Towards Sustainable Urban Water Services in Developing Countries: Tariffs Based on Willingness-to-Pay Studies

Abstract

Water supply and sanitation (WASH) service providers in most towns of developing countries, such as Godey Town in Ethiopia, the case study reported in this paper, deliver less than basic services. The costs for meeting the more ambitious WASH targets of the Sustainable Development Goals will be much higher than what has previously been invested in the sector. This study showed that a tariff structure designed using affordability and willingness-to-pay data would provide higher revenues than one solely based on estimated customers' affordability, or Ethiopian government's tariff guidelines. As in previous studies in Ethiopia, this study highlights government's low willingness-to-charge amidst a high customers' willingness-to-pay. Yet, there is need to increase water tariffs in developing countries, hence, moving towards financial sustainability and supplementing the other two Ts - taxes and transfers. Based on accurate and updated socio-economic data, the tariff can also be optimised to fulfil the social equity objective.

Keywords: Affordability; Cost Recovery; Revenue; Tariff Structure; Water Services; Willingness-To-Pay

Introduction

The much-acclaimed global development era of the Millennium Development Goals (MDGs) came to an end in 2015, and, although the global target for water supply was surpassed in 2010, there were blatant geographical disparities in the coverage levels. Though 2.6 billion people gained access to an improved drinking water sources between 1990 and 2015, three out of eight regions of the world, i.e. Oceania, Caucasus and Central Asia, and sub-Saharan

Africa did not meet the drinking water target – resulting into 663 million people with no access to an improved drinking water source. The inequalities are more glaring in the least developed countries, along the rural-urban divide, as well as between different local government units such as districts, parishes, zones and villages (UNICEF and WHO, 2015). The Sustainable Development Goals (SDGs) came up with more ambitious targets for water, sanitation and hygiene (WASH), in line with the overall goal (Goal 6) of ensuring '…. availability and sustainable management of water and sanitation for all', which emphasises the need for social equity in service provision.

To effectively achieve the attributes of safely managed drinking water services of accessibility, availability and quality, the water source should ideally be located on premises, i.e. within the dwelling, yard or plot, which will preferably be a piped water supply (WHO, 2017). Yet, as of 2015, only 39% of the population in developing countries had access to piped water services (WHO and UNICEF, 2017). A key barrier to extending and providing piped water services in many developing countries is the associated high costs in terms of capital and operation/maintenance expenditures. A study undertaken by Hutton and Varughese (2016) supported by the World Bank estimated that the total capital costs of extending safely managed drinking water services to achieving universal coverage is about US$ 37.6 billion per year (2015-2030), which is over three times the capital funding historically committed to extension of water services. This study also estimated that owing to the anticipated increase in the infrastructure portfolio, the operation and maintenance costs for sustaining the universal service coverage will raise to about 1.6 times of the capital costs by 2030 (Hutton and Varughese, 2016).

A discussion paper prepared by the World Bank and UNICEF in 2017 provided a framework for country-level discussions and set out important considerations in the process of national governments undertaking planning for achievement of SDG WASH targets. In addition to mobilising repayable funding, the discussion paper advocated for the use of existing financing sources more effectively (i.e. tariffs, taxes and transfers – the 3Ts), as well as mobilizing domestic private finance. These measures include (i) improving operational efficiency to reduce Capital Expenditure (CAPEX), Capital Maintenance Expenditure (CAPMANEX) and Operational Expenditure (OPEX); (ii) raising tariffs for the users that can afford; (iii) increasing and/or reallocating taxes; and (iv) attracting repayable finance (The World Bank, 2017).

The capability within the water sector to optimise an appropriate tariff structure amidst often conflicting objectives is currently not well developed (Nauges and Whittington, 2017). This paper, using a case study of a town in Somali Region of Ethiopia, contributes to the discussion on tariff optimisation by showing the feasibility of increasing revenues through tariffs, while ensuring social equity objectives. The main objectives of this paper are (i) to evaluate the basis of the design of water tariffs in a medium-sized town in Ethiopia through a comparative analysis of revenue collection projections; and (ii) identify the most financially viable tariff structure that could be implemented in the given socio-economic context.

The paper is structured as follows: the next section provides a brief literature review of how water tariff structures in developing countries could be designed to balance key objectives of revenue sufficiency and social equity; the third section describes the data collection methods used; the fourth section provides findings from the case study town; the fifth section presents the design of tariffs using three scenarios; and the last section provides the discussion of the findings and the conclusions therefrom.

Literature Review

. The value attached to WASH services is not necessarily commensurate to the costs incurred. Hence, a combination of taxes, transfers and tariffs (3Ts) is usually applied for financing the

WASH infrastructure. Nonetheless, increasing revenues through water tariffs is more desirable, as it makes service delivery more financially sustainable (OECD, 2009). A water tariff is an important management tool, which can create controversies mainly because of its multiple and often contradicting objectives (Whittington, 2003). Implementation of tariffs could also be highly political in contexts where consumers are used to considering water services as ‘free’.

Setting of water tariffs requires to balance the following key objectives (Kayaga and Smout, 2013; OEDC, 2009; Pinto and Marques, 2015; Whittington 2003) : (i) promoting revenue sufficiency or financial sustainability, so that the service provider can cover targeted proportions of CAPEX, OPEX and CAPMANEX; (ii) supporting poverty alleviation (social equity), by ensuring that basic WASH services are provided to poor families, through cross-subsidisation; (iii) promoting ecological sustainability or use efficiency, such that the water tariff sends signals to consumers that compel them to use water efficiently; (iv) promoting economic efficiency or allocation efficiency, i.e. water as a valuable economic good should be allocated to the uses that maximise overall benefits to society; (v) promoting economic equity, such that allocation of the costs among the consumers are proportional to the benefits they receive; and (vi) having a tariff structure that is simple for the customers to understand, and easy for the service provider to administer and enforce. Other less cited objectives include political acceptability, public acceptability, fairness and enhancement of credit rating for the service provider.

On the economic efficiency objective that is favoured by economists, the target is to set a price that signals to consumers the financial, environmental, and other costs of using the water service, i.e. prices should be set equal to the short-term marginal cost of producing and supplying one more cubic meter of water (Whittington, 2003). However, economically efficient tariffs do not necessarily result into full cost recovery when average costs are above marginal costs (Kayaga and Smout, 2013; Whittington, 2003). Revenue shortfalls will be bigger in situations of water scarcity and droughts, when consumption drops tremendously. This situation may be corrected by using a two-part tariff: a volumetric charge based on the marginal cost; and and a period fixed charge, to cover the revenue shortfall (Barberán and Arbués, 2009). Given the low service levels amidst limited resources, the most sought objective in water utilities of developing countries is revenue sufficiency. This means that there will be trade-offs with other objectives presented above. One of the most controversial potential conflicts in low-income countries is aiming for higher financial sustainability while adhering to social equity, i.e. affordability. Achieving both objectives requires critically assessing the levels of average tariffs, the tariff structure and the choice of cross-subsidisation mechanisms (Kayaga and Smout, 2013; OEDC, 2009). Affordability needs to be looked at with respect to the society, as well as vulnerable groups – and the affordability criteria should be based on reliable data on the income distribution and current/projected water demand (OEDC, 2009).

