

Tariff structuring in water and sanitation: public profiting arrangements on universalization initiatives

Marcelo Motta-Veiga^{a,b}

^a*Escola Nacional de Saúde Pública/Fiocruz, Rua Leopoldo Bulhões, 1480, Rio de Janeiro, Brasil*

^b*Universidade Federal do Estado do Rio de Janeiro, Rua Voluntários da Pátria, 107, Rio de Janeiro, Brasil*

E-mail: marcelo.veiga@unirio.br

Abstract

Water and sanitation service access is a global problem, impacting disproportionately poor communities of low-income countries. Failed universalization initiatives highlighted historical negligence, social inequality, and bad governance. Infrastructure developments require large investments, which most local governments cannot afford. Alternative funding might come from private investors through cost-effective project finance arrangements. Public services should be sustainable, conciliating users' willingness to pay with providers' willingness to supply. Governments have implemented profit-driven strategies over taxing outsourced public services to increase budget inflow. Inefficient tax schemes on essential public services have damaged universalization initiatives in developing countries. These negative taxing practices have damaged tariff structure, service sustainability, and project attractiveness. The public sector should not profit from unsustainable outsourced services that are required but they cannot supply. Water and sanitation expansions on low-income communities in developing countries should not take place as tariff-free schemes, but within a tax-exempt policy.

Keywords: Brazil; Subsidy; Tariff; Universalization; Water

Highlights

- Universalization initiatives in developing countries.
 - Economic sustainability of public services.
 - Subsidies for unsustainable public services.
 - Taxing water and sanitation services.
 - Tariff structure of water and sanitation services.
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1. Introduction

In developing countries, recurrent economic crises have imposed budget constraints, which limited public funds for keeping up with the rising population demands. In this scenario, most governments are likely to neglect essential services because there is a discrepancy between the duty to fulfill public needs and the capability for financing them. This capital shortage for funding generated concerns between society pressures and taxing limits. Citizens worldwide have complained about increasing taxes and diminishing services (Fitzgerald, 1988; Humphreys *et al.*, 2018).

This setup has inflicted severe public services competition over limited resources for financing. Scarce funding status demands prioritization. As a result, most governments have prioritized essential basic needs (e.g. education and health) over infrastructure investments, resulting in underfunded water-related services, which created challenges for supporting expansion initiatives (Humphreys *et al.*, 2018; OECD, 2011).

Financial constraints and substantial costs for increasing access to water and sanitation demand focusing on making the most of scarce public funding by selecting initiatives according to their benefit–cost ratio (BCR) (OECD, 2011). On this matter, governance and strategic planning are crucial to the effectiveness of water and sanitation services (WSS) investments. Inadequate governance assigns improper roles and responsibilities to stakeholders, affecting investment attractiveness. Investment selection should tie up resource protection (upstream) and wastewater treatment (downstream), which maximizes benefits and reduces unnecessary costs (Pinto *et al.*, 2017; Wang *et al.*, 2017).

Developed and developing countries are at distinct infrastructure phases. Developing countries are completing their primary infrastructure, while developed countries are facing the end of life of their existing framework. In developing countries, the ‘access gap’ for WSS creates pressure for universalization, especially within low-income communities. In developed countries, WSS expansions target stricter regulations compliance, because most of the high-return investments were secured in the late 19th century when basic infrastructure was developed (OECD, 2011; Fuente, 2019).

Moreover, WSS have an economy-of-scale line-up, which harms financial viability in poor small communities. Service connection costs have been an obstacle in these communities, which build opportunities for incentive schemes. Subsidies are undesirable economic distortions that have inflicted negligible improvements on reducing economic inequalities. Most subsidy schemes were poorly designed and did not meet equity goals. The inclusion/exclusion of households in any subsidization program should be based on reliable data and cannot rely only on self-reported information (Contreras *et al.*, 2018).

In this matter, good governance can develop sustainable public services but could generate legal and financial obstacles for cross-subsidization within sustainable and unsustainable services. It is a violation of federative autonomy, subsidy policies based on transferring funds from sustainable services in high-income communities located in one municipality to subsidize unsustainable services in low-income communities from another municipality. Hence, it would be mandatory to find other sources of financing for expanding non-sustainable services within poor municipalities (Motta & Moreira, 2006).

Additionally, most governments are eager to increase their income and to reduce public expenditure. A strategy to decrease funding requests is the creation of service utilities, supported by dedicated taxes (compulsory) or tariffs (noncompulsory) that can guarantee sufficient reserves. Legally, general taxes (e.g. property, income, and sales taxes) cannot be secured because they are inherently designed for funding the public budget, which is allocated through the discretionary power of executive power in office.

