The system also supports the process of establishing a baseline of rural water supply coverage and regular reporting as part of sector performance monitoring (MoW, 2013).

#### 4.5.1. Water point mapping implementation status

The current status shows that a functional web-based system was designed and institutionalised to produce and make public-accessible maps and data relating to water point functionality and coverage. A baseline survey of all installed public rural water points in 132 LGAs of Tanzania mainland was conducted and a total of 75,777 improved public water points were mapped, geo-located and visibly labelled national wide. The findings from the WPM database showed that only 46,697 water points of the total public water points in rural areas are functional and the rest 29,080 water points are not functioning as illustrated in **figure 4-3** (MoW, 2013). And data on relevant attributes (see *Appendix 6*), as discussed earlier, regarding each water point are collected by respective DWE office in a year- quarterly basis, that is after every three months.

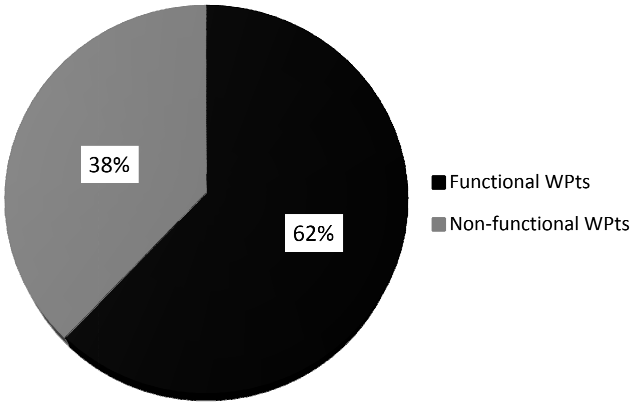


Figure 4-3: The functionality status of public water points in Tanzania (MoW, 2013)

By means of WPM system, every public user has access to the general information about distribution of water points through the official WPM website. The website is operational and offering different possibilities for public to view the water point data for the whole country and can execute brief reports for some administrative units in a form of map, tables, graphs and photographs. There are also some groups for registered users such as WPM system administrators on national level, WPM data editors at national and local levels, and WPM technical reporters at various regional levels that use advanced functionalities of the web application. However, the implementation of WPM objectives and targets faces some technological and resources challenges as pointed out during the key informants interview and from project reports. The challenges that were found include the following:

- A controversy among water- and water-related sector stakeholders on whether to include private water taps or not as it was observed during key informants interview, personal communication and fieldwork water points mapping. According to responds from the MoW and DWE officials, private or house connections where not included in the WPM database even if they offer service to the public. However, the on-field water points mapping shows that some of private water taps, which were serving the public, were geo-referenced in the national WPM dataset which implies that the coverage statistics derived from the WPM dataset, partly, take into account the contribution of private connections. Nonetheless, through personal communication[4] it was understood that the issue was discussed by the MoW and other sector-stakeholders and agreed to include private water pipes as long as they are publicly accessible.

- The limited number of skilled personnel, funds and lack of equipment and tools for enhancing WPM operation, particularly data updating, in most of local government authorities.

[4] Ben Taylor, during Q&A session after presention: "Water Point Mapping in Tanzania: a reality check", RWSN Webinar November 18, 2014.

- There is no yet tested semi- or full- automatic updating system or full updating mechanism through cellular network and system sensor technologies base on the local situation.
- Un-harmonized shape files for administrative boundaries from the NBS and Ministry of Lands as well as lack of updated shape files for administrative boundaries, for villages, wards, districts, and regions, due to regular establishment of new wards, districts and regions.
- Inadequate political will and support to WPM system as a planning and monitoring tool from the national to district level is an envisaged challenge as justified by the quote of the key informant interviewed in the Ministry of Water that; "...*without acceptance the WPMS will never be sustainable and may end once donor funding stops*".

#### 4.5.2. Water Point Mapping and GIS potentials

Despite the above-mentioned challenges, the observation revealed that updating mechanism of WPM database has some untapped potentials available for effective, efficient, and reliable operation of the system. The potentials include updating through mobile phones, LGA staff, and through Community Owned Water Supply Organizations (COWSO) or Village Water Committee (VWC). The up-to-date WPM database is of grand importance as can be of great value in constructing and operationalising water access indicators on the platform of GIS system (Ricard Giné-Garriga et al., 2013). With the use of modern technology and computer-based systems including GIS in line with relevant administrative data, indicators can be developed and operated into different levels of spatial units tailored to a particular decision problem (Martínez, 2009). This can make water access indicators more useful to provide local policy makers with strong evidences to inform their planning decision on equitable provisions of water supply services. The indicators may be more useful since are amenable to disaggregation to reveal inter-group disparities and the possible presence of discrimination as argued by Fukuda-Parr et al. (2014).

# 5. WATER ACCESS PERFORMANCE IN KIROMO AND ZINGA WARDS: CITIZENS' PERSPECTIVE

This chapter presents the empirical findings and discussion on 'how citizens as service users of water supply services describe their access to water' relative to the performance of water access indicators in the study area where household survey was conducted. It explicitly reveals the knowledge, experience and perception of citizens on performance of water access indicators. The chapter also discusses in detail the spatial coverage of water sources while unfolding the pockets of under- and over-served areas, the respective statistics of the population served, the level of service for each indicator in the study area, and comparative and integrated assessment of all water access indicators.

## 5.1. Water supply and service operation in Kiromo and Zinga wards

It is known from the literature that amid water supply service operation and management, the central concern is whether service provision and management is mainly a government responsibility, or water is supplied and controlled by market forces (private liability), or by the community using it as a common property with open access situations (Miranda, Hordijk, and Molina, 2011). The findings in Kiromo and Zinga showed that almost all approaches were concurrently operating though in different ways and scale. For instance, the government through the Ministry of Water was responsible for the provision of public water supply services, which were then managed by the community through Village Water Committee (VWC) as common properties. The water points under this category may be referred to as "publicly owned and operated water points". Meanwhile, water was supplied by the Dar es Salaam Water and Sewerage Corporation (DAWASCO) -on market based service delivery- as well as by civil societies where by institutions such as Mosques were supplying water to the citizens. Alongside the mentioned service suppliers, self-supply water sources was another common option found whereby citizens were collecting water from hand-dug wells, although most of them were unimproved sources, and rain water harvesting. Nevertheless, to facilitate access, various ways were used to transport water from the source of supply to the user, for instance, while some households were getting water by connecting plastic tubes from their neighbours' water taps to their houses (**figure 5-1**) or using pushcarts, others were carrying buckets.


Figure 5-1: A plastic water pipe (A) supplying water from the source (vendor's tap) to the user's home and a bucket (B) for carrying water from the source to home as found in Kiromo village (October, 2014).

#### 5.1.1. Private water supply services

The private piped water connections were due to existence of DAWASCO operations. The DAWASCO is a state corporation which provides services on market-based system -thus operating like private company- focusing on full cost recovery. Although the corporation was basically established to serve Dar es Salaam region, the findings showed that the study area were among the benefited parts of Bagamoyo district served by the corporation's projects owing to the fact that the main DAWASCO water pipe, that supply water from Ruvu river source to Dar es Salaam region and surrounding urban parts, pass through the area (EWURA, 2013). And it is the policy of the government that wherever the main infrastructures of public services and utilities pass, the area should be provided by service concerned. This was justified by the officials from the NBS and DWE of Bagamoyo District Council during the interviews whereby the NBS official was quoted saying;

*"...with the current Kikwete's [meaning Hon. Jakaya Mrisho Kikwete, the President of The United Republic of Tanzania] regime, wherever the main pipe of water is passing through the area, that area should get the service and in Kiromo and Zinga the main pipe from Ruvu river water is passing through the ward and that is the reason why Kiromo and Zinga are served by DAWASCO water connections."* He went further by saying *"...the situation at Kiromo and Zinga wards is different because the wards are in both DAWASCO projects [treated under urban water authority] and Ministry's of Water projects through Local Government Authority."*

The DAWASCO service operation is on the basis of market forces where by the financially capable citizens were getting water through private house connection and pay the corporation in monthly basis. Each connected households had a water-meter and they were paying as per volume-units of water consumed. However, the field observation found out that although the DAWASCO water connections were "privately owned" but majority of them were "publicly operated" as the owners were selling water to their neighbours who had no connection. Yet certainly, this was noted to be informal water selling activities despite the fact that it constituted the majority of access strategies, as also the findings by Nganyanyuka et al. (2014) found out.

#### 5.1.2. Public water points in Kiromo and Zinga

As discussed in the earlier section, the "publicly owned and operated water sources" were managed by the community through the VWC. The sources under this category are referred to as public water point and included sources such as communal standpipe, boreholes and dug wells. The findings showed that almost all public water points, particularly the public boreholes, were offering water service for free except for few communal standpipes which were connected to DAWASCO main pipe where the service was by payments. These communal standpipes were within the privately owned dwelling compounds and thus controlled by the owner of the compound. Such water points were offering service through pay, as a means of cost sharing strategy, and the payments made by users were meant for settling DAWSCO water bills and for maintenance. That stance was highlighted by the chairman of Mandawe village in Zinga:-

*"...this water tap [pointing to standpipe within his compound] is within the compound of my house but is for public use as it was installed by our Member of Parliament to serve the community...I am entitled to supervise it and thus charge the users so that to get money for settling water bills as well as for maintenance whenever breakdown happen."*

#### 5.1.3. Functionality status of public water points

According to the WPM status report of 2013 and the WPM digital database, Kiromo and Zinga are distributed by a total of 216 public water points (MoW, 2013). As can be seen in Fig. 5-2, more than one third of total number of water points were not functioning the main reasons being pump breakdown and pipes blockage, as mentioned by the DWE during the interview. Moreover, the findings, as can be deduced from **table 5-1**, showed that the number of non-functional water points managed by the VWC is nearly twice those privately managed water points. This may imply that the possible main cause for malfunctioning and breakdown of water points are likely due to lack of effective management and regular maintenance of facilities since the VWC failed to meet the maintenance cost as service were almost delivered for free and many citizens were reluctant to contribute for maintenance or repair cost. However, the central reason for their reluctance may be due to the fact that they rarely use water from the public water points as will be discussed in later sections. On the other hand, most of privately operated water points were not functioning due to failure of water taps owners to settle water bills from the DAWASCO.

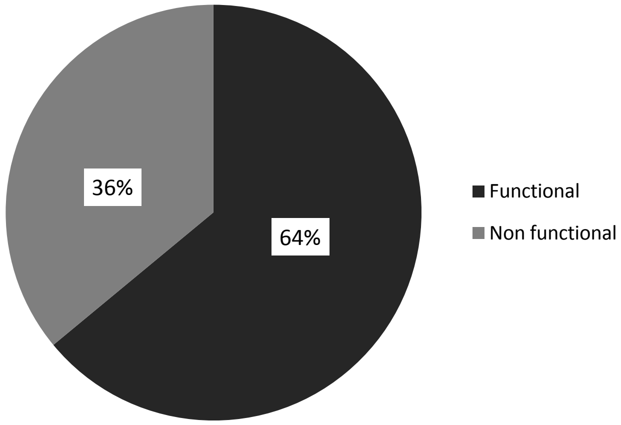


Figure 5-2: The functionality status of public water points in Kiromo and Zinga (WPM-Database, 2014)

The statistics in **table 5-1** presents the functionality status of water points as per category of management and operation. As it can be deduced from the table, majority of water points were managed by private operators over public operators.

Table 5-1: Functionality status of public water points by management types (MoW, 2013)

| Management | Functional Wpts | Percentage (column) | Non-functional WPts | Percentage (column) | Total |
|---|---|---|---|---|---|
| Private operator | 110 | 79 | 25 | 32 | **135** |
| Percentage (row) | (81) | | (19) | | **(100)** |
| Village Water Committee | 13 | 9 | 43 | 56 | **56** |
| Percentage (row) | (23) | | (77) | | **(100)** |
| Civil organisation/Parastatal | 15 | 11 | 7 | 9 | **22** |
| Percentage (row) | (68) | | (32) | | **(100)** |
| Others | 1 | 1 | 2 | 3 | **3** |
| Percentage (row) | (33) | | (67) | | **(100)** |
| **Total** | **139** | **100** | **77** | **100** | **216** |

**Figure 5-3** shows examples of functional and non-functional public water points as they were found during field data collection in Kiromo and Zinga wards. However, despite that a significant number of water points were functioning, the observation made during data collection showed that a noticeable number of them, particularly publicly managed water points, were in deteriorated -damaged or rusted- conditions to the extent that they may supply unsafe water due to contamination. This may suggest that the availability of improved sources does not necessarily translate into supply of safe drinking water, as water may become contaminated before it reaches the users. However, according to DWE, the deterioration of some water supply facilities was due to salinity of ground water which was reacting with facility infrastructure as well as lack of regular maintenance down to funds limitation.

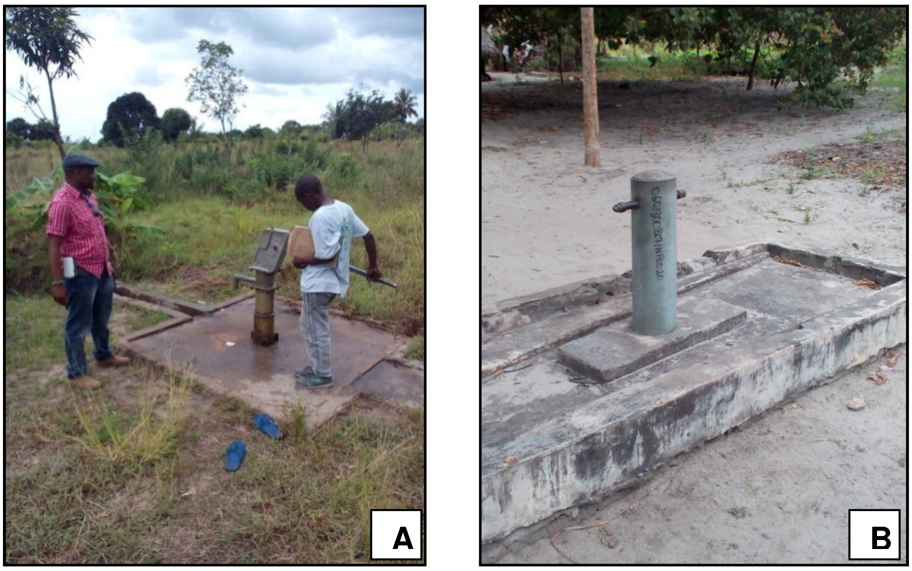


Figure 5-3: Examples of functional (A) and non-functional (B) public water points as found during mapping in Kiromo and Mandawe sub-villages (October, 2014).

#### 5.1.4. Spatial distribution of public water points

As one among the aim of this study was to map the spatial distribution of water points service coverage, the functional and non-functional water points (as geo-referenced in the 2013 WPM dataset) was spatially visualized by the aid of GIS functions (**figure 5-4**). The spatial pattern from the map showed that areas along and nearby roads and access ways as well as village centres had a better distribution of water points than areas away from the roads. This situation can be expected as public services, including water supply, are always provided where demand or users exist. And it is common that the areas close to infrastructures, such as roads, electricity and others, to be more populated than areas away from them simply because people are always attracted to live and run their economic and other activities in such areas. The findings showed that the explained situation exists in Kiromo and Zinga wards since housing units were more concentrated towards roads as well as village centres. Moreover, the inset map in **figure 5-4**, showing the zoomed-in spatial distribution of functional and non-functional public water points located within the study area, depicts similar pattern in terms of public water points' spatial distribution.