There are several tariff structures that can be developed with the main objective of balancing revenue sufficiency with maximising social equity. The most popular tariff structure, when well designed, is an Increasing Block Tariff (IBT), which is based on volumetric pricing, and water per billing period is divided into several discrete blocks for which separate price levels can be set (Kayaga and Smout, 2013; Liu et al, 2003). The common practice is to set the lowest block for lifeline water supply at zero or very low prices, so that large users can subsidise low users. However, there has been some pitfalls in the design and implementation of IBTs, which does not necessarily result in achieving the two key objectives. Examples are (i) not all consumers are metered; (ii) meters are not well maintained, and so they do not provide accurate records; (iii) the tariff structures are poorly designed, with disproportionate block sizes and/or price levels; and (iv) poor households usually share connections, raising their bills to the upper tariff blocks (Whittington, 2003).

A variant of IBTs which avoids some of the afore-mentioned setbacks is the Increasing Rate Tariff (IRT) in which some consumer categories could subsidise others (Lui et al, 2003). A common example is to set the price levels according to connection type, where industrial/commercial consumers and house connections could subsidise public standpipes and yard taps; or certain geographical areas could subsidise others (OEDC, 2009). There have also been suggestions that increasing rate tariffs could be made dependant on both the household water consumption and household size (Lui et al, 2003), although this would bring further complications of keeping track of household sizes, especially so in developing countries where families have a high level of social cohesion. A common practice is to set higher price levels for industrial and commercial consumption, to enable cross-subsidisation, but ensuring that water services are not overpriced to the extent of discouraging economical activities. When accurate and updated socio-economic data is used to design IRTs, they have been found to achieve both the financial sustainability and equity objectives (Liu et al, 2003).

To get the balance right and develop an effective tariff structure that achieves the afore-mentioned objectives, it is important for water utilities to develop financially and economically robust tariff designs (Nauges and Whittington, 2017). Hence, there is a need to collect accurate socio-economic data on the beneficiary communities, which enables differentiation according to income groups or vulnerability, and their affordability (OEDC, 2009). To obtain a better understanding of the users' perceptions of service delivery in a specific area, it is important to assess the actual demand and willingness to pay for the water services (Behailu et al, 2012). Willingness-to-pay studies are increasingly being conducted in developing countries, and most findings therefrom show that the WTP is higher than the existing water tariffs.

In Ethiopia, where fieldwork for this study was conducted, most previous studies in other cities have shown a much higher WTP than the existing tariffs. Examples of recent studies are Mekelle City, Northern Ethiopia (Getahun, 2013); Shebedino District, Southern Ethiopia (Behailu et al, 2012); Jijiga in Eastern Ethiopia (Hundie and Abdisa, 2016); Nebelet, Northern Ethiopia (Mezgebo & Ewnetu, 2015); and Dilla Town, Southern Ethiopia (Minota, 2014). It is not surprising that households and non-domestic consumers are willing to pay higher than what they currently pay for services of poor quality – many consumers are investing a lot of resources to develop and operate non-utility water sources, to cope with the poor-quality water utility services (Water and Sanitation Programme, 2011). In this study, the findings of a WTP study in Godey, South-eastern Ethiopia provided the basis for designing a tariff structure under one of the scenarios.

Data Collection Methods

We recruited one fieldwork supervisor and ten local research assistants, with a minimum of a college diploma and conversant in the local dialect, to collect data on the water supply situation in Godey Town, situated in the Somali Region of Ethiopia. The fieldwork, which was conducted during the water supply rehabilitation/expansion project period, took place during January-March 2014. Data were collected through the following methods:

1. Review of government and policy documents and consultancy reports;
2. Household surveys to provide information on the socio-economic profile for estimating the ability to pay for water services;
3. Willingness to Pay (WTP) Surveys of the participating households;
4. Focus Group Discussions (FGDs) with four groups of respondents, who were heads and/or spouses of households in two low-income urban settlements of the study area;

5. Key Informant Interviews, using a semi-structured guide, with key stakeholders in Godey and Somali Region; and
6. Observations made by the researchers during the fieldwork.

The designed data collection tools were pretested with the local research team, who proposed some changes based on the contextual situation in Godey. Prior to carrying out fieldwork, the research instruments were submitted to and approved by Loughborough University's Ethics Approvals (Human Participants) Sub-Committee, to ensure that they met the university's research ethical standards.

The household survey was combined with the WTP study instrument. The Contingent Valuation (CV) technique was used for the WTP study. Although the CV approach is commonly used by economists and policy makers to assess demand for WASH services, it uses hypothetical data: if not well designed and implemented, it could be prone to biases, e.g. strategic, enumerator, starting-point and hypothetic biases (Tussupova et al, 2015). Several measures were undertaken to minimise the biases (Tussupova et al, 2015; Whittington, 2002):

a. The instrument was designed, based on the observed practices in the water supply 'marketplace'.
b. An introduction in the survey instrument provided accurate information on anticipated benefits from the water supply project and explained the responsibilities of the consumer.
c. Research assistants underwent three days' training on the process of undertaking the WTP study
d. A pilot study was undertaken prior to the main fieldwork
e. To minimise starting-point bias, the enumerators alternately started with either the high bid, or low bid.

We carried out fieldwork in three *kebeles* (i.e. zones, the smallest administrative unit in the town) that were randomly selected from the six *kebeles* in Godey Town. The total number of households in the selected *kebeles* was 4962, as obtained from the Ethiopia Demographic and Health Survey 2011. We then randomly selected 200 households, and each respondent was given the option to opt-out – in which case the research assistant went to the next household. The time taken to cover the whole questionnaire ranged between 50-70 minutes. The research assistants were also asked to observe the surroundings and look out for collaborating evidence on source(s) of water used, and quality of services provided - in terms of reliability, continuity, pressure and water quality.