On the other hand, dedicated taxes and tariffs must be secured to a connected specific service, demanding that they must be assessed in terms of incurred costs and generated benefits. In this sense, public officials have tried to charge for services that they must finance uniquely through public funds. Thus, any public service generating universal benefits and/or with non-individualized costs must be financed exclusively through public funds (NACWA, 2016).

Economic crises advertise private sector capability for supporting WSS expanding initiatives, to replace the financially deprived public sector. Normally, private investors fulfill their long-term investments via attractive loans from development and/or public banks. In this regard, non-reimbursable or low-compensated public funds used to attract private investors could be simple outcome privatization of public finances (Fitzgerald, 1988; OECD, 2011).

A private involvement can range from full privatization to a simple operation outsourcing (e.g. purchase state-owned companies, contract services, or finance infrastructure). Private approaches can improve governance and sustainability by reducing implementation and operational costs; shortening setup length; transferring risks; and internalizing knowledge, experience, and technology. A public–private partnership (PPP) using strategies from the private sector to supply public services could help improve service efficiency (Akintoye *et al.*, 2003).

In this sense, a sustainable service should benefit all stakeholders, which implies balancing tradeoffs between public and private goals. Investors have different viewpoints on how to internalize WSS benefits in their project finance. Each stakeholder might have a different outcome expectation for participating in partnerships: users (high quality and lower tariff); service provider (financial outcome); and service holder/local government (social and environmental benefits). Thus, WSS infrastructure expansions should consider that incurred costs and expected benefits might influence participants in diverse ways (Steiner, 1980).

Various mixes of public–private investments to finance long-term infrastructure projects can be arranged. While some public services could be financed entirely through public funds, other services could be funded with no public resources. Alternatively, services can be financed entirely or partially by private sector and/or by users' payment of dedicated charges (tariff or tax). Thus, a public–private investment mix can range from zero to almost 100% of public funds supporting public services (see Figure 1 for financing public services from the governmental viewpoint).

Figure 1 shows different approaches for financing public services from zero to 100% of public funds supporting the service. The costs and benefits transported to the stakeholders vary according to individual needs and the existing local infrastructure. Water-related access gaps have enormous social, environmental, and health impacts and costs. Thus, most of the benefits from WSS interventions are avoidance of social, environmental, and health costs, which are hard to be internalized by the private sector. On the other hand, local governments might design strategies to increase their revenues by taxing public services or by charging contract-signing fees (OECD, 2011; WHO, 2012).

In this sense, outsourcing public services can be a source of income for financially unbalanced local governments. Municipalities are gaining from contracting the private sector to provide public services (contract-signing fee). The private sector is profit-driven and is not conceived as social, charitable, or philanthropic ventures. Any public income displaced from the private sector would be reimbursed by the users. This scheme is a disguised fund-transference from society (users) to local government through the service provider (third party).

The next section discusses global initiatives for expanding WSS. Most of these attempts have failed due to the lack of service sustainability. The third section presents a differential analysis on users' ability

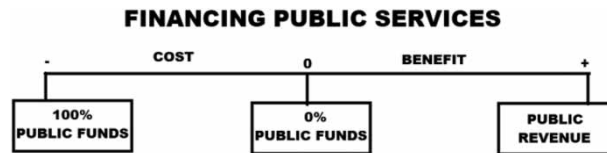


Fig. 1. Financing public services.

and willingness to pay (WTP) contrasting providers' willingness to supply (WTS) water-related services. The fourth section analyzed the Brazilian WSS negligent history and failed attempts to finance universalization. The fifth section analyzed strategies for supporting water-related service expansions, debating different tax arrangements to improve public revenue in expansion initiatives for increasing WSS access to poor communities.

2. Recent global initiatives on expanding water-related services for the poor

Worldwide, water scarcity is a reality for four out of 10 people, and three out of 10 people do not have access to safe drinking water. Currently, the environment receives 80% of total generated wastewater without any treatment, while 60% of the global population do not have access to basic sanitary facilities. Even though these aggregate numbers demonstrate an extremely serious scenario, they also hide severe inequalities that exist among the countries (WWDR, 2003; WHO & UNICEF, 2017; UNESCO, 2019).

The major burden of water-related access gaps affects low- and middle-income countries, where 842,000 people die each year from inadequate WSS. A sub-Saharan Africa region accounts for over 50% of the people consuming unsafe drinking water worldwide. This scenario pressed for an international agenda to reduce inequities and to increase WSS investments in developing countries (WHO & UNICEF, 2017; UNESCO, 2019).