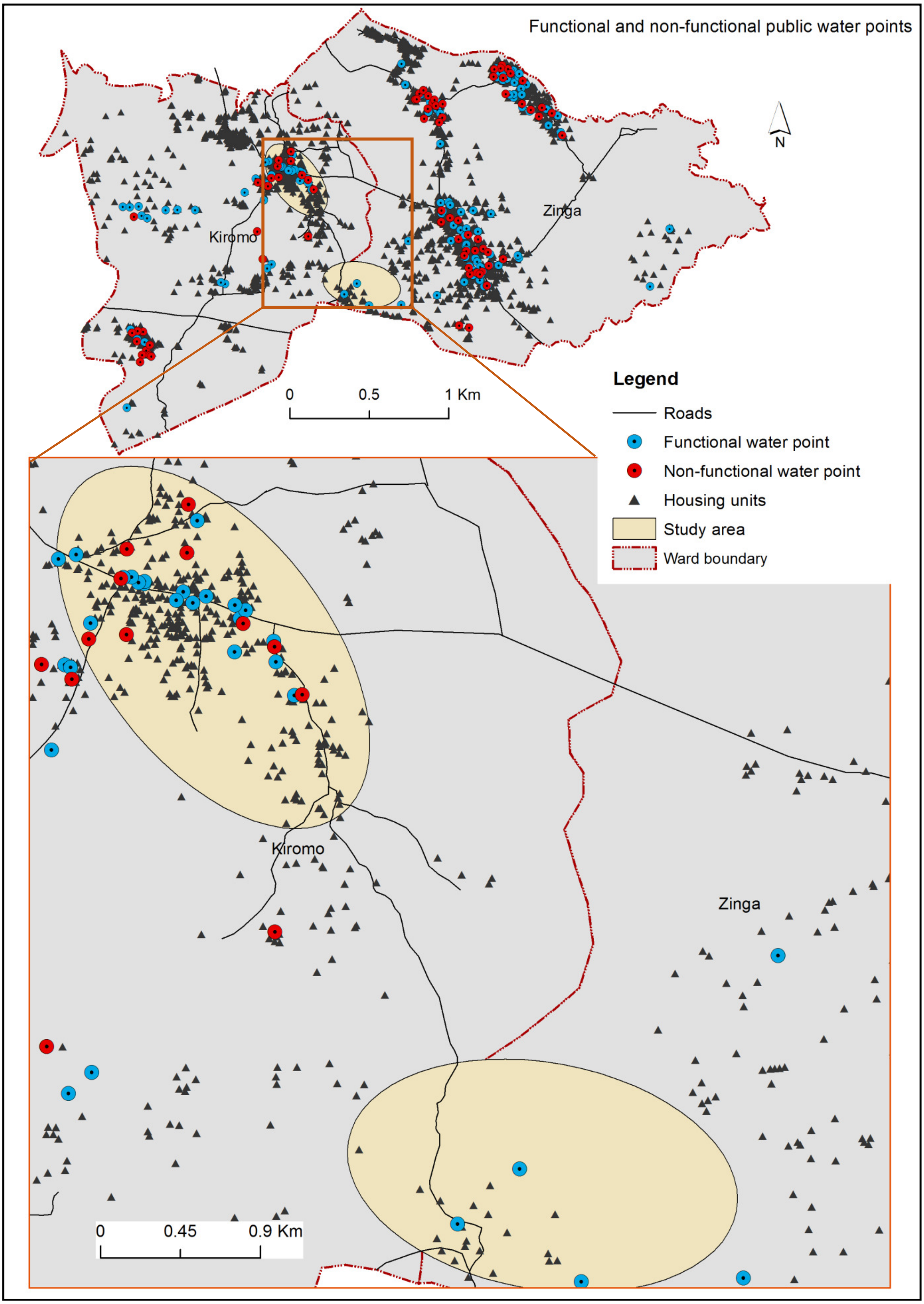


Figure 5-4: Spatial distribution of functional and non functional public water points in Kiromo and Zinga wards and the study areas (MoW, 2013)

#### 5.1.5. Public water points service coverage in Kiromo and Zinga wards

As outlined in the introduction that among the specific aims of this study was to map the distribution of water points and analyse the pockets of served and under-served areas, the functional water points were visualized and water access indicator that requires one outlet to serve a maximum of 250 people within a distance of 400 meter (United Republic of Tanzania, 2002) was considered. However, while considering the 2012 population data which indicates that Kiromo and Zinga wards had a total population of 18,468 (NBS, 2014b) and the available 139 functioning public water points (MoW, 2013), Kiromo and Zinga seems to achieve a 188 percent of full coverage (see **table 4-1** for formula). Yet the findings, as can be deduced from **figure 5-5**, showed that a significant number of housing units are further than 400 meters from public water points' service coverage which in turn implies that those housing units were underserved. And since, housing units were used as a proxy to population data, the results may suggest that citizens found in areas out of the specified service coverage were still facing problems of access to water. The underserved areas were computed as 400 meter radius from each housing unit, which means the service areas where a household can go to collect water. However, the visualization of 400 meter water point service coverage revealed an overlapping of coverage between public water points which were not more than 400 meters apart. This may imply that households within the overlaps were over-served with regard to the national standard of 'one outlet per 250 people within 400m'. The observed service coverage overlapping is likely to contribute to under- or over-estimation of overall water access coverage, as a consequence may render to reporting of unreliable water access statistics, as Satterthwaite (2003) called them "nonsense statistics".

Also, from the Euclidean distance map (**figure 5-6**) the spatial pattern of service coverage -with respect to the distance of 400 and 1000 meter benchmarks as considered by the MoW and NBS respectively- from the existing functional water point to housing dwellings can be deduced, and thus the pockets of underserved areas analysed. The variation in spatial coverage indicates that with NBS cut-off point more housing units seemed to have better access to water than the coverage benchmark by the Ministry of Water. However, the methods used by the NBS to determine distance between the water point and the user, simply by asking users, may not fully reflect the reality on the ground as users' responses might not be precise in terms of distance-metrics. Therefore, the need for mapping to spatially cross-check and validate both quantitative and qualitative data from surveys may be necessary to visualize and assess rural water access problems as well as in evaluating the success of the implemented policy interventions (Martínez, 2009). This may provide experts and policy makers with strong visual-evidence for their planning decisions on targeting areas that require urgent interventions and thus achieve a more equitable water supply service provision.

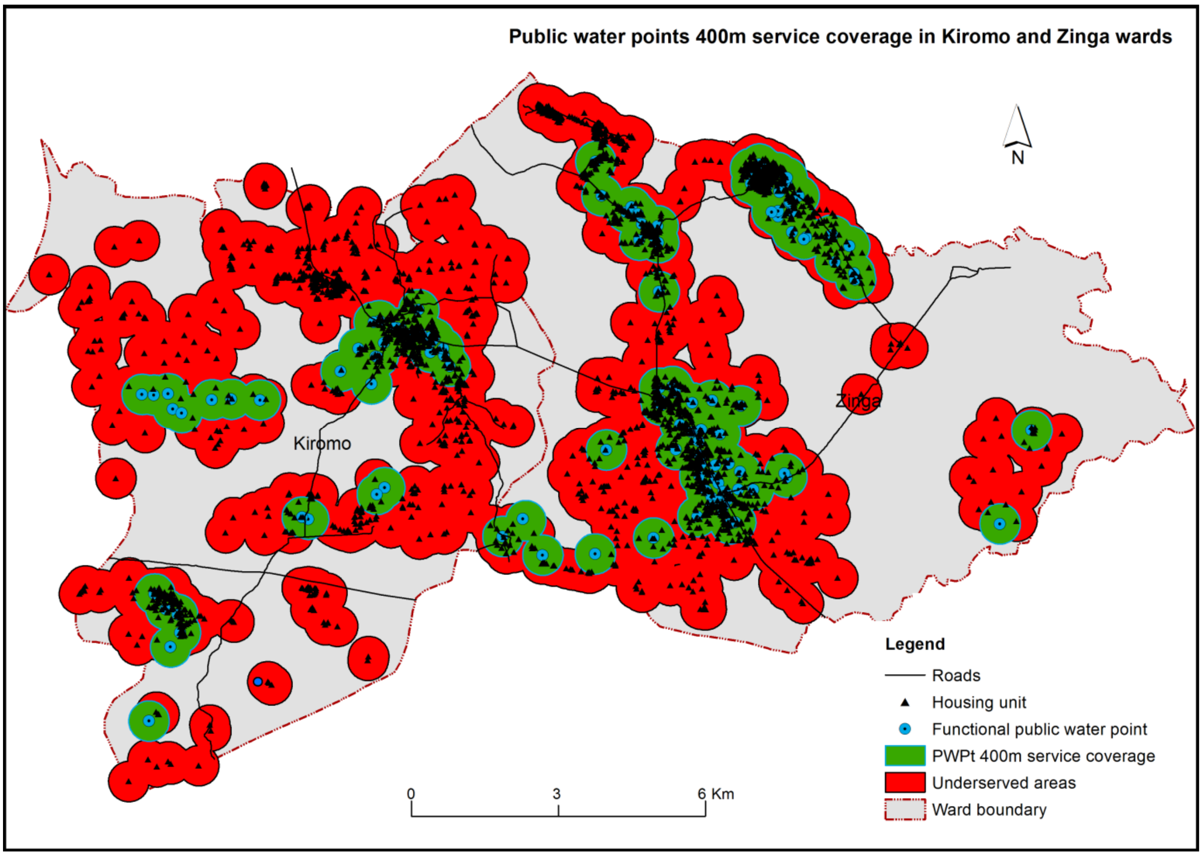


Figure 5-5: Public water point service coverage, accessibility within 400m, in Kiromo and Zinga wards (MoW, 2013)

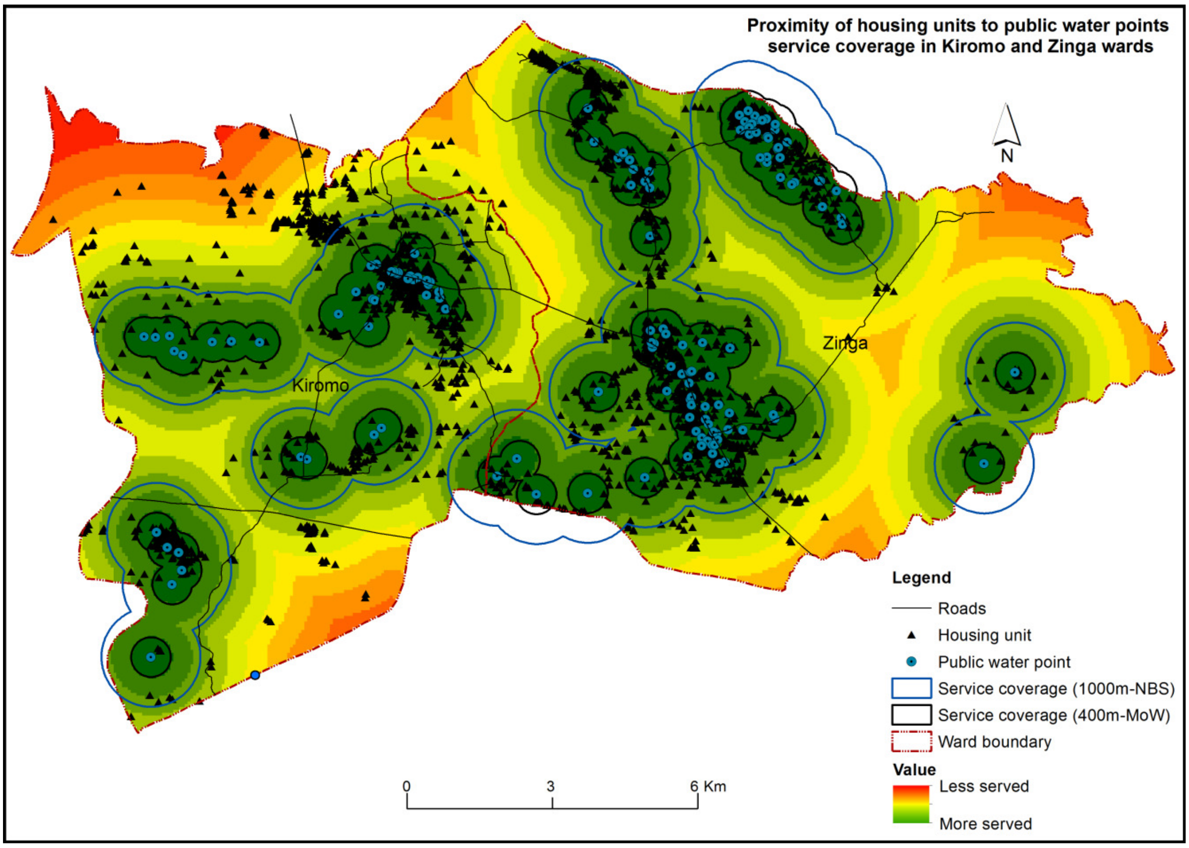


Figure 5-6: Euclidean distance of public water points to users' dwellings with respect to MoW and NBS service coverage benchmarks in Kiromo and Zinga wards.

## 5.2. Performance of water access dimensions: Citizens' perception

To examine how citizens, as service users, describe their access to water was among the specific aims of the study, the research, therefore, investigated citizens' expectation, experience, and perceptions on the performance of water access dimensions as well as their strategies to improve their access. The findings from analysis of data collected through household survey, followed by discussion and their implications are as presented in the following sub-sections.

### 5.2.1. Main sources of water

The type of water source is an important proxy indicator of the suitability of water for drinking and other domestic uses including cooking, washing, bathing and others. The sources that are likely to provide suitable water for domestic use are classified as "improved sources" as defined by the JMP (WHO and UNICEF, 2005). The findings from the study showed that "the neighbour's tap or standpipe" was most commonly used as the main source of drinking water and for cooking purpose, as mentioned by more than half of the respondents, while public water points was the least used source to serve the same purposes as can be deduced from **figure 5-7**. Yet, the evidence from the same figure indicated further that about 90 percent of the households in the study were using improved water sources as their main water source while only 10 percent used unimproved sources such as open shallow wells. This proportion of the households using improved water sources is far above the national average of 38 percent of households using piped water and the 61 percent of households using improved sources (NBS, 2014a). This result contradicts other previous studies such as that of Masanyiwa et al. (2014) who found out that public water points were the dominant source of drinking water in rural areas of central part of Tanzania. However, the results from this study are likely valid due to the presence of DAWASCO operation which provided many house connections in the study area, a situation which is rarely found in typical rural areas of Tanzania.

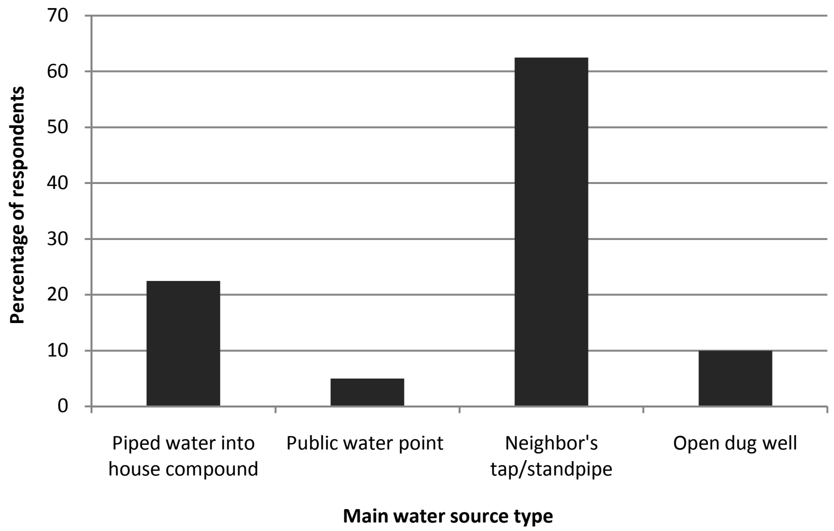


Figure 5-7: Main source of water for households according to source type in percentage (n=40)

### 5.2.2. Alternative sources of water

The results from the survey and field observation showed that almost 90 percent of the households had alternative sources of water while only 10 percent depended entirely on main source to serve their purposes. The results show that most of households that depended solely on one main source were those who had piped water into their house compounds. It was further observed that such households used enhancement strategies by fetching water from the main source, when the supply was available, and stored them in different types of storage facilities for use at the time when the supply from the main source was not available. The reasons for using alternatives included issues such as; particular purpose of water from the source for a specific use, affordability limitations, service unreliability and inconveniences, perceived low quality of water for a particular use from the main source, long distance to the main source, and other related reasons. And the most common water source types used as alternative source were firstly unprotected dug wells followed by public water points and piped water connections (**figure 5-8**). It was further observed that over half of the households were using unimproved water sources as an alternative source while 47 percent used another improved water sources as alternative source. However, the results indicate that the option of households to choose a particular source was not tied to the quality of water only but rather influenced by a number of factors that may be connected to water access dimensions.