During the same period, two Focus Group Discussions (FGDs) were conducted with female and male participants purposely selected from *Kebeles* 1 and 3 - these zones did not participate in the household surveys. For the FGDs, we adapted the PREPP (Participation-Ranking-Experience-Perception-Partnership) guide developed by Loughborough University's Water, Engineering and Development Centre for consulting urban poor communities on their preferences, experiences and perceptions (Coates et al, 2004). In all, thirty-five householders (18 women and 17 men) participated in the FGDs. All the FGDs were attended by the Head of GTWSSS, who provided background information on the current state and anticipated changes of the water supply system whenever prompted by the FGD facilitators.

Simultaneously, semi-structured interviews were held with six key informants in Godey Town and Jijiga Regional Headquarters, representing the civic leadership, the international donor agencies involved in the rehabilitation and expansion project, and GTWSSS, the water service provider in Godey Town. A semi-structured interview guide was used to solicit the key informants' views on the general state of water supply services in the town, key policy directions for urban water services; objectives and scope of cost recovery for piped water services; ability and willingness to pay for water services; and proposed suitable tariff structure, including issues of cross-subsidies to the urban poor.

Data collected from household surveys were compared and verified with data obtained from FGDs, key informant interviews and observations, which improved the validity and reliability of the study. After entering the raw data into an SPSS database, descriptive data analysis was carried out to map out frequency distribution tables on the socioeconomic characteristics of the respondents, and their WTP for the various service levels. Qualitative data analysis was accomplished with use of Microsoft Office tools, as proposed by La Pelle (2004), through which descriptive codes were developed, and themes/patterns identified.

Finally, after compiling the first draft of the findings from the fieldwork, a stakeholder workshop was organised in February 2014, at the Regional Headquarters in Jijidga, to present the preliminary findings and solicit inputs of key policy and senior technical staff in the Ethiopian water sector. The preliminary results were presented to a group of about 15 provincial and district officials, who made comments on the preliminary findings and provided suggestions for the design of the tariff structure.

Results and Analysis

Brief Description of the Research Setting

Godey Town, located near River Wabishebele, is a major town in Somali Region of Ethiopia. Temperatures in Godey Town ranges between 20-37ºC, with an annual average of 28.8ºC. Godey Town lies in the mid-southern part of Somali Region, in the Jarar Valley and Shebele sub-basin and relies mainly on surface water. Another less reliable water resource is rainfall, which is highly variable, ranging between 39mm and 361mm per annum. The main rainy season is in March-May, with lighter rains arriving in the September-November period.

The population of Godey Town during the 2007 national census was 43,234, 56% of whom were males (Central Statistical Agency [CSA], 2010). With an estimated population growth rate of about 4%, the projected town's population at the time of the study was 52,942 (CSA, 2013). Godey Town had 6,067 housing units during the 2007 census, of which 5,086 were made of conventional materials, 643 units were of improvised materials and 298 were mobile units.

Water services at the time of the study were provided by Godey Town Water Supply and Sewerage Service (GTWSSS), a semi-autonomous public utility overseen by the municipal water board. The water supply scheme that existed at the time of the study comprised of a water intake at River Wabishebele, a series of filtration tanks, slow sand filters, clear water reservoir with a chlorination system, an overhead reservoir, distribution pipes and stand taps that were not fully functional. For instance, the treatment plant reduced the turbidity from about 40000NTU to about 600NTU, and the chlorination system was dysfunctional at the time of the study. The plant was supplying up to 1,550 m^3/day to a 1410m^3 reservoir in the centre of town, two kilometres away (Abay Engineering, 2012a, 2012b).

The federal Ministry of Health is responsible for monitoring and surveillance of the drinking water quality (WQ) in the country, in line with the 2001 Ethiopian Quality and Standard Authority standard ES-261. Additionally, various units of the Ministry of Water and Energy performs internal drinking WQ assurance. However, by the time of the study, WQ monitoring roles were unclear, and WQ testing was done in an ad-hoc basis – mainly on demand during design of new water supply systems. Hence, the 2011 national drinking water quality monitoring and surveillance strategy was developed to address these gaps, by clarifying the roles and responsibilities, and identifying the required resources (Ministry of Health, 2011).

As of September 2013, there were about 220 household yard connections, 11 public fountains (public standpipes) and several hard stands at the water treatment plant, for filling donkey carts and water tankers. However, of the existing 11 public fountains, only two were functional in September 2013 (JICA, 2013). Hence water was rationed between the various *kebeles*. At the time of the study, GTWSSS had 22 staff and 2645 registered customers, with an estimated service coverage of 48.5% of the town's population. UNICEF's 2014 baseline survey found that only 37% of households in Godey Town had access to at least 20 litres of water per capita per day (IRC, 2016).

There was no centralised sewerage network in Godey town. A baseline survey in 2014 conducted as part of UNICEF's One WASH Plus project found that 13% of households in Godey Town had Ventilated Improved Pit (VIP) latrines; 61% had ordinary pit latrines with slab; 4% used public latrines or shared with neighbours; 7% had basic pit latrines with no slab; while 14% practiced open defecation (IRC, 2016).

Key Socioeconomic Characteristics

Many respondents to the household survey were female (63%), most of whom (85%) were spouses of heads of households. Most respondents (95%) were in the age bracket of 20-50 years; only 4% reported to be over 50 years old - this data corresponds to the findings of the Inter-Censual Population Survey of 2012 (CSA, 2013). Table 1 provides other key socioeconomic characteristics of the respondents.

Table 1: Other key socioeconomic characteristics of the respondents

1. Age bracket of respondent (n=200)	a. Less than 20 years – 1% b. 20+ - 30 years – 18.5% c. 30+ - 40 years – 46.5% d. 40+ - 50 years – 29.5% e. Over 50 years – 4.5%
2. Household size (n=200)	a. Less than 5 people – 12% b. 5 – 7 people – 44% c. 8 – 10 people – 32% d. Over 10 people – 12%
3. Ownership status of the house (n=200)	a. Privately owned – 89% b. Rented, landlord lives away – 9% c. Rented, landlord lives within the compound – 2%
4. Occupation of head of household (n=200)	a. Salaried worker – 23% b. Self-employed – 16.5% c. Labourers/Domestic workers – 10.5% d. Unemployed – 2% e. Others – 46%

The results displayed in Table 1 shows that household size for over 75% of participating households was between 5-10 people. The mean household size was 7.5. These findings are consistent with data from the national Central Statistics Agency, which, according to the 2012 Inter-Censual Population Survey, projected the average household in Somali Region to be 6.5, the highest in Ethiopia (CSA, 2012). Also, 88% of the surveyed households had at least one child under the age of 14. This is not surprising, given that 45% of Ethiopia's population is made up of children aged less than 14 years (CSA, 2013).