In 2010, the United Nations (UN) declared that the access to appropriate WSS is a basic human right, which implies social and political problems, not a technical issue. The UN Millennium Development Goal (MDG) was a global effort to reduce the number of people without access to safe drinking water and basic sanitation by 50% until 2015. MDG expected a massive financial support requirement, which is estimated by the Joint Monitoring Programme (JMP) for Water Supply and Sanitation as US \$332 billion for sanitation and US\$203 billion for drinking water supply (WHO, 2012; Neto & Camkin, 2020).

This sum of expected WSS investment did not occur. In 2015, the JMP revealed that one billion people were still without regular drinking water and 2.3 billion without basic sanitation. Thus, the UN created a Sustainable Development Goal (SDG #6) aiming to access water and sanitation for all. At the current level of investments, UN has estimated that for extending basic WSS to the unserved population would require US\$28.4 billion per year from 2015 to 2030 (25% for water and 75% for sanitation) just for supporting capital expenditures (CapEx). These figures correspond to 0.1% of the global GDP of the 140 countries surveyed in the report (WHO & UNICEF, 2017).

Water and sanitation for all (universalization) is a distinct problem that would require US\$114 billion or 0.39% of global GDP per year, which represents an investment figure over three times the historic capital expenditure. Additionally, WSS capital investment requirements for meeting SDG #6 within

poor regions are substantially larger, e.g. sub-Saharan Africa (2% of GDP) and Southern Asia (0.86% of GDP) (WB, 2016).

Furthermore, the World Health Organization (WHO) estimated that for every US\$1.00 invested in WSS, there would be an accumulated return of US\$5.50 from lowering health-associated costs, improving labor productivity, and reducing premature deaths (WHO, 2012). The MDG was more optimistic, reporting a BCR as high as 7–1 for developing countries investing in WSS. However, three quarters of these expected benefits would come from time saved on obtaining drinking water, and other substantial expected benefits would be the reduction of water-borne diseases (OECD, 2011).

In this sense, drinking water investments should provide the highest comparative benefits. Likewise, hygiene education can supply enormous benefits at a relatively low cost. Additionally, wastewater services can produce large comprehensive benefits because they reduce the risks associated with diffuse pollution, which are connected to improvements in the whole water system quality through the removal of polluting substances. However, the BCR for water-related investments diminishes with the increasing level of intervention sophistication, and once a certain degree of physical infrastructure is reached, marginal benefits tend to decrease drastically (WHO, 2012).

Many WSS initiatives in developing countries have failed because of inadequate tariff structure. The water and sanitation concession in Buenos Aires has bad cost allocation among stakeholders and inefficient tariff structure, which does not allow sound operational cost recovery (Mercadier & Brenner, 2020). In Algeria, water tariffs do not cover full-service costs, which makes the service unsustainable (Boukhari *et al.*, 2020). In Ghana, the recent privatization of water systems reinforced social inequalities, in which water became abundant for the rich and scarcer for the poor, who have no say in water-related privatizations (Twum & Abubakari, 2020).

Thus, implementing public policies for the poor is a complex task. Social-inclusive legislation can provide a legal framework, which can help low-income households in WSS expansions. Even though legal means is a vital element, social policies are inherently public decisions (not private) with political implications. Hence, socially inclusive initiatives should be backed by public funds and detailed service sustainability analysis, saving private providers from this public burden (Santos *et al.*, 2019).

Thus, an efficient water-related tariff structure is important to improve service sustainability, which promotes infrastructure investment, legal stability, and expenditure (capital and operational) recovery. In this sense, regulatory agencies should develop rules to balance social equity with service sustainability, facilitating supporting incentives for service providers to supply affordable public service for the poor.

Providing appropriate WSS infrastructure could not be sufficient to guarantee service quality. There is an inherent user behavior factor, in which society must be educated to use the structure properly. These psychological factors imply behavior changes that can aid users to improve their living conditions despite any public initiative. Hence, any WSS expansion initiative should incorporate incentives for promoting user changes by behavioral interventions at the community level (Mosler, 2012).

Finally, despite economic and technical feasibility, WSS investments should be analyzed in terms of social, health, and environmental advances, with benefits coming from a mix of tangible (e.g. lives saved, or diseases prevented) and intangible drivers (e.g. quality-of-life improvements or environmental sustainability). However, most of the outcomes from WSS interventions cannot be converted in terms of monetary compensations or transferred to private service providers. This inconsistency between who pays the burden and who gets the benefits might push WSS investments as a low value for the money, resulting in sub-optimal levels of public services (WWDR, 2003).