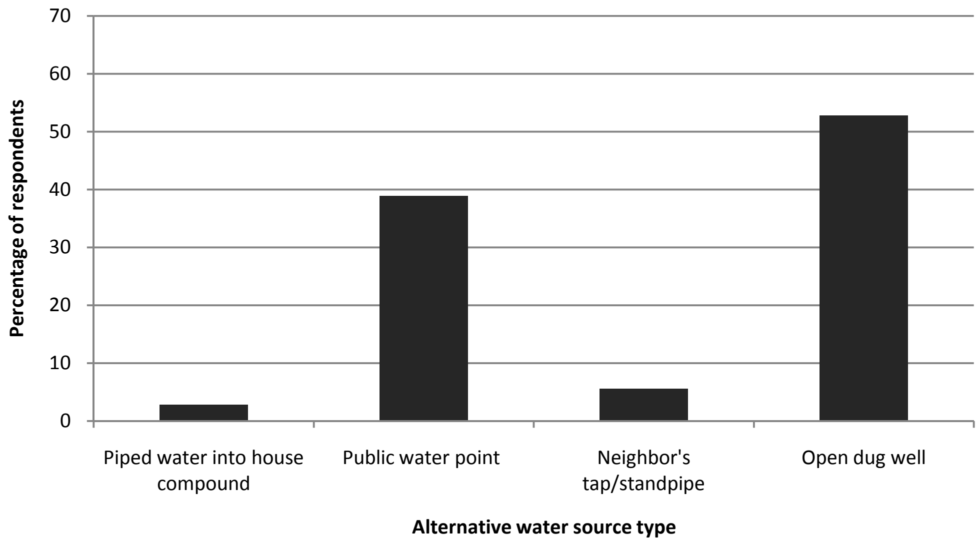


Figure 5-8: Alternative sources of water for households according to source type in percentage (n=40)

Nevertheless, the findings revealed that dependence on the above mentioned sources was somewhat subject to seasons of the year, dry and rainy season in particular. Almost 90 percent of the respondents pointed out that despite having their regular main and alternative sources, rain water collection were an additional source of water particularly during rainy season. The majority of respondents admitted that rainwater was a potentially safe and highly accessible supply, but surprisingly, the source was rarely used even for households with houses that had suitable roof for rain water harvesting. They claimed that rainwater was not their predominant main source because it was unpredictable in terms of time of supply and quantity wise as one respondent (HH_ID 23) was quoted saying;

*"...rain water is not the source to depend one for a long time because it is not regular in terms of when is neither going to rain nor its quantity especially in recent years where weather is unpredictable".*

The most common types of improved water sources in the study areas included piped water into house compound, public water taps or standpipes, and boreholes with water tap or mechanical hand pump as examples can be seen in **figure 5-9**. On the other hand, the typical unimproved water sources types included unprotected deep wells and open hand-dug shallow wells as **figure 5-10** shows their examples.

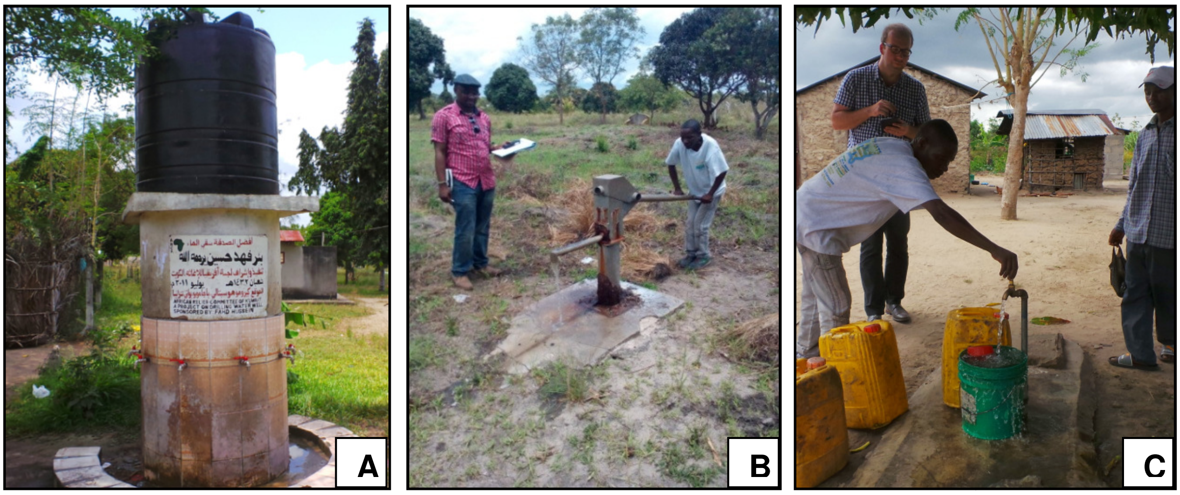


Figure 5-9: Examples of common types of improved water source, a borehole (A), a hand pump (B), and a standpipe (C) as found in Kiromo and Zinga wards (October, 2014).

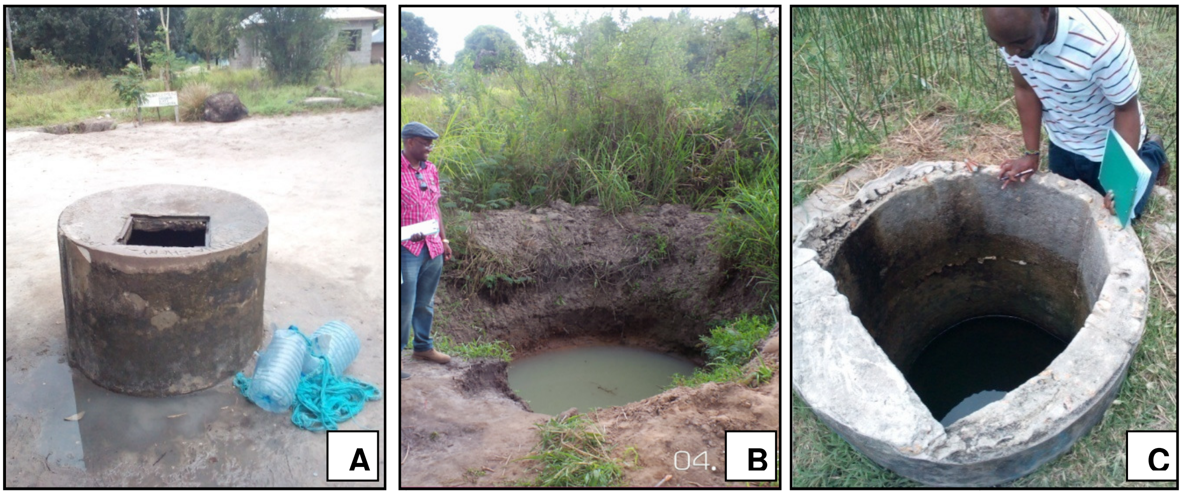


Figure 5-10: Examples of unimproved water sources, unprotected deep well (A), a hand-dug shallow well (B), and open shallow well (C) as found in Kiromo and Zinga wards (October, 2014).

### 5.2.3. Water use and water source types

As reported earlier, about 90 percent of surveyed households used water from improved source types particularly for drinking and cooking and water from unimproved source for other uses such as dish washing, laundry, bathing, and gardening. The main improved source type used by those households was water tap or standpipe within neighbours' or own dwelling compound. More than a half of the respondents' households used water from neighbour's standpipes, and 22 percent had house connections. That means about 85 percent of surveyed households used water from taps and standpipe only for drinking and cooking (**figure 5-11**). On the other hand, the findings from the same figure show that only 5 percent depended entirely on public water point for drinking water as well as for cooking while 10 percent use water from unprotected dug wells to serve the same purposes. The observation revealed further that the households with house connections used water from the tap also for other uses including watering gardens, livestock watering and construction purposes. This implies that the intended use of water may have an influence on the household's choice of water source type to use. These findings may suggest that, with diverse context and conditions on dimensions such as affordability, perceived quality, water supply reliability and availability, access convenience, distance to water source, and others among rural households, the "one-source-for-all purposes" solution may not work effectively in rural areas. The reason may be that, to them, water from different source types has different value depending on the intended use. Nganyanyuka et al. (2014) also argued that water from one particular source is not necessary to serve multiple purposes with prevailing diverse context and conditions. This was confirmed by one respondent from a household (HH_ID 4) which was provided by both a public water hand pump and DAWASCO standpipe connection within their house compound, who quoted saying;

"*...we get water from the tap particularly for drinking and cooking and from that hand pump (pointing to the public hand pump) we get water at any time specifically for our livestock...my goats and cows like very much water from the hand pump because has too much salty.*"

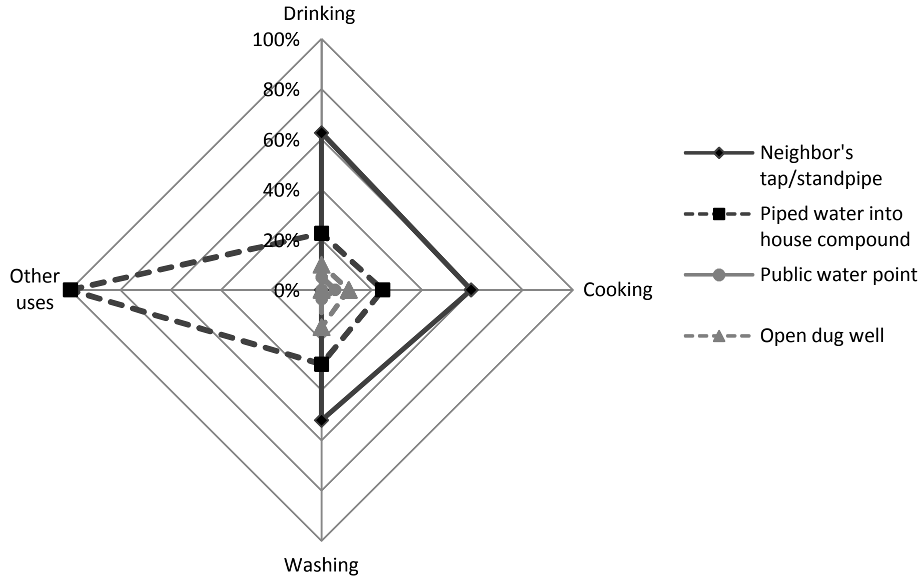


Figure 5-11: Use of main water sources according to four use categories in percentages

However, the findings suggests further that whilst the main source type is used principally for drinking and cooking purposes, alternative water source are mostly used for other purposes including dish washing, laundry, bathing, house cleanness, gardening, and others. For instance, the findings from the study showed that more than a half of interviewed households used water from unprotected open dug well for washing clothes, dishes, and other similar purposes, while about one third used public water point for similar purposes. However, about 10 percent of households, who completely depended on unimproved water sources, used water from open shallow wells for drinking and all other purposes. **Figure 5-12** illustrates the use of water from alternative sources against the respective use categories as observed from the survey findings in Kiromo and Zinga wards.

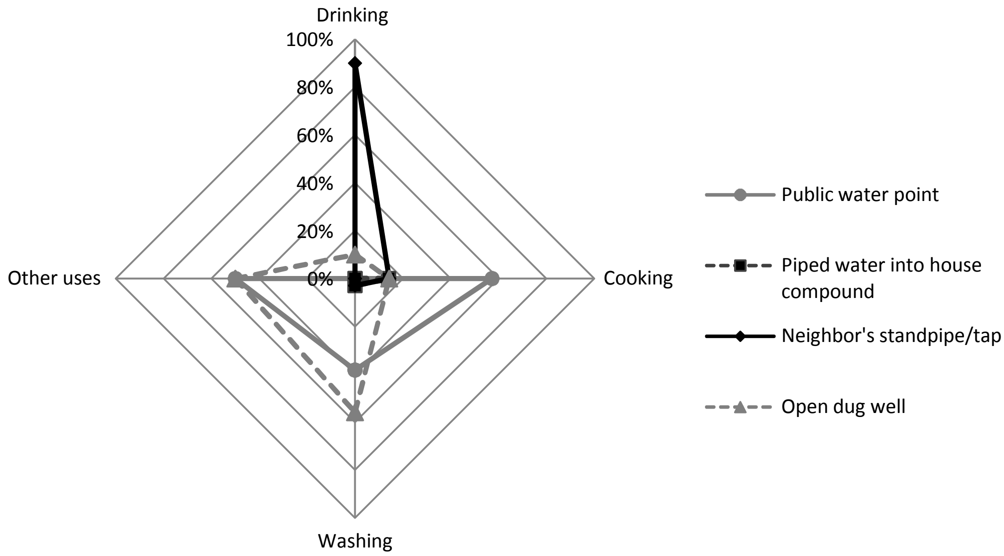


Figure 5-12: Use of alternative water sources according to four use categories in percentages

Notably, contrary to expectations the findings showed that a significant number of households in the study area used public water points as alternative source and for uses other than drinking despite the fact that all public water points were improved sources. The reason deduced was based on cost and the users' perception over the water quality from the public outlets as they perceived water from those sources to be of low quality and too salty particularly for drinking purpose as one respondent (HH-ID 31) was quoted saying:

*"...despite that the public hand pump [mama Mnekela public water point] is nearby my house and offer free service but we always opt to pay and fetch water from our neighbours simply because water from [the public hand pump] is too salty and thus not suitable for drinking, cooking and even for washing...it's just because we are not capable of paying for adequate quantity of water from the neighbour's standpipe that can serve all purposes otherwise we couldn't go for water from the hand pump."*

### 5.2.4. Distance to water sources

Proximity from home to the source of water is among the dimensions considered by citizens in their strategies to water access. The government through the MoW has set 400 meter from a water point to the user as a maximum distance (United Republic of Tanzania, 2002). However, the standard used by NBS to assess water access does not explicitly use 400 meters as a cut-off point instead any distance 'less than a kilometre' is used as a benchmark (see *Appendix 4*). Considering the maximum distance of 400 meter from a public water point, the findings from the study areas showed that only 3 households (8 percent) of surveyed households were not within the service coverage (**figure 5-13**). This implies that about 92 percent of households -in theory- could walk less than 400 meters to collect water from the source, a proportion that is far above even to the national average, of those who collect water within a distance of less than a kilometre, which account for only 47 percent (NBS, 2014a). In addition, the inset map in the same figure shows a zoomed-in spatial coverage of accessibility within 400 metres from the public water points so as to show an example of served and under-served households within the study area. The observation from the inset map shows that despite the huge number of installed publicly shared private water points as well as public water points, some households (for example HH_ID 26 and 27) still had to walk more than 400 meter to collect water for drinking and other domestic purposes.

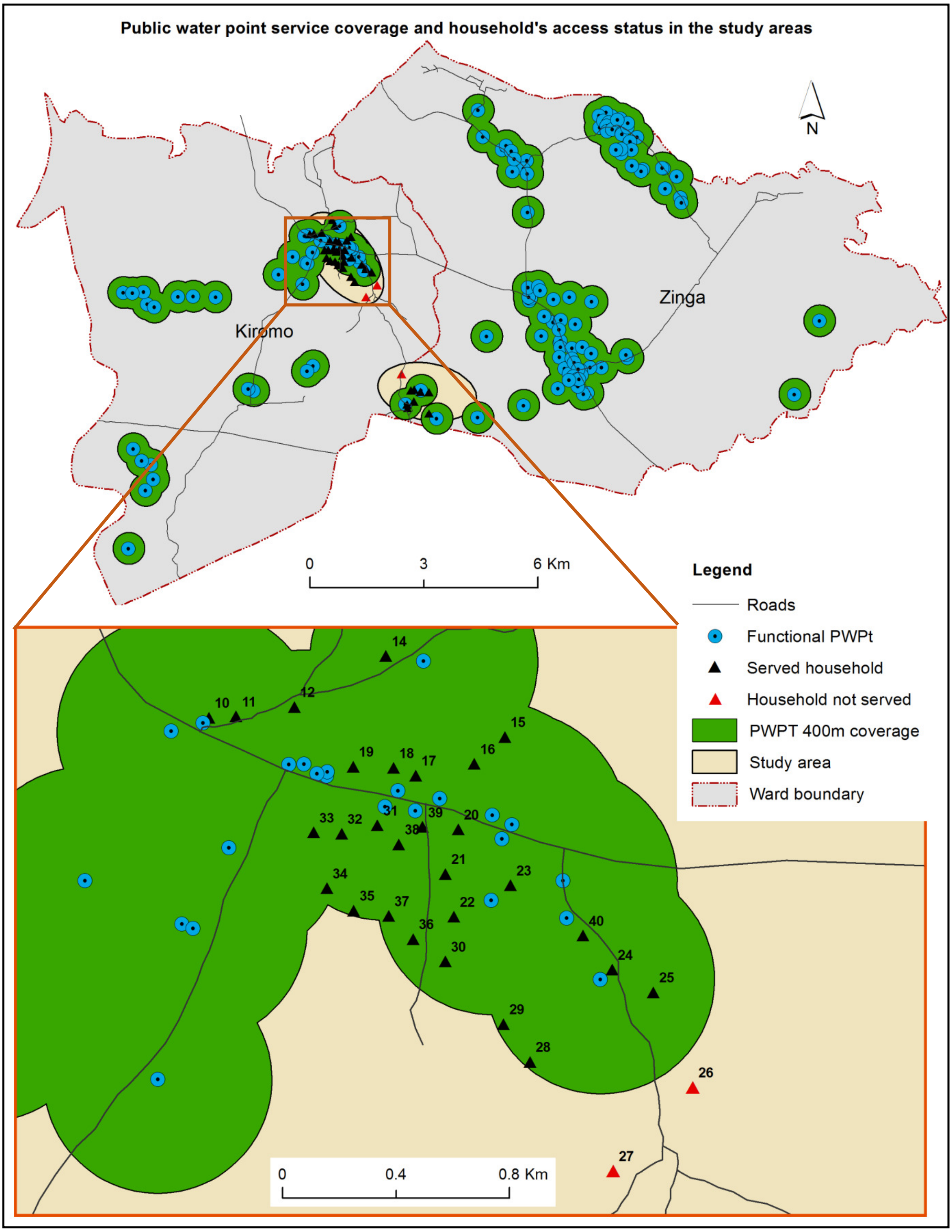


Figure 5-13: Water accessibility status for interviewed households within service coverage of 400 meter from a public water point in Kiromo and Zinga wards (n=40)

The observation found out further that majority of households located within 400 meter from a public water point were also connected with DAWASCO water pipe house connection or had nearby neighbours with house connection as can be seen in **figure 5-14**. The inset map in the figure zoomed-in one of the area, within the study area where household survey was conducted, with the situation where the 400m service coverage of a public water point was also distributed by DAWASCO private standpipes. As anyone can expect, the households within the public water point coverage areas, where also DAWASCO connections exist, were spending a mean time of about 15 minutes for collecting water from either source, the time which was within the national standard.