Almost all respondents (98%) lived in semi-detached houses, many of which were fenced. As shown in Table 1, most of these houses were privately owned (89%), while the remaining householders (22 respondents) rented the premises. Five out of 22 tenants (22%) stayed in the same compound with their landlords. This arrangement could have influenced the type of service level the tenants found appropriate. The occupation of heads of households was not well described. As shown in Table 1, almost half of the respondents (46%) said they were employed, but they were not at liberty to describe the type of employment. Whereas 23% were salaried workers, presumably receiving monthly salaries, a fifth of the respondents were self-employed (16.5%), labourers or were engaged in agriculture. The type of employment has implications on the frequency and reliability of earnings, which in turn affects the households' preferences of payment intervals and options.

Estimation of Household Expenditure

Increasingly, social scientists and economists prefer to use reported household expenditure, rather than reported household income, as a more accurate and easier indicator of household wealth in developing countries (Howe et al, 2009). It is usually difficult to estimate household incomes within the context of urban areas of developing countries where few households earn regular and well-documented incomes such as salaries from regular employment, as can be evidenced by the data presented in Table 1. Furthermore, much of economic activities are of informal nature, with hardly any books of accounts accurately kept. Some households may also have been relying on remittances from their relatives in bigger urban centres or in the diaspora, and many respondents would consider such information sensitive. Hence, as is a common practice used by socio-economic researchers, this study adopted average household expenditure as a proxy for household income.

Households were asked to provide average expenditures, in the past one year, on the following items, whichever were applicable to the household: (i) food purchases (per week or, per month); (ii) rent (per month); (iii) school fees (per term, per year); (iv) medical expenses (per month, per year); (v) clothes (per year); (vi) agricultural/livestock inputs (per year); (vii) transport (per month); (viii) hired labour (per month); (ix) mobile phone (per week or per month); (x) electricity (per month); (xi) charcoal/gas/firewood (per month); and other miscellaneous expenditures. These data were computed and standardised to expenditure per annum. Table 2 shows the descriptive statistics of the computed annual expenditure on various items, which excluded payment for water services.

Table 2: Descriptive statistics of annual expenditure (in ETB) on various household items (20 ETB = 1US$ at the time of the fieldwork in Feb 2014)

Item	Minimum	Maximum	Mean	Median	Std. Deviation	N
Food purchases	4800	96000	25024	21600	12624	200
Rent, if applicable	1800	18000	5430	3600	4437	20
School fees	300	16500	1995	1200	3137	57
Medical expenses	60	42000	4479	3000	6241	198
Clothes	100	60000	4052	3000	6510	197
Agricultural/livestock inputs	350	338000	18771	4250	68234	24
Transport	100	36400	6803	2400	9208	139
Hired labour	400	6000	4283	4800	1826	12
Mobile phone	30	78000	6481	5200	7994	187
Electricity	40	6000	716	600	929	69
Charcoal/Gas/firewood	300	26000	4818	4800	2198	197
Others (please state)	5400	5400	5400	5400	-	1

Table 2 shows that most households spent significantly on food, medical expenses, charcoal/gas/firewood, clothes, mobile phones, and transport, in that order. At least 25% the households also spent their income on electricity and school-fees for children. A further assessment of expenditure on utility services showed that households spent a mean figure of about 6500 Ethiopian Birr [ETB] (equivalent to 325 US$ at the time of the study), and 716 ETB (US$36) per annum on mobile phone and electricity, respectively. This is a good sign, showing that households were accustomed to paying utility bills.

When summed up, the data shown in Table 2 gives maximum, minimum and mean household expenditures for Godey Town of ETB 15,117; 1225 and 4241 respectively. The mean household expenditure data obtained by the national Central Statistics Agency (CSA) during the 2010/11 Household Consumption and Expenditure Survey are ETB 3066 and ETB 5291 in Somali region and in urban areas of Ethiopia, respectively (CSA, 2012). Given the time difference between these two surveys, and effects of data aggregation associated with national/regional surveys, the mean household expenditure obtained in these two surveys compare favourably.

For this study, households have been grouped into three categories. About 38% of the households, who reportedly spent less than 3000 ETB per month, are categorized as low-income households. About 46% reported to be spending between 3001 – 6000 ETB, are categorised as middle-income, while 16% who reportedly spent over 6000 ETB are high-income. The mean values of expenditures for various income brackets were computed as follows:

- Low income – ETB 2392
- Middle income – ETB 4355
- High income – EBT 8303

Increasingly, social scientists and economists prefer to use reported household expenditure, rather than reported household income, as a more accurate and easier indicator of household wealth in developing countries (Howe et al, 2009). This is because it is usually difficult to estimate household incomes within the context of urban areas of developing countries where few households earn regular and well-documented incomes such as salaries from regular employment, as can be evidenced by the data presented in Table 1. Furthermore, much of economic activities are of informal nature, with hardly any books of accounts accurately kept. Some households may also have been relying on remittances from their relatives in bigger urban centres or in the diaspora, and many respondents would consider such information sensitive. Hence, as is a common practice used by socio-economic researchers, this study adopted average household expenditure as a proxy for household income.

Water Services in Godey Town

Residents in Godey Town had to economise the use of water for household use, as a coping strategy to the grossly inadequate water supply services provided by the urban water utility. Of the 169 respondents who indicated the approximate total amount of water (supplied by the water utility and/or other alternative sources of water) used by the households, 115 (68%) used 200 litres; 25 (15%) used less than 200 litres; 22 (13%) used 400 litres; and six (4%) used 250-300 litres.

Utility Water Services

Only 30 households (15% of the total sample) said they received water services from the water utility. The study also found that only 7 of the 30 households using utility water supplies (23%) solely depended on utility water services. The rest of households supplemented the utility services with other sources of water, the choice depending on which season it was. When asked what percentage of their total household water requirements was obtained from the utility, 73% of responses (n=30) said at least 80% of their needs were from the utility during the dry season. Other sources of water during the dry season included water vendors (n=16); the utility reservoir (n=5) and the river, using donkey carts (n=1). During the rainy season, 20 households (out of 30) stated they harvested rainwater to supplement utility water services.

All households used the three sources to supplement water requirements for the various household chores. Water vendors provided water services to more households (n=24), while rainwater was used by fewer households (n=4) - probably because of its seasonal nature, coupled with requirement for relatively larger one-off investment costs in the rainwater collection and storage. More households used water from alternative sources for bathing, house-cleaning and clothes-washing (n= 24), compared to water for drinking/cooking (n=12).

Respondents who reportedly used utility-supplied water (n=30) were asked to estimate the average amount of household water use per day. Sixteen respondents used about 200 litres; seven used 100 litres; four used 400 litres, while three used between 250-300 litres. Seven of the households who used utility water fetched it away from their plots. Three of these travelled between 1-2 kilometres to get to the water reservoir. One person claimed to travel more than two kilometres to reach the source. Four travelled less than a kilometre. Five people said they spent up to 1 hour to make a round trip journey, including waiting time.