3. Ability to pay, WTP, and WTS

Universalizing WSS services requires balancing diverse points of view (municipalities, users, and service providers). The shortage of public investments (e.g. non-reimbursable or low-rate public funds) spreads the decision-making power to users and to service providers. In this sense, WSS assessments should integrate affordability, WTP, and WTS, and should not be planned solely through political goals and limited information. Tariff structures differ from water-abundant to water-scarce regions and could be used as incentives for encouraging water saving and for suppressing environmental impacts (Berbela *et al.*, 2019).

In general, water-related services require substantial long-term capital expenditures (CapEx), which generate massive fixed-costs. If this scenario creates a natural monopolistic market, only one firm would be able to efficiently supply the service within diminishing marginal and/or average total costs range (see Figure 2).

In natural monopolies, expanding WSS through existing infrastructures are beneficial to all stakeholders (users, service provider, and service holders) because they imply declining average and marginal costs, which should lead to smaller tariffs at a similar service quality level. This scenario is represented at the negative slope side on Figure 2 (economy of scale), indicating the declining (average and marginal) costs associated with additional amounts of service supplied.

Investment challenges occur when expanding WSS require infrastructure development. WSS investments compete with other basic needs for financing and should be analyzed from both private and public finance procedures. Typically, service tariffs should cover all incurred costs and internalize all externalities.

Charging users for essential public services involves contradictory viewpoints, particularly in poor communities. WSS cost assessments are technical and straightforward tasks. On the other hand, WSS benefit valuations can be economical and/or political missions. In this sense, successful valuation strategies should incorporate all key attributes: the users' ability to pay (ATP) and WTP, and the service providers' WTS.

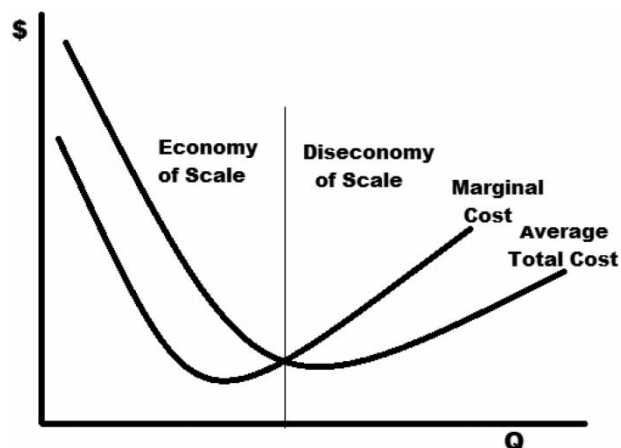


Fig. 2. Economy of scale.

Academic studies (Fujita *et al.*, 2005; Tussupova *et al.*, 2015) showed that up to 90% of users have willingness to pay (WTP) a certain amount to improve WSS infrastructure. Generally, the WTP for sanitation is lower than for drinking water, especially inside low-income communities (see Figure 3).

WTP is the highest amount users are willing to pay for additional unit of service and represents the genuine demand curve for water-related services, which is conceptually different from ATP assessment (e.g. percentage of monthly household income), because it is established upon WSS perceived benefits (e.g. access limitations, scarcity, and quality) and users' socioeconomic attributes (e.g. education and available income). In high-income communities, WTP might be lower than ATP, while in low-income communities WTP might be higher than ATP (World Bank, 2008).

Typically, the cost of supplying sanitation services is higher, the benefits are diffuse, and WTP is lower, resulting in smaller prioritization assessment by municipalities and users, which entails higher challenges for funding universalization initiatives when compared to drinking water expansions (Fujita *et al.*, 2005; Tussupova *et al.*, 2015).

Usually, social-inclusive policies for expanding WSS involve social tariffs that are lower than the actual service costs, requiring subsidization. Subsidized tariffs discourage conscious users' behavior (endanger water-saving policies) and dissuade venture capital. Inefficient political interference should be avoided, and users should pay at least an amount to cover their own service costs, up to the limit of their ATP (affordability).

Tariff structures should guarantee full cost recovery, especially within pro-poor initiatives. In poorer communities, public drinking water locations and connection cost subsidies could help alleviate financial struggles. Still, any incentive promoting unsustainable users' behavior should be prevented (Whittington, 2003).

Alternatively, enforcing a financially sustainable tariff structure within poor communities can be politically problematic because users might not have willingness to pay (WTP) an amount that covers their own incurred costs. Tariff elasticity of low-income users is minimal because they cannot adjust their consumption behavior to comply with incremental tariff scenarios. In these cases, cross-subsidization is the usual strategy, although it has limited scope and produces undesirable market distortions (Olivier, 2010).