Moreover, about two third of the respondents were using the nearest main water sources while the remaining used other than nearest water sources. To explain the later situation, the inset map in **figure 5-14** zoomed-in on a sub-area of the study area where households used water sources that were relatively far from their homes although there were other closer sources available. For instance, despite that a public water point (WPt named *Mpanda*) within the compound of household number 8 and offered free service, for household 8 and relatively nearby households number 6 and 7, the private owned standpipe located in household number 1 was the main source of water for drinking and cooking. That means, to households 6, 7 and 8 the longer distance between their homes and the standpipe at household number 1 was less important than the perceived unacceptable quality of water (too much salty) of the nearby public water point named *Mpanda*. This result may imply that, users are likely to give more attention on the 'use of water for a particular intended purpose' rather than just proximity to the source. Other observed reasons for households to use water sources which were relatively far away from their homes included:

- Existing social and cultural issues such as interaction between user or buyer and water vendor or operator whereby the two parties are tied up with the prevailing good relation between them. For instance, some households were opting to use a particular water source, even if it is located relatively far away from his or her home, only because the water tap was installed within the house compound of a relative or they can get credit from the vendor when they lack money to pay for the service (see section 5.2.11)
- Inconvenience and reliability of water supply from particular source due to conditions such as physical barriers restricting access to the sources, limitations on time of providing service, and others (see section 5.2.9).
- Location of water points: some, public water points in particular, were located in areas that were perceived insecure for particularly women and children, to access the source especially during night-time. For instance, one public water point was located in isolated area and nearby cemeteries and thus was likely to hamper women access to the outlet especially during evening to night-time for security reasons. In one case as observed from a female respondent during the survey, she was frightening to collect water from a nearby water tap and chose to use the furthest one just because a group of young males were operating a motorcycle garage nearby the closer water tap.
- Last but not very common, were issues related to social-cultural factors such as religious relations between the user and water supply operators.

Furthermore, taking into account the proximity indicator of 400 meters service coverage by each public water point, it is likely that even if a household is within 400 meter of water point yet they may choose to use a water point further away from their home. According to Masanyiwa et al. (2014), the location of household with regard to that of water source is also an important determinant factor of users' satisfaction because of its implications for the distance to the source and time to collect water. However, the empirical findings from Kiromo and Zinga partly nullified that stance because majority of households near public water points were not using the those water points and instead opted for other sources such as neighbours' stand pipes which were further away from their houses as discussed in the earlier sections. This may suggests that not only proximity to water sources matters to service users rather other attributes of water access as they have different value depending on the prevailing conditions and context of the user and the intended use of water (Nganyanyuka et al., 2014).

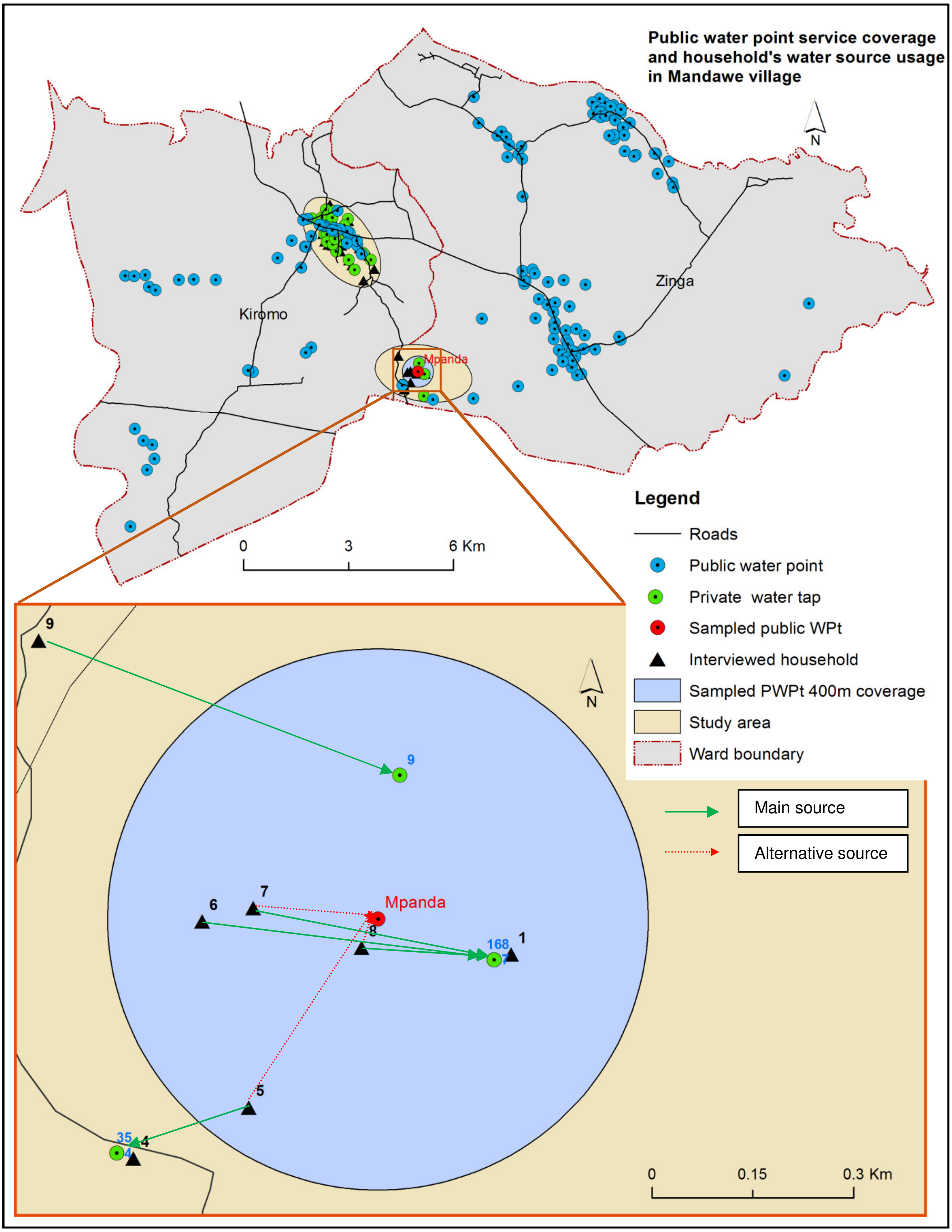


Figure 5-14: Public water point service coverage (accessibility within 400m), private standpipes and water source types used by respective households.

### 5.2.5. Time spent for a round trip to collect water

From theory, it can be deduced that time spent to collect water is closely related to the distance from the source, however distance does not justly measure the water collection efforts as it does not account for collecting and waiting time the case of queue (Masanyiwa et al., 2014). With that argument and the fact that water policy and most of national surveys use 30 minutes as a benchmark in determining an optimal access to water source (MoWLD et al., 2002; URT, 2012) as well as for comparison purpose, the study considered 'time spent for a round trip to collect water from the source' as a separate water access dimension. The results showed that the overall mean time spent by households to collect water from improved sources in Kiromo and Zinga was about 11 minutes which is less than the national benchmark of 30 minutes. More than 90 percent of the respondents were collecting water within 30 minutes while only 8 percent spent more than 30 minutes.

However, the distribution of scores was asymmetrical (*skeweness*=1.802) whereby the variation in time spent vary from 2 to more than 40 minutes with a median of 8 minutes as can be construed from a box plot in **figure 5-15**. From the same figure, the findings shows that out of 7 outliers, 3 extreme cases spent more than 30 minutes to collect water. That means despite the average of 11 minutes there were some households which spent more than the national standard of 30 minutes for a round trip to collect water. However, almost all households in unusual cases were found in Mandawe and Chaga sub-villages which are located far away from the village centres and piped connections were hardly found. Yet, the proportion is less than the national mean time spent by rural households to collect water from improved sources within 30 minutes which was reported to be 47 percent in the year 2010 (URT, 2012). It seems possible that this significant difference observed was also due to the existence of DAWASCO water pipe connections, which led to many private or house connections, within the study areas, contrary to the experience from most of rural villages in Tanzania where rural population depends solely on public water points (Masanyiwa et al., 2014).

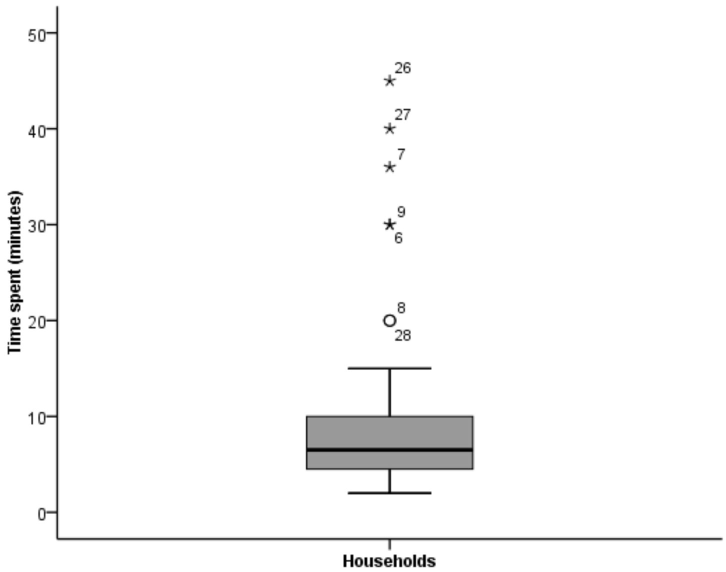


Figure 5-15: A box plot showing the distribution of time (in minutes) spent to collect water

**Citizens' perception on time spent to collect water**

Despite that majority of households was collecting water within 30 minutes, the findings showed that about one third of the respondents considered the spent time to be a very long time. That implies that they were not satisfied with the time they spent to collect water from the sources. On the other hand, about 37 percent of the respondents perceived the time spent as very short to short while the remaining respondents considered the time as moderate (**figure 5-16**). However, the analysis showed further that the majority of households with water tap house connections spent relatively less time and they were more satisfied than others who had no house connections. Moreover, even some households which were collecting water from their nearest neighbours, in less than 30 or even 15 minutes, were still not satisfied simply because to them satisfaction meant to have a house connection.

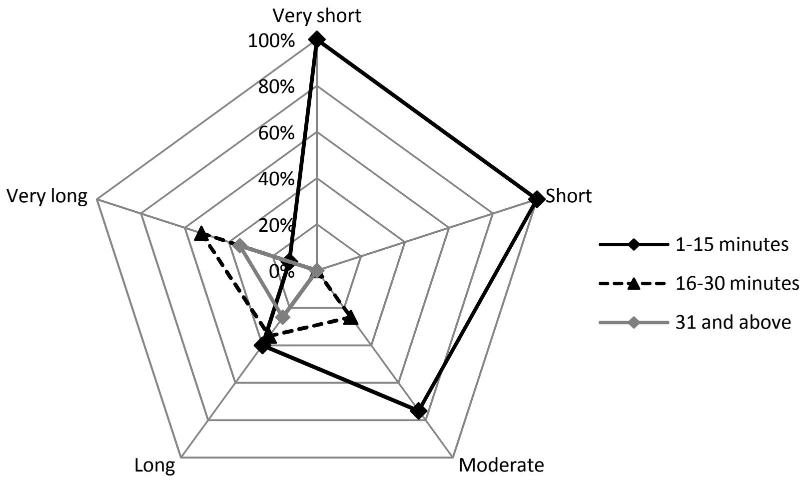


Figure 5-16: A radar chart showing the perception on time spent for water collection

#### 5.2.6. Affordability to water supply services

The level at which water service is affordable is often determined by the price of water in relation to the ability of the user to pay. To evaluate the level of affordability to water supply services there was a need to compare monthly average expenditure on water services and household monthly disposable income or expenditure (Hutton, 2012; Barifashe, 2014). Due to difficulties in getting household's income data, the level of affordability in the study area was determined by asking the households what amount do they pay for the service and then find it's proportion to the national average monthly expenditure on basic needs per household which was about 52,000/- Tshs[5] (NBS, 2014a). In addition, 5 percent of disposable expenditure as specified by the World Bank and ADB (Hutton, 2012) was used as the benchmark for determining the affordability level of households to water supply services.

The results in the study area showed that 85 percent of the surveyed households were paying for the service while 15 percent got water for free. The latter group were also divided into those who relied on public water points which offered free service or fetching water from their neighbours for free because of vendor's excuse owing to factors such as users being too old, disabled or other social factors. The observed payment arrangement by households buying water were under two categories; first the households with DAWASCO piped water connections within their dwelling's compound were paying to the corporation on monthly basis 'post-paid' and the official price was 1.08 Tshs per litre consumed (Nganyanyuka et al., 2014). The second category involved households buying water, at a price of 100/- Tshs per 20 litres, from their neighbour's or communal standpipes where the payment was done on a 'pre-paid' modality although the practice was not officially recognised by the DAWSCO as a main supplier. However, water from the public water points were supplied for free of charge, as discussed in earlier sections, although ad hoc contributions were solicited from users in case of pump breakdowns to meet maintenance costs. **Table 5-3** presents the price of water in the study areas as per each service provider offering service within the area.

[5] US$1 = 1680 Tshs

Table 5-2: Price of water in Kiromo and Zinga by different service operators

| Service provider | Service operator | Mode of payment | Price per 20 litres (Tshs) |
|---|---|---|---|
| DAWASCO pipe connection | DAWASCO | Post-paid | 22/- |
| Public water points | VWC | Free | - |
| Private water vendors | Tap owners | Pre-paid | 100/- |
| Civil institutions (e.g. Mosque) | Institution concerned | Pre-paid | 100/- |

As can be deduced from data presented in **table 5-2**, it is apparent that there is a significant difference in price of water supply services between DAWASCO pipe connection and other service operators. The findings showed that while those who were buying water from neighbours' taps paid 100/- Tshs per 20 litres, households with DAWASCO piped water connection were paying only around 22/- Tshs per the same volume of 20 litres (**table 5-2**). The former category was paying nearly five times the amount paid by the water tap owners to the corporation. The existing significant difference between the two price may be associated with the prevailing parallel operation of multi-actors service providers in the study area which can be referred to as *'triangular interaction'* (Hordijk et al., 2014) between the state, civil society and the market-based (DAWASCO) service delivery. In the existence of multi-actor approach in water service provision, it is often that where public provision fails to reach and satisfy the poor, market forces might compel the poor to pay even 10 times higher than what could be paid to the public service as argued by Hordijk et al. (2014). Nevertheless, monetary and no-monetary costs such as bureaucracy involved when applying for DAWASCO piped water connections were mentioned as main constraints to majority of households to access official piped water house connection. Consequently, those who could not afford the installation fees relied on either neighbours' water taps or unimproved water sources such as open shallow wells, which were likely to be contaminated and thus pose health threats to users.