Households were asked to rate the quality of water services provided by the water utility in terms of water quality, pressure, availability and reliability. Most households showed an average level of satisfaction (i.e. ‘fair’) with water quality (90%, n=27) and pressure (80%, n=24). Reliability and availability had lower ratings, with 60% (n=18) and 47% (n=14) rating them as ‘bad’, respectively. These findings were not surprising, given that the water utility had to ration water between various *kebeles*, because of the low capacity of the water supply system.

Participants in the four FGDs validated the findings from the household survey. Private yard connections and public standpipes were ranked as the 4^{th} and 6^{th} most used sources of water, respectively. The GTWSS reservoir was considered by all participants to be of good water quality. However, it was far away from the communities and required donkey carts for water transportation. Also, there were always long queues. On the other hand, the main drawback of public standpipes was their low water pressure and not having provision provision for filling barrels on donkey carts. Hence it required many trips to collect water for a family, typically requiring 2 barrels of water per day. FGD participants rated the private yard tap as the best source of water. Water from this source was considered cheaper than other sources, sometimes as much as four times cheaper. However, few households had yard tap connections at the time of the study – 89 (3.5%) and 25 (1%) in *Kabeles* 1 and 2 respectively, mainly due to the poor institutional capacity of the utility.

Non-utility Water Sources

Most households (90%) accessed non-utility sources of water all the year round, although 71% sometimes experienced water shortages from these sources. Households were asked rated the quality of service from non-utility sources in terms of water quality, quantity available, reliability of source, distance travelled to collect the water, and time taken to get the water. None of the aspects were rated as 'excellent'. Only 'quantity available' had a reasonable rating, with 49% (n=95) rating it as either 'good' or 'fair'. Most households rated the alternative water sources as 'bad' with respect to distance travelled (70%, n=136); time taken to get the water (68%, n=131); water quality (64%, n=125); reliability of the source (60%, n=117); and quantity available (51%, n=99). These findings point to the fact that households were not satisfied with services they obtained from these water sources, and they would probably entirely switch to utility water if GTWSSS improved the level of services.

Water vendors were considered a main source of household water supply by 171 respondents (85%) – a finding that is consistent with the results presented earlier, which shows that 83% of the households who claimed to use water from GTWSSS received their supplies through water cart vendors. While 101 households used rainwater as a main source during the wet season, 91 respondents considered surface water sources to be a main source of water for the household.

Findings from the household survey were supported by the FGDs conducted in two other *kebeles*. All FGDs ranked donkey cart vendors are the most regularly used source of water, followed by the river source. These vendors mainly obtained water from *birkas*, the utility's reservoir, the river or from ponds. *Birkas* are constructed underground water storage tanks that store rain water during the rainy season and are subsequently used in the dry spells.

The common theme emerging from all the FGDs was that much as donkey cart vendors were the most commonly used source of water, this was mainly because of lack of choice. FGD participants listed the following key setbacks with *birkas*: (i) poor water quality and related issues of hygiene – vended water was associated with water-borne diseases such as typhoid and diarrhoea; (ii) water from vendors was not always reliable – as one participant said: *sometimes when you need a donkey cart to get water, they are not available*; (iii) a high price paid for the water – they paid between 15-20 ETB per barrel, which, for a household that used two barrels, was equivalent to 1,200 ETB per month. This price increased if utility reservoirs were being regularly cleaned.

Other non-utility water sources listed by FGD participants were river water, rainwater and bottled water. River water was the primary source of water in Godey Town, as all other sources derived their water from it, including GTWSSS. When everything else had failed, households resorted to this source. However, the water quality was perceived poor. Also, it is further away from town, and only those with donkey carts could easily draw water from the river. The river is 3 kilometres away from town, and it could take up to two hours to fetch the water. Collecting water from the river was also associated with risks of children drowning or being attacked by crocodiles. During the wet season, rain water was considered a good source of water for every household's water needs in Somaliland. However, the main setback was the cost associated with constructing the storage facilities. On the other hand, bottled water was considered a luxury, and was rarely used in the home, because of the high costs. It was mainly dedicated for the sick and babies.

Households' Willingness-To-Pay for Improved Water Services

A Contingent Evaluation Methodology (CVM) was used to assess the households' willingness to pay for improved water services. After asking the households about the current water supply sources, enumerators used this information to present a hypothetical scenario, involving several improved water supply options, which were 'offered' to the respondents at various prices. Respondents were told that after the rehabilitation and expansion of the water supply system, it was expected that the water services would be reliable, with a good water quality and adequate pressure; and that all connections would be metered so that families would pay only for water that they will consume. It was also explained that the households would have to separately pay for installing internal plumbing, independent of the water utility.

Estimated prices of these options were informed by findings of the feasibility and preliminary design studies conducted in 2012 (Abay Engineering plc, 2012a). For households which were not yet registered customers of GTWSSS, they were also asked about the one-off connection costs and charges that would be required for registering as customers of the utility.

There were four categories of responses. Of the 30 households who already had a private yard tap connection, 18 of them (9% of the total sample) wanted to upgrade to a private house connection. Others already with a private yard tap (N=12, 6% of the total sample) preferred to keep the status quo. The largest category (N= 163, 81% of the total sample) was of households that relied on non-utility water services, who preferred to get a private yard tap connection. No households indicated they wanted a 'shared yard tap'. Seven respondents that were non-customers indicated they had no interest in subscribing to the water utility soon.

According to FGDs, this category could have been households that had made huge investments into purchasing donkey carts for drawing water not only for their household use, but also as a business. There is a high willingness to become a registered customer of GTWSSS if the utility could provide the improved services. Over 85% households that expressed preference to obtain services through yard-taps were willing to pay at least 2000 ETB (about 100 US$) as one-off capital costs, as shown below:

- Less than 1500 ETB – 2
- Up to 1500 ETB - 22
- Up to 2000 ETB - 28
- Up to 2500 ETB - 46
- Up to 3000 ETB - 69

On the other hand, 18 households stated a preference for a private house connection, all of whom were already customers of the water utility, connected through private yard-taps. It is worth noting that although this category represented only 9% of the whole sample, they made up 60% of the households which already have a yard tap. This finding is consistent with the universally accepted Maslow's Hierarchy of Needs theory that households will seek to move to the next service level whenever an opportunity arises. Interestingly, the relative WTP for installing a private house connection was lower than the WTP for households hoping to install private yard-taps, as shown below:

- Less than 1500 ETB – 8
- Up to 1500 ETB - 2
- Up to 2000 ETB - 3
- Up to 2500 ETB - 3

- Up to 3000 ETB - 3

The willingness-to-connect findings shown above were confirmed by all four FGDs, in which all groups ranked the private yard connection as the most preferred. Whereas two groups suggested public water points as second choice – to serve the poorest households, no group listed private house connection as a suitable service option. Participants thought the shared yard-tap was unsuitable mainly because of challenges of fairly apportioning the bills and ensuring that the water point is effectively maintained. Observations by the field staff also noted that many of the households were enclosed in fences, which may not have favoured sharing of such facilities. This preference was also endorsed by the Manager of the water utility, who attended all FGD sessions.

FGD participants were confident that over 90% of households would be able and willing to pay for and maintain private yard-tap connections, based on the following observations: (i) The daily expenditure on water of most households at the time of the study was about 40 ETB, which was much higher than the projected post-rehabilitation water tariff levels; (ii) the projected one-off connection costs were much lower than what households invested in buying donkey carts, i.e. about 13,000 ETB; and (iii) although so many households already owned donkey carts (for example in Kebele 1, 1541 out of 2500 households owned donkey carts), the cost of feeding the donkey was high, e.g. 40 ETB per donkey per day.

Based on the bidding game, about 80% (n=133) of households that wanted to move to private yard-taps were willing to pay at least 200 ETB per month for water bills, as shown below:

- Less than 150 ETB – 9
- Up to 150 ETB - 25
- Up to 200 ETB - 42

- Up to 250 ETB - 41
- Up to 300 ETB - 50

Based on the maximum amount individual households were willing to pay for improved services, the mean WTP for yard-taps was computed at EBT 209. On the other hand, the mean for the private house connection was computed at EBT384, with the following range of WTP figures:

- Up to 250 ETB – 1
- Up to 300 ETB - 2
- Up to 350 ETB - 3
- Up to 400 ETB - 4
- Up to 500 ETB – 6
- Up to 500 ETB – 1

Design of Tariff Structure

Computation of the Average Tariff

Prior to designing a tariff structure, we computed the average tariff following the rehabilitation and expansion of water services in Godey. It was specified in the policy documents that tariffs were to be computed based on the Historical Accounting method, and should be comprised of fixed and the volumetric charges. Fixed charges are proportioned according to meter sizes and cater for administrative charges such meter reading and bill delivery. To compute the tariff, we used figures, parameters and assumptions provided in key policy documents, feasibility study and preliminary design that were conducted at the time of the study, some of which are presented in Table 3. The average tariff obtained was 8.6 ETB/ m^3 inclusive of the fixed charges. This tariff is inclusive of the costs the utility will incur in conforming to water quality standards, as prescribed in the Ethiopia's 2011 National Drinking Water Quality Monitoring and Surveillance Strategy.

Table 3: Key parameters, values and assumptions adopted from policy documents and consultancy reports

Given parameter/assumption	Notes
Economic life of key infrastructure items • Civil works – 50 years • Mechanical/electrical works – 15 years • Distribution network – 25 years	Straight-line depreciation to be applied
Design period – 20 years	Some of the components were to be implemented in two phases
Capital costs • Phase 1 (service up to Year 10): 34.7 million Birr • Phase 2 (services beyond Year 10): 12 million Birr	Those to be phase were service reservoirs, water treatment units and pumps
Depreciation costs • Phase 1 only - 1.136 million Birr p.a. • Additional costs in Phase 2 - 0.364 million Birr p.a.	
Average Operating Expenditure over 5 years – 4.5 ETB per m^3	Inflation assumed at 3% p.a.
Return on Capital Employed - 5% p.a.	Adapted for the context from Consumer Council for Water (George & Lennard, 2006)
Average Non-Revenue Water over first 5 years	25%

(Source: Ministry of Water and Energy, 2013; Abey Engineering, 2012a; 2012b)

Development of Simple Objective and Constraint Functions

We set out to design a tariff structure that optimises revenues while ensuring that it promotes social equity, using three scenarios, based on: (i) guidelines provided by the government; (ii) affordability to pay criterion; and (iii) findings from the willingness-to-pay study. We opted for an Increasing Rate Tariff, with prices differentiated between the following customer categories:

- Households drawing water from public standpipes or public fountains (pf)

- Households drawing water from private yard-taps (yt)
- Households with private house connections (hc)
- Public institutions (pi)
- Industrial/commercial consumers (ic)

These household categories have been found effective where they have been applied; they are simple to apply and implement; they are a good proxy for water use; and they easily map on the income brackets presented in Section 4. Furthermore, with a high household size in the study area (mean of 7.5 – see Table 1), implementing the increasing block tariff according to the tariff block recommended by the Government of Ethiopia, i.e. 0-6 m^3, 6-10 m^3, 10-16 m^3, and >16 m^3 (Ministry of Water and Energy, 2013) would distort the social equity objective. We used the following base optimisation function:

$$\text{Maximise Revenue, R, where } R = \{Q_{pf}X_{pf} + Q_{yt}X_{yt} + Q_{hc}X_{hc} + Q_{pi}X_{pi} + Q_{ic}X_{ic}\}$$

Q and X are quantities consumed and price for the various categories listed above. The following assumptions were made concerning income levels and affordability:

- Users of Public standpipes fall in low-income bracket, with an average monthly household income of I_L;
- Users of public yard taps fall in the middle-income bracket, with an average monthly income of I_M;
- Households with private house connections are also high-income earners, with a monthly average income of I_H;
- The UNDP's (2006) rule-of-thumb affordability criteria of a maximum spend of 3% of house income on water services applies in the study setting.

Then, the following constraints apply to the revenue function:

$$Q_{pf}X_{pf} \leq 3\% \ I_L;$$

$$Q_{yt}X_{yt} \leq 3\% \ I_M;$$

$$Q_{hc}X_{hc} \leq 3\% \ I_{H.}$$

To enable cross-subsidisation from non-household consumers to households, the prices for non-household consumers were set as follows:

$$X_{pi}=f_{pi}X_{hc};$$

$$X_{ic}=f_{ic}X_{hc}$$

where f_{pi}, $f_{ic} \geq 1$.

The above simple mathematic functions were used to design the tariff structure for Godey Town, based on three scenarios described in the proceeding sub-sections.