In the case of household's expenditure on water services, the findings showed that the median expenditure was about 15,000/- Tshs per month per household ranging from 6,000/- to about 45, 000/- Tshs with only 2 extreme cases who spent around 60,000/- Tshs on water services (**figure 5-17**). However, with respect to the national average monthly total expenditure on basic needs (51,689/- Tshs) and the benchmark of 5 percent of disposable expenditure, the average proportion of household's expenditure on water services was to be around 2,584/- Tshs. That means, almost all surveyed households in the study areas spend more, on water services, than the national and international specified standards since their expenditures are far above 5 percent of total expenditure on the basic needs. This evidence may suggest that the majority of citizens' in the study area had worse access to water in terms of affordability.

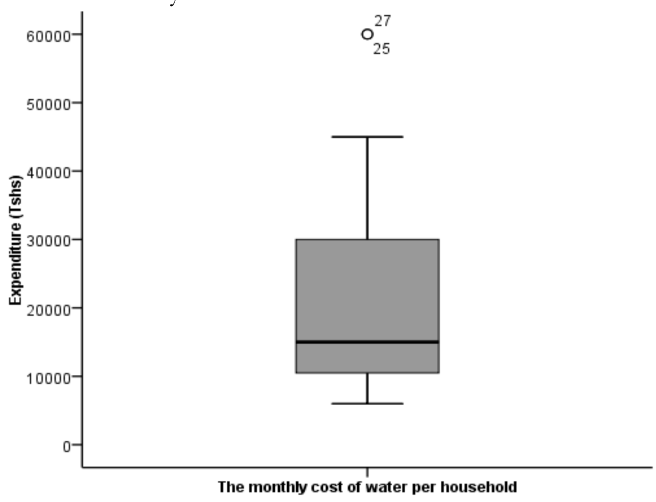


Figure 5-17: Proportion of households' monthly expenditure on water services

**Citizens' perception on the cost of water service**

Yet, despite that the households' average expenditure is far above the national standard, about 10 percent of respondents were very satisfied with the cost while about 40 percent considered the cost as higher for them to afford without interfering the budget for other needs as can be deduced from **figure 5-18**. However, the observation found out that while almost all households who were satisfied with the cost had DAWASCO pipe connections within the compounds of their houses, those who were not satisfied were buying water from their neighbours taps and Mosques. These findings may pose challenge to the concept of access to domestic water as a basic need and human right, since nearly half of the respondents claimed to be incapable to afford the cost unless sacrifice the budget for other basic needs. This may propose that since water was recognised as a human right and partly framed as an economic good, then the right to water is not on just water but instead to affordable water as argued by Masanyiwa et al. (2014).

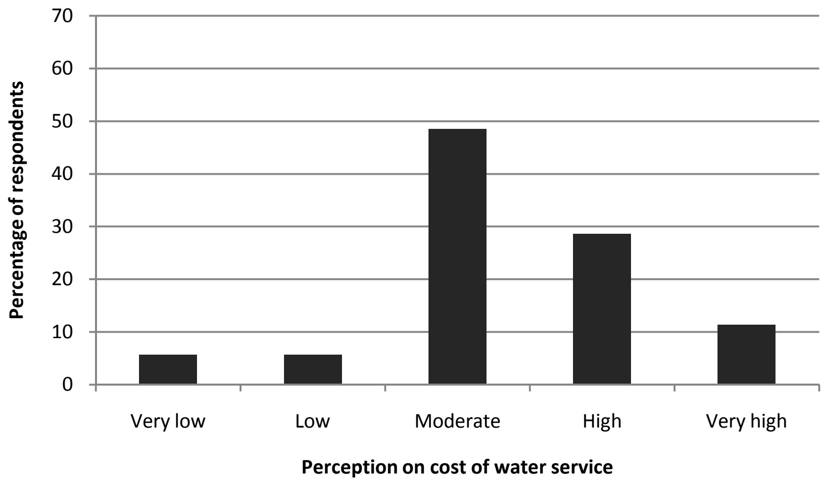


Figure 5-18: Citizens perception on the prevailing cost of water in the study area (n=40)

### 5.2.7. Quantity of water consumed

The national government through the Ministry of Water and other donor agencies had a target of providing at least 25 litres of water per capita per day as a minimum basic level of service in rural areas of Tanzania (United Republic of Tanzania, 2002). The findings from the study areas showed that the mean quantity of water, from improved sources, used per capita per day was about 29 litres, the amount above the minimum basic service level specified by the government with the range from 5 litres to about 60 litres per capita per day. However, the distribution of data is somewhat symmetrical as scores are skewed at 0.335 whereby the median is 29 similar to the average quantity and close to the mid-spread (IQR) of 24 litres (**figure 5-19**). According to the statistical results, about 60 percent of surveyed households met and were above the national target of using at least 25 litres per capita per day while 40 percent were below to far below the set national target. However, there are several possible explanations for the category that were below the national benchmark including factors such as limited affordability, water supply unreliability and access inconveniences, and others.

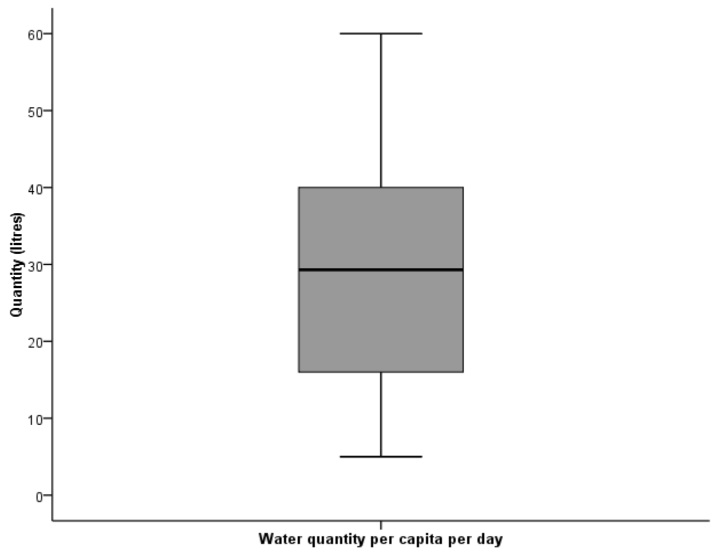


Figure 5-19: The average quantity of water (in litres) from improved sources used by each household's member per day (n=40)

**Citizens' satisfaction for the quantity of water used**

The results showed that about 47.5 percent of the respondents were satisfied with the quantity of water used while 37.5 percent were not satisfied. They indicated further that majority of those who were satisfied were using the quantity of water beyond the national average and collected water from house connection standpipes or neighbour's taps of within 15 minutes collection time. This was deduced after computing the bivariate correlation between the two variable, satisfaction against time spent, using spearman's rho whereby the spearman correlation was 0.465 that suggests a somewhat strong relationship between the variables and $p=0.003$ at $p<0.05$ which conclude that there is statistical significant relationship between time spent to collect water, quantity of water used and level of users' satisfaction. However, the households that were not satisfied on the quantity of water they used highlighted financial capacity as a major constraints for accessing adequate quantity of water for household's domestic uses.

### 5.2.8. Water supply service reliability

Reliability in this case means regularity or consistency in water supply service duration. According to national water policy and other national directives objectives water have to be supplied daily, meaning 24 hours a day (United Republic of Tanzania, 2002) given the fact that water is needed all the time. However, the results in the study area showed that the supply of water from the main sources mentioned was neither "24 hours a day" nor "some hours of each day" but rather "some days of each week". They showed further with about 88 percent of the mentioned main improved sources, particularly DAWASCO piped water, water was supplied on average of some hours of 3 to 4 days a week. This finding is incredibly contrasting to the DAWASCO water supply performance status report that remained at an average of 8 hours of service a day -to all connected users- until 2013 (EWURA, 2013). Nevertheless, the public water points, boreholes in particular, which served for only 5 percent of the surveyed households as main source, water was available 24 hours daily. And about 7 percent of households who depended on unimproved sources such as open dug well were getting water inconsistently since water in those sources were depending on seasons of the year. Further observation showed that during the days when water was available, the supply was usually during day time and rarely during the night.

### 5.2.9. Access convenience

In terms of access convenience, the findings revealed that a number of households those were collecting water from neighbours' taps their access to water were subjective to tap owners' terms and conditions as well as willingness. For instance, some households (HH_ID 20 for example) were not using the nearby neighbours' water taps because the taps were locked in most of time of the day depending on the presence of the owner. **Figure 5-20** shows examples of publicly operated private water points which were found locked, during household survey, simply because the tap owners were not around. However, even when the tap owner was around, he was free to decide on whether to sell water to all or just offer service to some particular buyers since the operation was not guided by any formal rules or regulations. On the other hand, the observations found out that several water tap owners had a restricted time for offering service such as from only 0800 hours to 1800 hours of the day as observed during household survey. Owing to such restrictions, buyers or users were not allowed to collect water from those taps on time earlier than 0800 hours nor after 1800 hours. However, such limited duration of time for collecting water may not be of convenience to users who leave their homes for jobs, agricultural and other activities much earlier than 0800 hours and return home later than 1800 hours. As a consequence, such users may be forced to either go for other improved water sources which are relatively far away from home but without such limitations or opt to use other unimproved water sources, often associated with a risk of contamination, which are accessible 24 hours daily.

Also, physical barriers such as fences with gates surrounding houses with water taps found to limit smooth and free access of water buyers or users from those particular sources. Therefore, in order to reduce or avoid disturbances to house owners as well as enjoy free service, the users or buyers were either opting to limit their frequency of water collection trips or go for other water taps which were relatively further away from their homes. As a consequence, users may be forced to consume less than required quantity of water or spend time, on collecting water, that were to be spent for other household's productive activities.

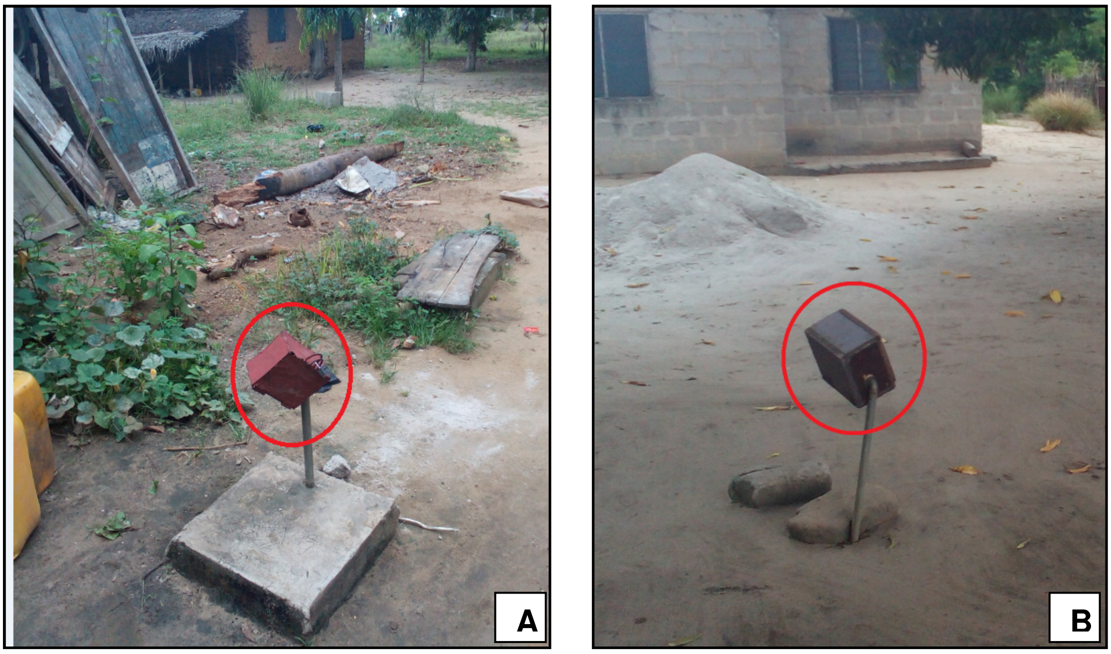


Figure 5-20: Examples of locked water standpipes (red circle) on picture 'A' and 'B' as found during survey in Kiromo and Zinga villages (October, 2014).

#### 5.2.10. Water quality

Quality of water is among the important dimensions for determining citizens' access to water as observed during household survey. Although water quality was not detailed covered in this study, but the highlights to its importance to the citizens in the study area seems of great importance. The observation revealed that while to service provider water quality refers to the set of standards on chemical, physical, microbiological, and radiological characteristics of water, to users the perceived quality is all that matters.

The perceived quality particularly in terms of whether water is fresh or salty, of water supplied by a specific source had an influence on the use of water from that particular source. For instance, water from improved public water points were perceived to be of low quality, because of salt contents, and thus not used for drinking rather for other purposes including dish washing, laundry, house cleanness and other uses. On the other hand, the citizens perceive DAWASCO piped water to be fresh and of high quality and thus suitable for drinking and cooking as well as for other domestic purposes. However, water from the taps might not be safe enough for drinking -without additional treatment- as leakages were found in some water pipes and a number of facilities were in deteriorated conditions (see **figure 5-21**) to the extent of risking safety of the supplied water from contamination. This findings is in line with the argument that using an improved water source does not necessarily mean access to safe water since deterioration of water sources may lead to unsafe water even from pipes (Nganyanyuka et al., 2014; Pigeon, 2012).

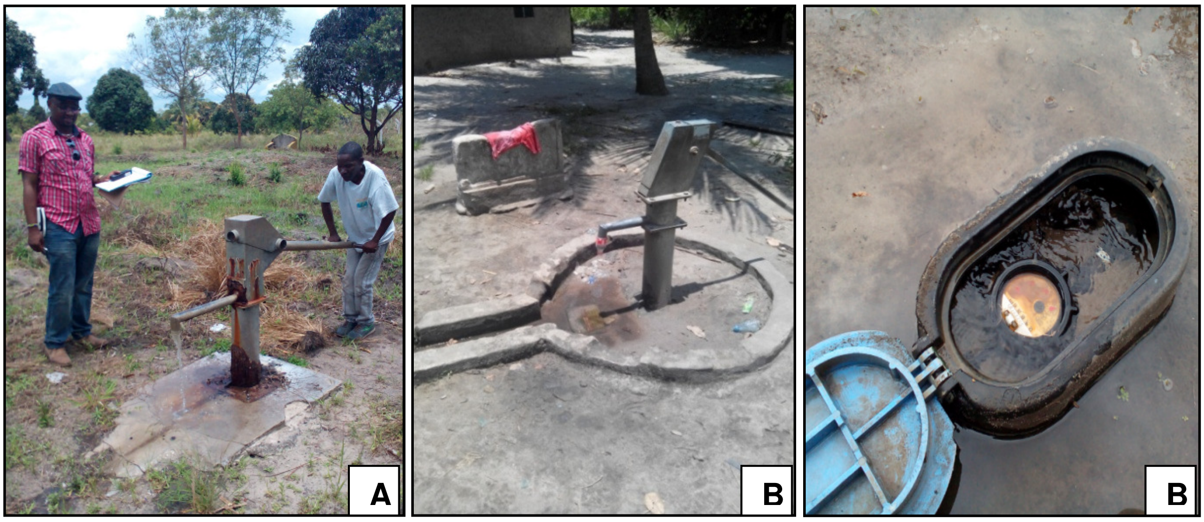


Figure 5-21: Examples of two deteriorated improved water sources (A and B) and a leaked water meter (C) as found in Kiromo and Mandawe villages (October, 2014).