Scenario 1: Tariff Structure Based on Guidelines Provided by the Ethiopian Government

We applied the guidelines issued by the Ministry of Water and Energy (2013) to design the first tariff structure model. Projected water consumption, Operating Expenditure (OPEX), depreciation costs and non-revenue water projection were extracted from the consultancy reports. The guidelines recommended that households drawing water from public standpipes (i.e. assumed to be the poorest households) would pay only OPEX costs per m^3 (6.1 ETB/m^3) of water sold. Other categories of consumers were required to pay OPEX costs per m^3 plus a contribution to depreciation costs. The depreciation charges are for replacement of capital installations as they 'wear and tear', i.e. capital maintenance expenditure (CAPMANEX). According to the Ministry of Water and Energy's guideline (2013), other than for customers drawing water from public fountains, all other customer categories should contribute to depreciation charges and capital charges, on a sliding scale. Accordingly, for Scenario 1, the unit depreciation costs (i.e. annual depreciation costs and capital charges divided by average annual water consumption) is computed and added onto the unit OPEX,   as shown below:

- Public fountain (pf) – 0
- Private yard-tap – 0.25
- House connection (hc) – 0.5
- Public institutions (pi) – 1.25
- Commercial/Industrial properties (ci) – 1.5

The price levels (in EBT/m3) computed using these weighting factors are 6.1 for public fountains, 6.4 for private yard-taps, 6.4 for house connections, 7.5 for public institutions, and 7.7 for commercial/industrial properties. All these prices do not cover full costs, at an average tariff of 8.6 ETB/m^3. Hence, there would be a projected deficit of ETB 10,887,400 over the five-year period, with higher annual deficits in earlier years.

Scenario 2: Tariff Structure Based on Affordability

We adopted the UNDP's (2006) affordability threshold for water services of 3% of the household's total expenditure, which was applied to averages of reported expenditures for low-, medium- and high-income brackets, to map on users of public fountains, yard-taps and private house connections, respectively. We adopted multiplying factors of 1.15 and 1.25 to the price level of household connections, to obtain tariffs for public institutions and industrial/commercial properties respectively. These low indices would keep non-domestic tariffs within reasonable ranges, as per the government's objective of encouraging economic activities in the region.

The computed price levels are 6.9, 8 and 8.5 ETB/m^3 for public fountains, yard-taps and private house connections respectively. As a result, the price for public institutions and commercial/industrial properties worked out to be 9.8 and 10.6 ETB/m^3. If implemented, it would produce a surplus of ETB 9,108,345 over the first five-year period.

Scenario 3: Tariff Structure Based on Willingness-To-Pay

For the third scenario, we computed the tariffs for the middle- and high-income households based on the willingness-to-pay survey results. In the survey sample, there were no households that opted to draw water from a public fountain, a service level that is considered transitional. Hence, we maintained the price for public fountains at 6.9 ETB/m^3, as computed in Scenario 2 above. The price levels for prospective yard-tap and private household connections went up by over 2.5 times higher than the ones based on estimated affordability, to 18.6 and 21.3 ETB/m^3 respectively.

For this scenario, the price for non-household consumers was fixed at the same level as for private household connections, which is a good enough price level. If this tariff structure was to be implemented, the revenue surplus would be ETB 75,421,000 over the first five-year period.

Discussion and Conclusion

Financial resources are critical for the sustainability of urban water services in developing countries. Most urban water utilities in developing countries currently rely on Taxes and Transfers (the first 2Ts) for capital expenditure and, to some extent, for operating expenditure. These 2Ts are managed by national governments, with so many demands from different sectors chasing the same limited pots. Water utilities need to improve the level of revenue collection, through the third T – Tariffs, to have a more reliable funding source, which the utilities could control better.

Poor cost recovery by utilities in many resource-constrained countries has led to vicious cycles, where low financial resources result into poor service delivery, leading to low customer satisfaction, which in turn leads to further reduction in cost recovery rates. Also, with a higher level of cost recovery, water utilities will expand services to the currently unserved households. Higher cost recovery rates would improve their creditworthiness and credit rating, and hence improved access to external finance (such as loans), and other non-traditional sources of finance, such as bonds. Furthermore, maintaining substantial cash reserves has become more important for utilities, to have the capacity to deal with adverse effects created by the climate change (Nauges and Whittington, 2017).

Getting the right tariff structure that enhances revenue sufficiency and ensures affordability by different community segments in a given context requires collection and analysis of relevant, accurate data. Using Godey, a town in Ethiopia as a case study, this research has shown that households may have a higher willingness-to-pay for water services than the tariffs set by the governments and/or service providers. Since Godey Town did not have a reticulated sewerage system, the study was limited to obtaining the willingness-to-pay for only water services, by contingent valuation (CV) method. Precautions were taken to minimise various biases of CV surveys that have been highlighted in the literature (e.g. Tussupova et al, 2015; Whittington, 2002), so as to improve the validity and reliability of the study, as described in Section 3. Increasingly, documented research is providing evidence of the reliability of WTP studies, as long as they are designed and administered properly (Tussupova et al, 2015). Nonetheless, affordability of poor households needs to be considered in the design of tariffs, to ensure conformity to the equity objective.

While there is a projected deficit of over ETB 10 million (over the first five-year operational period) when the government guidelines for tariff design are adhered to, incorporating affordability criteria in the design of the tariff improves to a surplus of ETB 9 million, and exponentially raises to a higher surplus of over ETB 75 million when we apply data from willingness-to-pay studies. It's important to point out that the willingness to pay in Godey, the case study town was unusually high, which could be because of poor water supply service levels in an arid location, characterised by an elevated temperature (average of over 28ºC), and hardly any viable alternative water sources. Nonetheless, findings of this study agree with what was found in other regions of Ethiopia (as reported in Section 2), and in other developing countries, that usually, there is a high households' WTP for improved water services.

The findings of this and other WTP studies in Ethiopia point to an example of 'willingness to pay but unwilling to charge', which has been a historical shortcoming for the water sector in some countries such as India (Water and Sanitation Program, 1999). Some scholars have associated this state of condition with water utilities that lack autonomy, have an unclear and ambiguous relationship with central government agencies, and usually have poor management structures (Zikos and Bithas, 2006). This case study also shows that, with good socio-economic data, cross-subsidy mechanisms could be implemented to achieve the objective of balancing equity and financial sustainability objectives.

The disparity in existing water tariffs and consumers' WTP for water services is a symptom of engrained issues concerned with the institutional capacity of the water utility, which is not only about capabilities with the organisation, but encompasses the wider external operating environment (Kayaga et al, 2013). For water utilities that are autonomous, the main implications of the findings are that they should develop the capabilities or outsource the skills to collect the necessary socio-economic data to analyse how tariff structures can affect revenues, water use, social equity and economic efficiency. For the utilities with less autonomy, they need to engage with the relevant policy makers and provide evidence of benefits of aligning the willingness to charge with the willingness to pay for water services, while at the same time fulling the equity objective.

Acknowledgements

This research was funded by Japan International Cooperation Agency (JICA). We are grateful to the local researchers and all stakeholders.