#### 5.2.11. Acceptability

It is known from the literature that acceptability is crucial in determining citizens' access to water since water supply facilities may not be used if they fail to meet the social or cultural standards of the people they are meant to serve. The findings from the study area showed that the existing social and cultural issues such as social interaction between user or buyer and service operator or water vendor, religious interaction as well as factors on gender issues also had an influence on the decision to use a particular source. For instance, some households were opting to use particular water sources, even if there were located relatively far away from their homes, just because of good social or religious relationship between the water supply operator and the users to the extent that users can get credit when they lack money to pay for the service. This was confirmed by one of the respondent (HH_ID 5) in Mandawe village who was quoted saying:

*"...I always go to chairman's water tap because he is a good man and he sometimes allows me to collect water even when I have no money to pay for the service."*

### 5.3. Citizens' perception on the overall performance of water access dimensions

Despite that some of water access dimensions, such as proximity to the source, showed better performance, the findings regarding users' perception on the overall performance of water access dimensions showed that nearly two third of respondents were dissatisfied with the performance, the proportion which is beyond the national average of 58 percent as reported in the Poverty and Human

Development Report following a Round 4 Afro barometer survey in 2008 (United Republic of Tanzania, 2012). And about 35 percent of respondents were satisfied to very-satisfied with the performance while none of the households were in neutral category of satisfaction level as can be deduced from **figure 5-22**. The observations revealed further that majority of the households with DAWASCO piped water connection within their compounds were more satisfied with the performance of access dimensions than who were depending on neighbours' water taps and public water points This was justified by the statement of one respondent (HH_ID 01) with piped water connection within house compound who was quoted saying:

*"....being honest am very satisfied with the service in all aspects because I spend no more than two minutes to collect water from that tap [pointing to the standpipe within his home compound] when the water is available and store in plastic drums for use when is not supplied".*

On the other hand, the majority of households who were very dissatisfied depended mainly on open shallow wells for collecting water to serve all household's purposes. And the reasons mentioned for depending on unimproved sources included inability to pay for house connection fees and even for tap water, and long distance to improved sources. However, the users were conscious on the risk associated with using water from unimproved sources such as transmission of water borne diseases including diarrhoea and cholera.

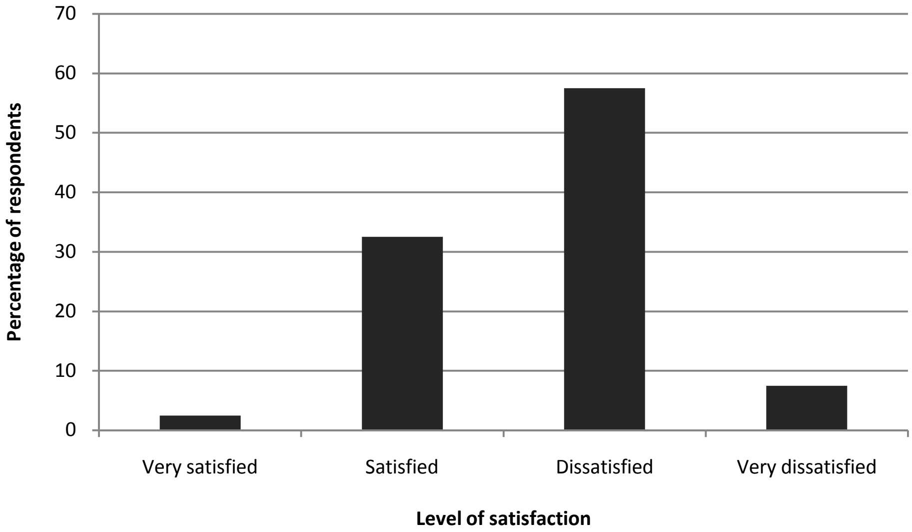


Figure 5-22: Overall citizens' satisfaction level to water access (n=40)

Nevertheless, when the respondents were asked to mention aspects that are important for better access to water, the majority of respondents mentioned piped water house connection as the first solution for improving their access to water problems. This is reflected in the visualisation of their opinions (see **figure 5-23**) through Wardle word cloud computer application that gave an insight into the transcribed citizens' opinions on the asked question (question 27 in *Appendix 2*). The mentioned solution is likely to be valid since house connection may be perceived as being linked to better performance of a number of other access dimensions including proximity, time spent for collecting water, and quantity to be consumed.


Figure 5-23: Visualization of citizens' opinions on aspects that are of preference to optimal access to water (n=40)

However, variation in level of satisfaction between genders was another issue revealed during the survey. The results showed that women were more dissatisfied on the overall performance of access dimensions than men as can be construed from **figure 5-24**. The level of dissatisfaction of women on overall performance of water access dimensions was far above men's dissatisfaction probably because they were the main responsible member to collect water for the households' use and thus victims of consequences of poor performance on water access dimensions. The findings showed further that while 82 percent of females were responsible to collect water for their households, only 18 percent of males were responsible to the same task (**figure 5-25**). These findings, corroborate the observations of other previous studies, such as of Masanyiwa et al. (2014) who found out that women and girls bear the primary responsibility for domestic water provision. This might be the case since men and women have different requirements for and access to water as well as different roles and responsibilities in relation to water provision for household's domestic use influenced by gender-power relations at household as well as community levels (Masanyiwa et al., 2014). Apparently, there might be several possible arguments on such stances, yet socio-cultural norms and traditions of a particular area such as those consider the duty of fetching water to be a 'feminine' duty should not be overlooked.

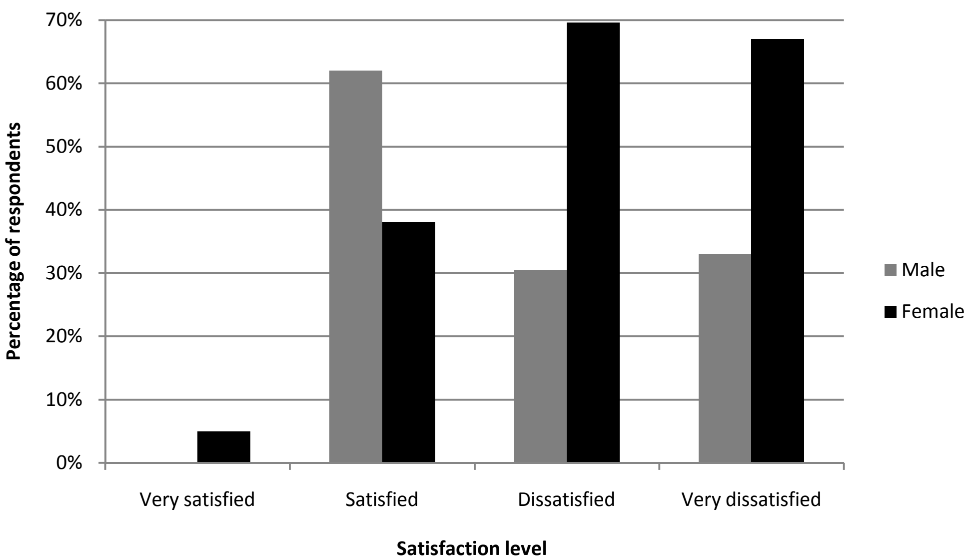


Figure 5-24: Citizens' level of satisfaction to water access by gender (male-n= 14, female-n=26)

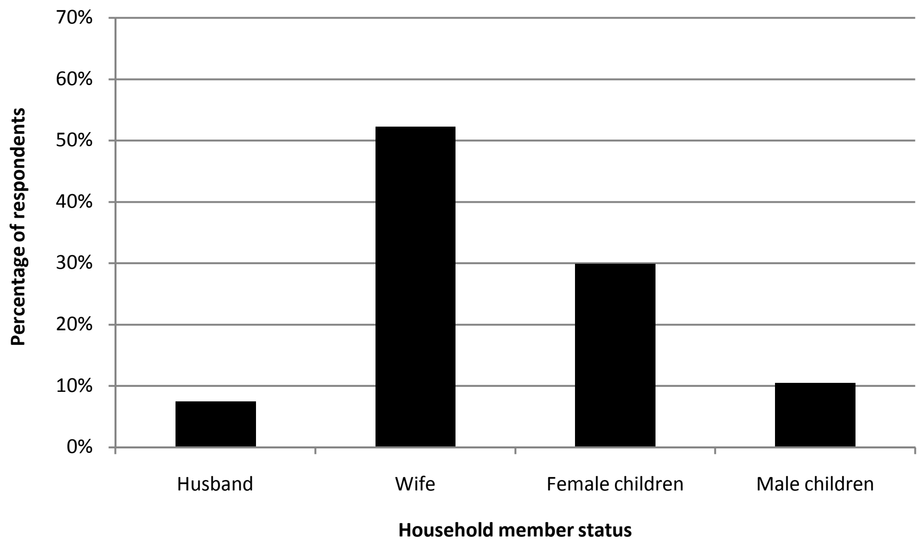


Figure 5-25: Roles and responsibilities of household members on collecting water for household's domestic uses (n=40)

Another issue observed during the survey is the influence of seasons of the year, wet and dry season in particular, on the overall performance of water access dimensions. The findings showed that 60 percent of respondents perceive better performance of water access dimensions during wet season than during dry season and the remaining 40 percent consider no significant differences between the two seasons. According to the responses from the former category, the performance is better during wet season because during that period user collected water from rainfall and the wells were filled up with rain water and thus improve their access to water for various domestic purposes. On the other hand, some households, especially with house water pipe connections, argued partly that the influence of seasons of the year was not that significant on their access to water because they were always using water from the taps for drinking purpose and rain water for other purposes. However, their practice of not depending so much on rain water collection is likely to be valid since the supply from rain is somewhat uncertain in terms when is it going to rain as well as in what quantity.

## 5.4. Categories of citizens' strategies to water access

The adopted households' strategies and initiatives towards improving their access to water in the study area, as discussed in earlier sections, aimed to supplement public water supplies. They were very common not only to households in communities that were too small to qualify for public water point delivery but also in areas where groundwater were plenty. The strategies can mainly be classified into three categories, as adopted from Nganyanyuka et al. (2014), which are:

### 5.4.1. Enhancement and Adaptation

Whereas "enhancement" strategy entail strategies that trying to solve the deficiencies related to water access dimensions such as to increase the quantity of water supply services by supplementing the available supplies, "adaptation" strategy is about adjusting behaviour to accommodate the unreliable supply of water such as controlling consumption or buying storage facilities such as metal and plastic drums buckets with or without lid, jerry can and others so that to store water when the supply is accessible. The findings in the study area revealed a number of strategies for both enhancement and adaptation implemented by households to improve their access to water as can be seen in **table 5-4**.

### 5.4.2. Individual and Communal strategies

The observation disclosed that most of enhancement as well as adaptation strategies used by households to solve water access dimensions shortcomings fall under 'individual' strategies or 'communal' initiatives as outlined in **table 5-3**.

### 5.4.3. Short term and Long term strategies

Another category of strategies and initiatives is based on time lengthy to serve the intended purpose. Most households in study areas were depending on short term strategies and initiatives to improve their access to water than long term ones. For instance, about 63 and 10 percent of surveyed households depend on neighbours' standpipe water supply and dug shallows wells respectively which obviously are short term strategies as well as for 5 percent who were using public water point. Conversely, about 22 percent implemented long term strategy by connecting piped water within the compound of their houses.

**Table 5-3** outline different common strategies and initiatives used by households in the study areas to improve their access to water. It also highlights whether the strategy was for enhancement or adaptation, individual or communal initiative, short term or long term, and which particular dimension was solved by each strategy.

Table 5-3: Citizens' strategies and initiatives towards improving their access to water

| | **Categories of strategies** | | | | | | **Dimensions of access** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Citizens' water access strategy** | Short term | Long term | Communal | Individual | Enhancement | Adaptation | Proximity | Affordability | Reliability | Collection time | Quantity | Perceived quality |
| Buying water - neighbour's standpipe | ● | | | ● | ● | ● | ● | ● | | | ● | ● |
| Buying water from Mosques | ● | | ● | | ● | | ● | | ● | | ● | |
| Standpipe in house compound/yard | | ● | | ● | | | ● | ● | | ● | ● | ● |
| Digging shallow wells for public use | ● | | ● | | ● | | ● | ● | * | ● | * | |
| Digging shallow wells for private use | ● | | | ● | ● | ● | ● | ● | * | ● | * | |
| Harvesting rain water | ● | | | ● | ● | | | ● | * | | | ● |
| Buying water storage containers | ● | | | ● | ● | ● | | ● | | ● | ● | |
| Water use depending on source | ● | | | ● | ● | ● | ● | ● | | | ● | ● |
| Household water treatment | ● | | | ● | | ● | | | | | | ● |

Note: * Indicates strategy that its performance depends on season of the year, particularly wet and dry season

Source: Adopted from Nganyanyuka et al. (2014)

However, the findings revealed that despite the fact that informal private water selling activities have a vital contribution towards sector performance since they constituted the majority of citizens' access strategies, as justified in earlier sections; the reported official statistics do not consider their roles instead they are too focused on the role played by national government and international agencies only. This finding is in agreement with Nganyanyuka et al. (2014) and Satterthwaite (2003) who concluded that official statistics, of water access, are only partially relevant as they ignore the vital contribution of informal, private water selling, activities which have significant contribution towards sector development.

### 5.5. Measuring water access views: service provider and users

The most striking challenges observed on the progress to measure citizens' access to water is the discrepancies on the understanding of water access concept as well as on methodological approaches adopted to determine access between the government, as service provider, and the citizens, as service users. However, by understanding similarities and differences between the service providers' or "supply side" and users' or "demand side" practice, we can increase our understanding and learn more about both, and thus be able to propose which is more useful or valid on the issue at stake. The following paragraphs, therefore, present the contrast between the supply side views and the users or citizens views on determining water access.

The previous discussion showed that the current practice of the government, through the MoW and LGA, to monitoring progress of water access goals and targets define and estimate water access in terms of water supply service coverage with more focus on quantifying water-infrastructure provision to justify the investment made on them (value-for-money). Furthermore, the basic methodological approach used to determine water access is significantly centred on quantitative and objective dimensions of access to water. However, the power of indicators benchmark and the reported official statistics, derived from them, inherent in those goals and targets left out a number of concerns that might be captured from users' experience and perceptions. The official aggregated coverage estimates, with quantification nature, are not adequate to monitor the targets as they somewhat do not take into account what matters most to citizens as service users. Whereas the quantitative and objective indicators is the hub to the monitoring of water access goals and targets on the supply side, a day-to-day strategies of accessing water is the central concern to citizens as water supply service users.

The results from both quantitative and qualitative approaches used in this study revealed that the objectivity of the definitions as well as the approaches used by service providers to estimate access in terms of coverage, to some extent, do not fully confine the complex nature of water access from users perspectives. With users' perspectives, water access was interpreted in terms of "actual use" of water for an intended purpose rather than mere provision of water supply infrastructures as it was found that even though public water points were installed but some were not used as expected by the service providers. The observations established that actual use of water from different sources were subjective to dimensions beyond physical access and coverage as users focused more on other attributes including affordability issues, water quantity and perceived quality, water supply service reliability and convenience, existing social relationship between water supplier and users, and the associated strategies to improve their access to water. The findings, as discussed in earlier sections, suggest that with the prevailing diverse socio-economic and cultural context amid households, users are more likely to demand certain elements to determine their access to water as far as there is multiple and competing uses of water with diverse context. For instance, attributes such as perceived quality of water with respect to intended use by the household may compel users to go for particular water sources located at relatively longer distance and ignore other near sources as they are perceived to supply water with unacceptable quality to serve the intended use. This justifies the argument that a mere provision of water supply infrastructure, as it is the focus of supply side, does not necessary imply the actual use by the intended households or users (Kayaga et al., 2009; Nganyanyuka et al., 2013). The implications from these findings suggest that, the operational definition and indicators practice by the supply side leave out some important access dimensions from users' perspectives which are essential for sustainability of water infrastructure and facilities, as well as access strategies which are obviously of great concern to them since they aim at solving their day-to-day water access problems.

Nevertheless, the current practice on estimating and compiling water access official statistics, by service providers, are more likely to provide a misleading depiction of the extent of water access problems on the ground (Satterthwaite, 2003) merely because they are generated at high levels of aggregation and thus fails to reflect asymmetries of citizens' modes of access to water in the presence of users' diverse socio-economic condition and context. **Table 5-4** presents the summary of important aspects of water access considered by the government as service provider and those derived from users' experience and perceptions.

Table 5-4: Variation in water access dimensions as considered by service provider and perceived by citizens as service users

| Water access aspects and users access strategies | Description | Service provider | Citizens |
|---|---|---|---|
| Water source type | Whether improved or unimproved source | ● | |
| Water use | Water use depending on source type | | ● |
| Water point functionality status | Whether functional or non-functional | ● | ● |
| Management of water source | Whether VWC, private or civil society | ● | |
| Distance to the source | A maximum distance of 400m from a water source to user's home | ● | |
| Time spent for a round trip | Time spent for a round trip (go, wait, collect and return) of collecting water | ● | ● |
| Quantity supplied | Quantity of water supplied by the source | ● | |
| Quantity consumed | Quantity of water consumed by household per day | | ● |
| Quality of water | Quality of water according to objective health standards such as of WHO | ● | |
| Perceived quality | Quality of water from the source as perceived by users | | ● |
| Affordability | Capacity to pay for adequate water supply services | | ● |
| Water supply reliability | Availability of water supply service for 24 hours daily | ● | ● |
| Convenience | Restriction to smooth physical-access to water source | | ● |
| Acceptability | Consideration to social and cultural factors | | ● |
| Access strategies | Strategies and initiatives of citizens to improve their access to water such as self supply | | ● |

# 6. CONCLUSIONS AND RECOMMENDATIONS

This chapter gives summary of the results and discussion by referring to the objectives and answers of the research questions posed in the introduction. It also presents possible propositions that may be noteworthy and opportune for the post-2015 development agenda discussions. Additionally, the chapter highlights areas for further studies.