References

Abay Engineering plc, 2012a. Consultancy Service for Godey & Jigjiga Towns Planning and Implementation of Town Water Supply and Sanitation Improvement Program, Godey Town – Final Feasibility and Preliminary Design Report (unpublished), Addis Ababa, Ethiopia.

Abay Engineering plc, 2012b. Consultancy Service for Godey & Jigjiga Towns Planning and Implementation of Town Water Supply and Sanitation Improvement Program, Godey Town – Final Business Plan Report (unpublished), Addis Ababa, Ethiopia.

Barberán, R.; Arbués, F. Equity in domestic water rates design. Water Resour. Manag. 2009, 23, 2101–2118.

Behailu, S., Kume, A. & Biruck Desalegn, B. (2012) Household's willingness to pay for improved water service: a case study in Shebedino District, Southern Ethiopia, Water and Environment Journal 26, 429–434.

Central Statistical Agency (CSA) (2010) The 2007 population and housing census of Ethiopia, Population Census Commission, Central Statistical Agency, Ethiopia, Addis Ababa.

Central Statistical Agency (CSA) (2013) Population Projection of Ethiopia for all Regions at Wereda Level from 2014 – 2017, Population Census Commission, Central Statistical Agency, Ethiopia, Addis Ababa.

Central Statistical Agency of Ethiopia (2013) Inter-Censual Population Survey (ICPS) 2012 Projection Report, Addis Ababa, CSA.

Coates, S., Sansom, K., Kayaga, S., Chary, S., Narender, A. and Njiru, C. (2004) Serving all urban consumers - a marketing approach to water services in low- and middle-income countries: Book 3 - PREPP - utility consultation with the urban poor; Loughborough University, UK.

George, M. and Lennard, L (2006) A Guide to Understanding Water Company Accounts, Consumer Council for Water, UK.

Getahun, S.F. (2013) Households' Willingness to Pay for Improved Water Supply Services in Mekelle City, Northern Ethiopia, MSc dissertation, Mekelle University, Ethiopia.

Howe, L.D., Hargreaves, J.R., Gabrysch S., and Huttly S.R. (2009) Is the wealth index a proxy for consumption expenditure? A systematic review. Journal of Epidemiology and Community Health. 2009 Nov;63(11):871–7.

Hundie, S.K. and Abdisa, L.T. (2016) Households' Willingness to Pay for Improved Water Supply: Application of the Contingent Valuation Method; Evidence from Jigjiga Town, Ethiopia, The Romanian Economic Journal, 62, 191-214.

Hutton, G. and Varughese, M. (2016) The Costs of Meeting the 2030 Sustainable Development Goal Targets on Drinking Water, Sanitation, and Hygiene; Technical Paper for the Water and Sanitation Program (WSP), The World Bank.

IRC (2016) Water, sanitation and hygiene in Gode, Somali: baseline survey factsheet, One WASH Plus National Program, Ethiopia.

Japan International Cooperation Agency (JICA) (2013) Unpublished Consolidated Notes for Urban Wash Mission to Godey, 12-18 September 2013.

Kayaga, S., Mugabi, J. and Kingdom, W. (2013) Evaluating the institutional sustainability of an urban water utility: a conceptual framework and research directions, Utilities Policy, 27, pp.15-27.

Kayaga, S and Smout, I (2014) "Tariff structures and incentives for water demand management", Proceedings of the Institution of Civil Engineers – Water Management, 167(8), pp.448-456.

La Pelle, N. (2004), 'Simplifying qualitative data analysis using general purpose software tools', Field Materials, Vol 16, No 1, pp 85–108.

Liu, J., Savenije, H.H.G and Xu, J. (2003) Water as an economic good and water tariff design comparison between IBT-con and IRT-cap, Physics and Chemistry of the Earth, 28, 209-217.

Mezgebo, G.K. and Ewnetu, Z (2015) Households willingness to pay for improved urban water services: A case study from Nebelet Town, Ethiopia, Journal of Development and Agricultural Economics, 7(1), 12-19.

Ministry of Health, Ethiopia (2011) National Drinking Water Quality Monitoring and Surveillance Strategy, Addis Ababa.

Ministry of Water and Energy, Ethiopia (2013) National Guidance for Urban Water Utilities Tariff Setting, Addis Ababa.

Minota, T. (2014) Determinants of households' willingness to pay for improved water supply services in Dilla Town, Southern Ethiopia: an application of the Contingent Valuation Method, MSc dissertation, Addis Ababa University, Ehtiopia.

Nauges, C. and Whittington, D. (2017) Evaluating the performance of alternative municipal tariff designs: quantifying the trade-offs between equity, economic efficiency, and cost recovery, World Development, 91, 125-143.

Organisation for Economic Co-operation and Development (OECD) (2009) Managing Water for All: And OECD perspective on pricing and financing, Paris.

Pinto, F.S. and Marques, R.C. (2015) Tariff recommendations: a panacea for the Portuguese water sector? Utilities Policy, 34, 36-44.

The World Bank (2017) Sanitation and Water for All: How can the Financing Gap Be Filled? A discussion paper, Washington DC.

Tussupova, K., Berndtsson, R., Bramryd, T. and Raikhan Beisenova, R. (2015) Investigating Willingness to Pay to Improve Water Supply Services: Application of Contingent Valuation Method, Water, 7, 3024-3039.

UNICEF and WHO (2015) Progress on Sanitation and Drinking Water – 2015 update and MDG assessment.

United Nations Development Programme (UNDP) (2006) Beyond Scarcity: Power, Poverty and the Global Water Crisis. Human Development Report. New York.

Water and Sanitation Program (WSP) (1999) Willing to pay but unwilling to charge: Do willingness-to-pay studies make a difference? Field Note, The World Bank, Washington DC.

Water and Sanitation Programme (2011) Cost Recovery in Urban Water Services: Select Experiences in Indian Cities, Technical Paper, The World Bank, Washington DC.

Whittington, D. (2002) Improving the performance of contingent valuation studies in developing countries, Environmental and Resource Economics, 2002(22), 323–367.

Whittington, D. (2003) Municipal water pricing and tariff design: a reform agenda for South Asia, Water Policy 5, 61-76.

WHO and UNICEF (2017) Progress on drinking water, sanitation and hygiene: 2017 update and SDG baselines.

WHO, 2017. Safely managed drinking water - thematic report on drinking water 2017.

Zikos, D and Bithas, K. (2006) The Case of a "Weak Water" Governance Model: Athens – Greece; Proceedings of the 2006 IASME/WSEAS International Conference on Water Resources, Hydraulics & Hydrology, Chalkida, Greece, May 11-13, 2006.