## 6.1. Conclusions

The main goal of this research was to examine the selection, use and practice of water access indicators in measuring citizens' access to water in rural areas of Tanzania. To achieve the goal, the conceptual framework was formulated based on the reviewed literatures. Making use of data collected and analysed by statistical tools, the current practice of water access indicators to measuring rural water access and on how citizens describe their access to water was examined. And by the use GIS tools and satellite image, the spatial distribution of water points service coverage in Kiromo and Zinga wards was mapped and the pockets of served and underserved areas analysed. From the findings, the most striking challenges on the current practice to measure citizens' access to water is the discrepancies on the understanding of water access concept as well as on methodological approaches adopted to determine access between and among the government and its agencies, and the citizens as service users. The synthesis of results with respect to objectives and questions of the research are as presented below.

### 6.1.1. Water access concept definition

As discussed previously, for the government better access to water exists when a household collects water within a distance of not more than 400 meter while spending a maximum of 30 minutes for a round trip, with the consumption of at least 25 litres per person per day. Also, as the service provider, an optimal water access to the government is when one water point serves 250 people within 400 meter. This objective definition interprets water access in terms of service "coverage" and management. On the other hand, the findings showed that among users better access to water is likely to mean "actual use of water for an intended purpose". The definition goes beyond physical access to water as well as service coverage issues, as the evidence confirmed that a mere provision of water supply facilities does not necessarily indicate actual use by the intended users. A good example is when it was found, in the study area, that even though public water points were installed but a remarkable number of them were not used as expected by the service providers.

### 6.1.2. Methodological approaches to measuring water access

The government through the MoW and NBS are the key institutions in measuring and assessing citizens' access to water in Tanzania, although in some circumstances data are collected through commissioned pieces of research undertaken by other organizations such as academic and research institutions. The evidence from the findings indicate that both systems focused more on quantitative information which may be taken as indicative rather than on ground truth-revealing. This is likely due to factors such as errors in surveys design, implementation and analysis, as well as the fact that they both miss dimensions which are not easily quantifiable. Also, their aggregation nature, in compilation and reporting, fails to capture the prevailing intra-district, -ward, as well as intra-village differences. Yet, the methodological approaches adopted to collect, analyse and compiling data showed discrepancies between them as well as within institution, the NBS in particular. The discrepancies are in the following aspects:

**i. Data types, sources and collection approach**

Whereas the MoW use administrative data collected from each local government authority to monitor the progress on water access service coverage goals and targets, the NBS collects data through household based national surveys such as national population census, HBS, and DHS to assess the impacts of water supply services delivered to the citizens. With the ministry's approach, data are collected at water point scheme level, compiled and reported at national level aggregate. The types of data collected focused mainly on water points' functionality, management, technical specifications, and quality and quantity of water supplied at each outlet. However, despite that the MoW has adopted the WPM system for collecting and updating water access data, the implementation of the system faced a number of technological and resources limitations and thus yet to optimally be used. By such shortcomings, administrative data can easily be manipulated, by the local authorities or the ministry, by overstating progress and understating challenges in order to meet performance targets established by the central government, as argued by Nganyanyuka et al. (2014) that inadequate counting in water access may benefit local governments by hiding the extent of the problem. It is, therefore, the conclusion of this study that administrative data are partially appropriate to measure citizens' water access as they give more attention on service coverage or physical access, while a mere provision of water supply facilities provides no guarantee that the water is safe, adequate, used and reliable year around.

On the other hand, although the NBS assesses water access through frequent national household survey data, but the problem of data aggregation and timeliness reporting is still a challenge that requires attention. However, to achieve timely reporting as well as reduce problems connected to aggregate data, there are computer assisted programs and information and communication technologies that can speed up the data collection, processing and analysis. In addition, the variations across surveys' frameworks and contents -in terms of dimensions considered and questions wording- over time as well as sample design between them is another challenge. This challenge might contribute to water access data inconsistence and difficulties in comparing the progress of water access targets as well as performance of poverty reduction measures over time and places. Nevertheless, the findings suggest that the two approaches may both be employed in parallel whereby the survey-based approach can be used to cross check administrative data, and the surveys frameworks and contents can be harmonized to enhance reliability and data consistence.

**ii. Geographical scale of measurement and mapping**

As discussed previously, the current official statistics are generated at high levels of aggregation and thus are more likely to provide unreliable statistics and under- or over-estimations which may give out a misleading picture on the extent of water access problem on the ground. The aggregate data often, characterizing greater water supply coverage and are connected with the problem of ecological fallacy. Simply because they fail to reflect asymmetries of citizens' access to water strategies by not accounting for prevailing diverse socio-economic and cultural context and conditions that have an influence on the choice of users' modes of access. However, the government has potential, although are yet to be fully utilized, of using WPM and GIS systems to reduce the problems connected to ecological fallacy. This can only be achieved when water access indicators will be operationalised by the two systems. The GIS-based indicators are capable to address the ecological fallacy when are combined with different data such as socio-economic data from census as well as administrative data to communicate and visualize the gaps between different socio-economic groups in different spatial scales. Thus, the approach can be used to assess rural water access problems as well as evaluating the success of implemented sector interventions. Yet, for the adoption of GIS-indicators to succeed, they should be able to respond to the local needs and policy demand as recommended by Martínez (2009).

**iii. Water access indicators practice**

The current practice shows that, the predominant used indicator to estimate citizens' water coverage by the government is the Functional Water Point Density (FWPD). With FWPD, percentage of full coverage is determined by taking the number of functioning water points times 250 inhabitants divide by the available population size of a particular area expressed in percentage, regardless of distance benchmark specified by the water policy. However, the government measures the performance of citizens' water access using other indicator dimensions including water points' functionality status, technical specification, management, source quality, and water quality and quantity supplied at each outlet. Yet, all those dimensions give more focus on performance of supply side to justify the investment on water supply infrastructure made by the government and development partners while insignificantly account for demand side or service users.

### 6.1.3. Spatial distribution of water points and service coverage

The spatial pattern observed from geographical distribution of water points in the study area showed the obvious pattern that the concentration of water points were increasing as one moves towards roads and village centres. This is because those areas are socio-economic hubs of rural areas and thus becomes more populated than areas away from roads and village centres. From that pattern, areas with reasonable population to qualify for public water point provision but lack water points (the under-served areas) can be analysed. However, particularly in this study, the spatial findings on the analysis of under-served areas may not fully reflect the reality on the ground because housing units were used as proxy to population density, the situation which is not necessary true that each housing unit was used for dwelling. Nevertheless the spatial findings with regard to a 400 meter benchmark revealed the overlapping of water points' service coverage which in turn may render to under-estimation of coverage statistics as users within overlap areas are over served.

### 6.1.4. Citizens' perception on the performance of water access indicators

With regard to prevailing households' diverse socio-economic context and conditions the findings revealed that households are more likely to opt for certain access strategies depending on its socio-economic and cultural condition. For instance, a household might opt to use water from a particular source depending on factors such as the intended use, the reliable supply of water they can afford, access convenience, perceived quality, acceptability issues and others. However, in particular case the distance or proximity to the source was found to be of low priority to majority of users in this study, probably because of DAWASCO house pipe connections which increases the amount of water supply sources. Yet markedly, the study provides additional compelling evidence that service reliability, access convenience and acceptability in terms of social and cultural issues, dimensions which were previously less acknowledged, are of high influence to citizens' better access to water. And the performance of some of water access dimensions are linked to one another, for instance better performance in supply reliability might have influence on quantity of water consumed and spent time for water collection.

### 6.1.5. Variation between the government practice and citizens perceptions

The findings from both quantitative and qualitative approaches used in this study revealed that the current practice of government to monitor progress of national goal as well as MDGs on citizens water access by relying more on objective or statistical indicators seemed insufficient to capture the complex nature of water access from users' perspectives. The practice does not take into account users' expectations, experience, perceptions on water access as well as some of their strategies and initiatives that aimed at improving their access to water. Moreover, the estimates derived from adopted indicators do not depict the reality on the ground, for instance, with FWPD indicator, Kiromo and Zinga wards seemed to achieve 188 percent of coverage while from users perceptions water access problems were still a challenge. Moreover, the official statistics do not acknowledge the vital contribution of informal private water selling activities and strategies towards sector performance despite the fact that they constitute the majority of citizens' water access strategies. With such practice, the study concludes that official statistics of water access are partially valid to reflect the actual situation on the ground since the process of monitoring goals and targets are too focused on the role of national government and international agencies while neglecting the investments and initiatives that citizens and their organizations can bring to poverty reduction.

#### 6.1.6. General conclusion

In general, the findings of this study do not contradict the current consensus initiatives, and the positive effects of the MDGs as well as of national goals progress towards water-related poverty reduction. However, the power of indicators benchmark and reported official statistics, on the basis of those standards, inherent in these goals and targets left a number of concerns and often unintended consequences, as discussed in earlier sections, which certainly deserve attention in light of a post-2015 development agenda discussion as also argued by Fukuda-Parr et al. (2014). As noted in earlier discussions, a simple list of numerical targets as well as the current monitoring framework may not articulate an agenda for a complex and normative phenomena, such as water access as a human right. For instance, the reported official aggregate coverage statistics, with quantification nature, are not adequate to monitor the targets as they partially take into account what matters most to citizens in their day-to-day efforts. Instead, water access as a human right requires targets and indicators that are both quantitative and qualitative, as many essential dimensions of water access cannot be reliably quantified. Thus, as the post-2015 development agenda debate moves towards shaping an ambitious sustainable development frameworks to meet the needs of both people and planet (United Nations, 2012), it is important that the basis for target design and water access indicators selection takes into consideration many of the above discussed concerns so as to create a balanced, nationally relevant and action-oriented framework.

However, in the national context, the findings can be useful in the application of remedy policies on water sector by providing a better understanding on "who counts what and how" when measuring citizens' access to water. This is particularly useful for sector practitioners and policy makers as it provides inputs necessary for monitoring the progress of national and global goals as well as water-sector development.

### 6.2. Recommendations

#### 6.2.1. Areas for further studies

From the experience learned from national goals and MDG goal 7 monitoring, the problem of data in terms of adequate quality, timeliness, aggregation, reliability, and others is still a challenge that requires attention as the world moves to post-2015 development agenda. Therefore, since data on water access indicators seems to be central to monitoring the progress of water access goals and targets, further studies are required on how to develop and mobilise the publicly available advanced data collection and analytics tools and algorithms to better capture and evaluate both objective and subjective indicators. For instance, technical mechanisms and algorithms on how WPM system, GIS and remote sensing can integrate new data, perception-based data in particular, to be collected through new advanced techniques and tools, with traditional data so as to produce high-quality information that is more detailed, timely, and relevant for multiple purposes and users. Yet, it remains a challenge how to find out better ways of taking-into-boat informal strategies, initiatives and activities that reflect the local citizens' needs, expectations, and experiences. It may be possible that by taking into account the contribution of informal sector-operations, the collected data will reflect the reality on the ground, and thus provide clear inputs for sector-policy regeneration.

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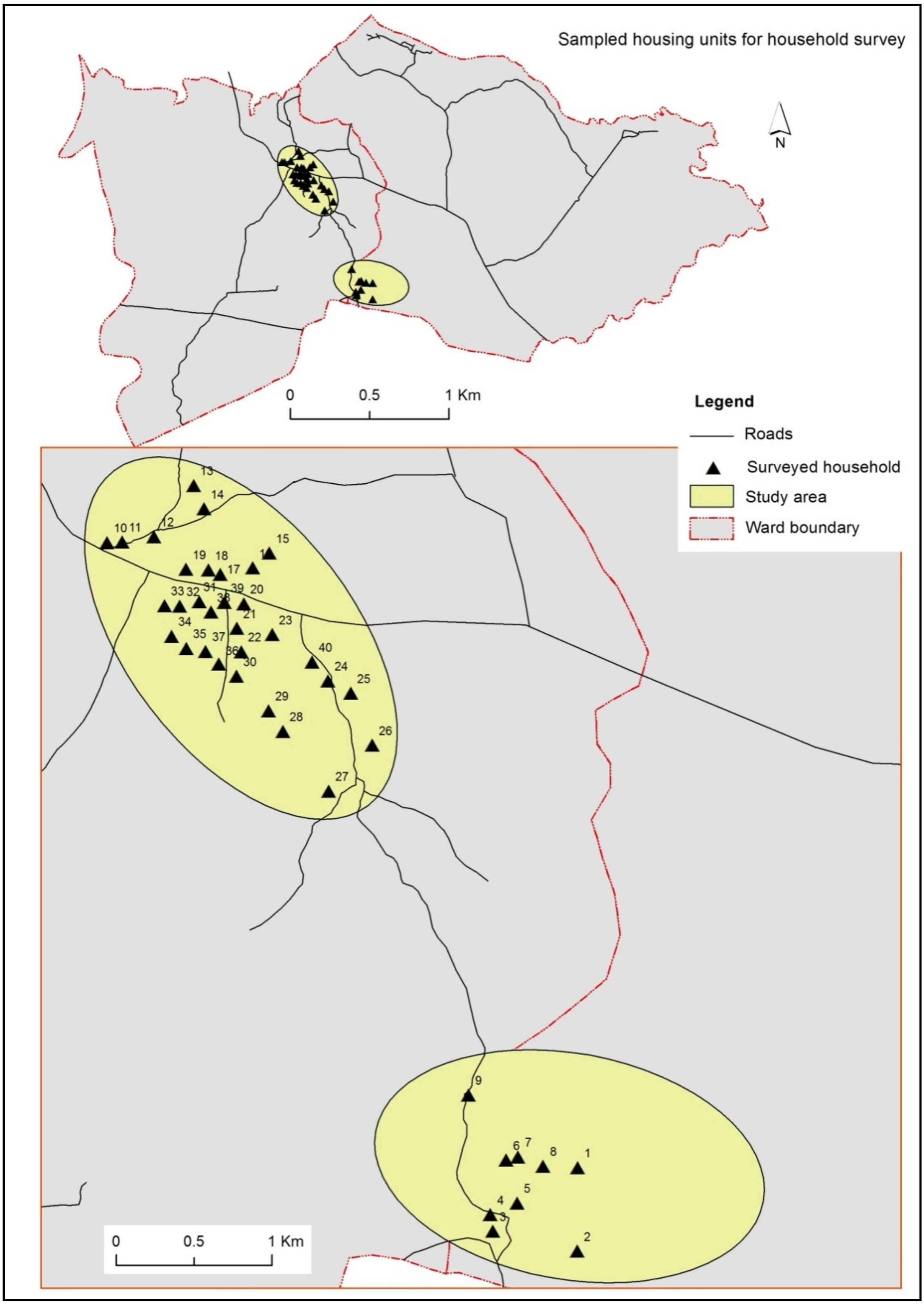
# LIST OF APPENDICES

**Appendix 1:** A map showing sampled housing units (n=40) where household interview was conducted through the prepared questionnaires.



**Appendix 2:** A sample of questions used to collect data during household survey in Kiromo and Zinga wards, Bagamoyo district in Tanzania

**QUESTIONNAIRES FOR HOUSEHOLD INTERVIEW**

1. Ward name:……………………………Sub-Village name:………………………………………

2. Name of interviewer:…………………………………………………..

3. GPS coordinates (house location): Household No…………...
   a. X-coordinates: ……………………………………….
   b. Y-coordinates: ……………………………………….

**A. Household details**

1. What is your position in the household:
   a. Husband [ ]   b. Wife [ ]   c. Other (specify)…………………….
2. What is the educational level of;

| | Pre-primary | Primary | Secondary | Post secondary | Other (specify) |
|---|---|---|---|---|---|
| Husband | | | | | |
| Wife | | | | | |

3. What is your employment status?

| | Employee | Self employment in non-agriculture | Self employment in agriculture | Other (specify) |
|---|---|---|---|---|
| Husband | | | | |
| Wife | | | | |

4. What is the number of people in your household? ………………………..
5. How many bedrooms are in this house? ………………………….
6. What is the main building materials used for building this house? (*Circle the answer*)
   - Roofing materials - a. Iron sheets b. Grass c. Mud and leaves d. Others (specify)……
   - Flooring materials - a. Cement b. Ceramic tiles c. Earth/Sand d. Others (specify)…...
   - Wall materials – a. Cement bricks b. Burnt bricks c. Sundried bricks d. Poles and mud e. Others (specify)……………………………………
7. Is the house owned by the household? Yes [ ] No [ ]
8. Does your household own the following assets in working condition? (*Circle the answer*)
   a. Mobile phone b. Television c. Motor vehicle c. Motorcycle d. Bicycle e. Others (specify please)……………………………………………………………………….

**B. Water service provision and access**

**I. Water sources, proximity and costs**

1. What is the main source of water used by the household? (*Circle the answer*)
   a. Piped water into house/plot/yard
   b. Public water point (hand pump/tap/kiosk)
   c. Neighbour's tap/standpipe
   d. Protected dug well
   e. Open dug well
   f. Surface water (e.g. river, dam, lake)
   g. Others (specify)………………………….….
2. Where is the main source of water you are using? (*Specify the name of the place or facility*)? ……….. ………
3. What are the uses of water collected from the mentioned source? *(Multiple answers are possible).* a. Drinking b. Cooking c. Dish washing d. Bathing e. Laundry
   f. Others (please specify…………………….)

4. Do you have any other alternative sources of water? Yes [ ] No [ ]. *(If Yes ask question 4 and if No go to question 5)*

5. What are those alternative sources? (*more than one answer is possible)*

| | Alternative source | Water use | Service provider | Reliability | |
|---|---|---|---|---|---|
| | | | | **hrs/day** | **dys/wk** |
| | Public water point (hand pump/tap/kiosk) | | | | |
| | Piped water into house/plot | | | | |
| | Neighbour's tap/standpipe | | | | |
| | Protected dug well | | | | |
| | Open dug well | | | | |
| | Surface water (e.g. river, dam) | | | | |
| | Others (Specify)…………… | | | | |

6. How long does it take to reach the source, get water and come back? (walking time in minutes): ………………………………………………………………………………
7. How do you consider the time spent for fetching water?
   Very short [ ] Short [ ] Moderate [ ] Long [ ] Very long [ ]
8. Who is the service provider of the water you are using?
   a. District council authority [ ]
   b. Local community organization [ ]
   c. NGOs [ ]
   d. Others (specify)............................................
9. Who is responsible for collecting water from the source? a. Husband [ ] b. Wife [ ] c. Female children [ ] d. Male children [ ] e. Others (specify please)………………
10. Do you pay for water from the sources you mentioned in questions 1 and 4 above?
    Yes [ ] No [ ]. *(If Yes, ask question 11 and 12 and if No, jump to qn.13)*
11. How much money (in Tshs) in average do you pay for water supplied per household per day for each source?
    a. Main source Tshs…………………...
    b. Alternative source(s)…………………………………………………….…….
12. How do you consider the cost of water supplied?
    Very low [ ] Low [ ] Moderate [ ] High [ ] Very high [ ]
13. Is the main water source the nearest source from this house? Yes [ ] No [ ]. (*If No, ask question 14).*
14. Why not using the nearest water source? (multiple answers are possible)
    - High water price [ ]
    - Low discharge [ ]
    - Short duration of supply [ ]
    - Inappropriate time of supply [ ]
    - User long queue [ ]
    - Other (specify): ………………………

**II. Water supply quantity and reliability**

15. What is the average quantity (in 20litres bucket) of water does the household use per day?...................…..............
16. How satisfied are you with the quantity of water you are using?
    - Very satisfied [ ]
    - Satisfied [ ]
    - Neither satisfied nor dissatisfied [ ]
    - Dissatisfied [ ]
    - Very dissatisfied [ ]
17. If not satisfied what quantity of water will you consider enough?.........................................

18. How many hours per day water is supplied/available?………………………………
19. How many days per week water is supplied?.............................................................
20. At what time of the day water is supplied? Day time [ ] Night time [ ] Both [ ]
21. How satisfied are you with the frequency of water supply or availability?
    - o Very satisfied
    - o Satisfied
    - o Neither satisfied nor dissatisfied
    - o Dissatisfied
    - o Very dissatisfied
22. Is the water availability varies with months? Yes [ ] No [ ] *(If Yes ask question 22 and 23 if No go to qn. 24)*
23. Which months are marked by scarcity of water supply? *(If any selected ask qns. 14 and 15)*

    J F M A M J J A S O N D
24. What alternative source do you use during water-scarcity period?
    ……………………………………………………………………………….
25. How long does it take to get water from that source during water-scarcity period? (walking time- go, wait and return in minutes): ……………………….................................
26. In general, how do you consider your access to water supply services?
    - o Very satisfied
    - o Satisfied
    - o Neither satisfied nor dissatisfied
    - o Dissatisfied
    - o Very dissatisfied
27. From your opinion, what aspects do you consider important for an optimal access to water?……………………………………………………………………………………………………
    ……………………………………………………………………………………………………
    …………………………………………………….

**Thanks for your co-operation!**

**Appendix 3**: Sample of guiding questions used during key informant interviews during field data collection in Tanzania.

**QUESTIONS FOR KEY INFORMANTS**

The questions listed below aim at collecting information on "how citizens' access to water is measured and mapped" particularly in the case of rural water supply services. The research in connection with those questions is using Kiromo ward in Bagamoyo rural areas as a case study. I therefore kindly request you to participate in this research by answering the down listed questions. I either guarantee you that the provided information will be used to address the purpose of the research and not for any other intention, and will be treated with full confidentiality. If you have any queries about these questions, please contact me through (+255) 764 407 969 or a.a.mwamaso@student.utwente.nl

**I. Measuring/determining access to water**

1. The government policy documents define citizens' access to water in terms of the following variables;
    a. Walking distance of not more than 400m from water point
    b. Water point per population coverage (1wpt per 250 population)
    c. Walking time to fetch water of not more than 30minutes from water point
    d. Quantity (at least 25litres per capita per day)
    e. Water supply reliability (daily water supply)
    f. Affordability (cost sharing)

    Which variables among those mentioned above do you practically take into account when assessing citizens' access to water?
2. What type of data do you use to assess citizens' access to water?
3. How is data collected and compiled?
4. How frequently is the collected data updated?
5. Do you use the data for any other purpose?
6. Do you share the collected data with any other institution? Yes [ ] No [ ] *(if yes ask question 7 and if no jump to qn 8)*
7. Which institution and what type of data do you share?
8. What is the purpose of sharing data?
9. Who has the official role to publish the results? (*Circle the answer*)
    a. The ministry of water
    b. The national bureau of statistics (NBS)
    c. Other (please specify…………………………………)
10. Do you consider the same variables and same data when reporting the results for the government use and international donor agencies' use? Yes [ ] No [ ] (*if no ask Why?*)
11. What sources of water do you consider when determining citizens' access to water?
    a. Public water point (hand pump/tap/kiosk)
    b. Piped into house/plot/yard
    c. Neighbour's tap/standpipe
    d. Protected dug well
    e. Open dug well
    f. Surface water (e.g. river, dam, lake)
    g. Others (specify)…………………………..….

**II. Methods and techniques**

12. How do you determine rural water supply coverage?
13. Do you employ Water Point Mapping (WPM) and Geographical Information System in your operations on assessing citizens' access to water? Yes [ ] No [ ] *(If Yes ask qn. 14-15 and if No go to qn. 16)*
14. How do you employ WPM and GI systems in your operations?
15. What are the benefits of employing WPM system in your operations with regard to determining citizens' access to water?
16. Why do you not use WPM system in your operations?

**III. Citizens involvement**

17. Do you involve citizens 'as service users' in determining their access to water?
    Yes [ ] No [ ] *(If yes ask qn. 18 and if no go to qn. 19)*
18. How do you involve the citizens?
19. Why do you not involve citizens in determining their access to water?

**IV. Opinions**

20. What do you think are the limitations of the current practice in determining water access?
21. What do you think should be done by the government to improve the measures on determining citizens' access to water?

**Thanks for your cooperation!**

**Appendix 4**: A sample of water access questions in Household Budget Survey 2011/2012 by the NBS

**9. What type of storage container is used to collect water from the source?**

- Overhead tank .......... ☐ 1
- Underground tank .......... ☐ 2
- Drums - metal / plastic .......... ☐ 3
- Bucket with lid .......... ☐ 4
- Bucket without lid .......... ☐ 5
- Jerry can .......... ☐ 6
- Traditional clay pot with cover .......... ☐ 7
- Traditional clay pot without cover .......... ☐ 8
- Other (*specify*): ____________________ ☐ 9

**10. What is the main source of drinking water for your household in the rainy season?**

- Piped water into dwelling .......... ☐ 1
- Piped water to yard/plot .......... ☐ 2
- Public tap/standpipe .......... ☐ 3
- Tubewell/borehole .......... ☐ 4
- Protected dug well .......... ☐ 5
- Unprotected dug well .......... ☐ 6
- Protected spring .......... ☐ 7
- Unprotected spring .......... ☐ 8
- Rainwater collection .......... ☐ 9
- Bottled water .......... ☐ 10
- Surface water (river, dam, lake, pond, stream, canal, irrigation channels) .......... ☐ 13
- Other (*specify*): ____________________ ☐ 14

**11. What is the main source of drinking water for your household in the dry season?**

- Piped water into dwelling .......... ☐ 1
- Piped water to yard/plot .......... ☐ 2
- Public tap/standpipe .......... ☐ 3
- Tubewell/borehole .......... ☐ 4
- Protected dug well .......... ☐ 5
- Unprotected dug well .......... ☐ 6
- Protected spring .......... ☐ 7
- Unprotected spring .......... ☐ 8
- Rainwater collection .......... ☐ 9
- Bottled water .......... ☐ 10
- Surface water (river, dam, lake, pond, stream, canal, irrigation channels) .......... ☐ 13
- Other (*specify*): ____________________ ☐ 14

**12. How much do you pay for 20 litres of water?** Tshs ☐☐☐☐☐☐☐

**13. How far is it between your house and the place you collect water in the rainy season?**

- It is in my home .......... ☐ 1
- Less than 500m .......... ☐ 2
- 500m - 1 km .......... ☐ 3
- 1-2 km .......... ☐ 4
- 2-5 km .......... ☐ 5
- 5-8 km .......... ☐ 6
- Greater than 8km .......... ☐ 7

**14. How far is it between your house and the place you collect water in the dry season?**

- It is in my home .......... ☐ 1
- Less than 500m .......... ☐ 2
- 500m - 1 km .......... ☐ 3
- 1-2 km .......... ☐ 4
- 2-5 km .......... ☐ 5
- 5-8 km .......... ☐ 6
- Greater than 8km .......... ☐ 7

**15. Who usually goes to this source to fetch water for your household?**

- Adult woman .......... ☐ 1
- Adult man .......... ☐ 2
- Female child (under 15 years) .......... ☐ 3
- Male child (under 15 years) .......... ☐ 4

**16. How many times a day does the household collect water in a day in the rainy season?** ☐☐

**17. How many times a day does the household collect water in a day in the dry season?** ☐☐

**Appendix 5:** A sample of 2012 National Population and Housing Census long questionnaire with only one question about water access

| G: HOUSING CONDITIONS AND OWNERSHIP OF ASSETS | | | | | | |
|---|---|---|---|---|---|---|
| How many rooms are available for sleeping in this household? | What is the main source of drinking water for this household? | | What is the main source of energy used by this household for cooking? | | What is the main source of energy used by this household for lighting? | |
| (46) | (47) | | (48) | | (49) | |
| RECORD NUMBER OF ROOMS FOR SLEEPING | Piped water into dwelling | =01 | Electricity (TANESCO/ZECO) | =01 | Electricity (TANESCO/ZECO) | =01 |
| | Piped water in the yard/plot | =02 | Solar | =02 | Solar | =02 |
| | Public tap/standpipe | =03 | Generator/private sources | =03 | Generator (private source) | =03 |
| | Tubewell/borehole | =04 | Cooking Gas | =04 | Gas (Industrial) | =04 |
| | Protected dug well | =05 | Gas (Biogas) | =05 | Gas (Biogas) | =05 |
| | Unprotected dug well | =06 | Electricity (Wind) | =06 | Electricity (Wind) | =06 |
| | Protected spring | =07 | Paraffin | =07 | Acetylene lamp | =07 |
| | Unprotected spring | =08 | Coal | =08 | Kerosene (lantern/chimney) | =08 |
| | Rainwater collection | =09 | Charcoal | =09 | Kerosene (Wick lamps) | =09 |
| | Bottled water | =10 | Firewood | =10 | Candles | =10 |
| | Cart with small tank/drum | =11 | Wood/ residuals | =11 | Firewood | =11 |
| | Tanker truck | =12 | Animal residuals | =12 | Torch/Rechargeable lamps | =12 |
| | Surface water (river, dam, lake, pond, stream,charco, canal, irrigation channels) | =13 | Not Applicable | =13 | | |
| | | | Improved cooking fuel | | Have electricity | |
| | | | Non improved cooking fuel | | Have no electricity | |
| ☐☐ | ☐☐ | | ☐☐ | | ☐☐ | |
| | Improved source | | | | | |
| | Non improved source | | | | | |

**Appendix 6:** A sample of entry form used by District Engineer office to collect data on water point at scheme level for administrative purposes.

**WATER POINT MAPPING – DATA ENTRY FORM 2011:**

| | | | |
|---|---|---|---|
| Date of record | | WPT Name | |
| Recording Organization | | WPT Code | |
| Region | | Population Served | |
| District | | WPT Photo ID | |
| LGA Name | | Scheme name | |
| Ward | | Water Permit | YES or No |
| Village | | Catchment | |
| Village Population | | Funder | |
| Village Registration No | | Installer | |
| Village Photo | | Year of construction | |
| No. of Private connection | | GPS way point no. | Dec° |
| Sub Village | | | Dec° |

**Source type**
- ○ Shallow well
- ○ Hand Drilled tube well
- ○ Machine Drilled bore hole
- ○ Dam
- ○ River/Lake
- ○ Spring
- ○ Rainwater harvest rooftop
- ○ Rainwater harvest ground
- ○ Others....

**Extraction System**
- ○ None
- ○ Mono
- ○ Cemo
- ○ Climax
- ○ KSB
- ○ Surbmersible
- ○ Gravity
- ○ Affridave
- ○ Nira/Tanira
- ○ SWN 80
- ○ SWN 81
- ○ India Mark II
- ○ India Mark III
- ○ Walimi
- ○ Windmill
- ○ Gravity
- ○ Others.......

**Water point type**
- ○ Hand Pump
- ○ Communal Standpipe
- ○ Communal Standpipe multiple
- ○ Dam
- ○ Improved Spring
- ○ Windimill
- ○ Others......

**Status**
- ○ Functional
- ○ Non Functional
- ○ Functional need repair
- ○ Not Functional > 6 months
- ○ Not Functional < 6 months
- ○ Not Functional < 3 months

**Hardware Problem**
- ○ None
- ○ Source damaged
- ○ Pump broken
- ○ Pump stolen
- ○ Engine broken
- ○ Engine Stolen
- ○ Tank out of use
- ○ Pipe broken
- ○ Tap poorly sited
- ○ Tap broken
- ○ Under construction
- ○ On Rehabilitation
- ○ Other..............

**Water quantity**
- ○ Enough
- ○ Insufficient
- ○ Seasonal
- ○ Dry
- ○ Others....

**Water quality**
- ○ Soft
- ○ Milky
- ○ Coloured
- ○ Salty
- ○ Salty abandoned
- ○ Flouride
- ○ Floured abandone
- ○ Others.........

Breakdown year

Reason for not functioning

**Scheme management**
- ○ VWC
- ○ WUG
- ○ WUA
- ○ Company
- ○ Trust
- ○ Water board
- ○ Parastatal
- ○ Private
- ○ Other

**Wpt Management**
- ○ VWC
- ○ WUG
- ○ WUA
- ○ Company
- ○ Trust
- ○ Water board
- ○ Parastatal
- ○ Private
- ○ Other

**Water payments**
- ○ Pay per bucket
- ○ Pay monthly
- ○ Pay annualy
- ○ Pay when scheme fail
- ○ Never pay
- ○ Other..............

**Public meeting**
- Yes ○
- No ○

**Amount Tshs**

General Comments