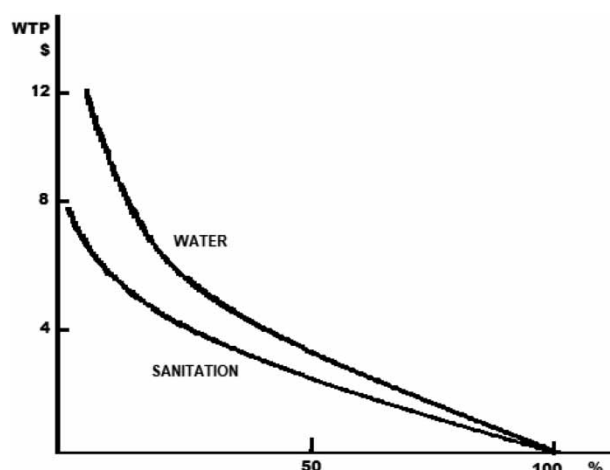


Fig. 3. WTP for WSS. Source: adapted from Fujita *et al.* (2005).

On most occasions, affordability is simplified as a ratio between public service expenditure and monthly income. However, affordability (ATP) is a more complex issue because it has subjective components relative to individual preferences. Thus, inadequate affordability assessment should be avoided. Only the fraction of the actual household consumption covering basic needs should be used to estimate affordability (Fuente, 2019).

The WTP for safe drinking water varies from 2 to 6% of monthly household income according to the socioeconomic status. The World Bank assumes that 5% of household income would be a reasonable target for users to pay for drinking water (2%) and sanitation (3%) services. In low-income communities, this restriction may provoke unsustainable services because the expected revenue might be lower than incurred costs (McPhail & Bank, 1993; Fujita *et al.*, 2005; World Bank, 2008; Dey *et al.*, 2019).

Otherwise, WTP should be assessed locally because different communities have distinct needs. In poor communities supplied with inadequate drinking water and/or contaminated water, WTP should be comparatively higher than ATP. Social tariffs should promote water conservation, social equity, and service sustainability. Thus, charging social tariffs for drinking water sufficient to secure basic needs might be socially, but not financially efficient policies (Castro-Rodriguez *et al.*, 2002; Lopes, 2020).

On WSS expansions requiring the infrastructure development, the service provider WTS is based on project finance assessment (expected revenue and service incurred cost). The equilibrium for two communities (A and B) is represented in Figure 4. The WTP is the demand curve (D), while marginal cost is the curve (C). Community A (left side) has higher WTP and income level than community B (right side). Marginal cost (C) is assumed to be the same for both communities.

Figure 4 shows a target tariff (P^*) applied per unit of service provided for the two communities (A and B). In this scenario, there is no tariff discrimination. In both communities, the tariff (P^*) leads to a total revenue that is lower than the total incurred cost, requiring some subsidies for financial sustainability (WTS). In community A, the demand curve (D_a) showed that WSS is universal; the service provider

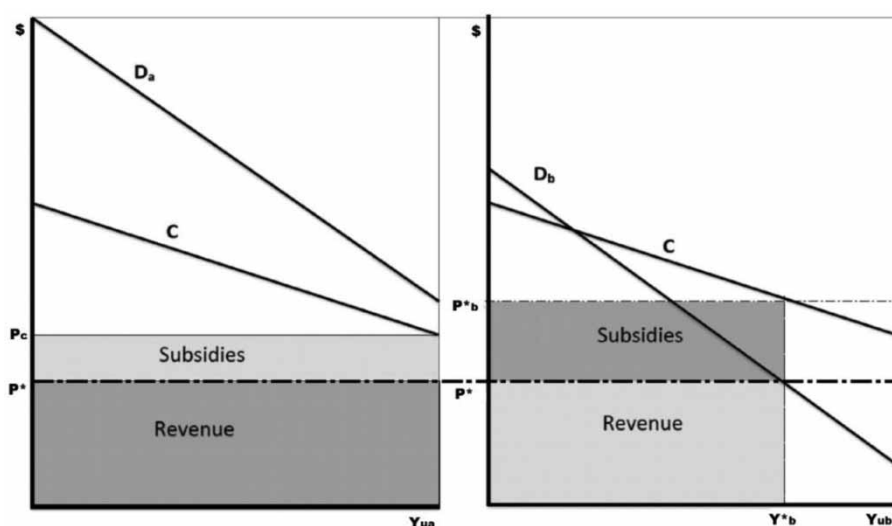


Fig. 4. WSS demand and supply equilibrium in two communities.

has willingness to supply (WTS) the service to all (Y_{ua}). In community B, the demand curve (D_b) implied an access gap ($Y_{ub} - Y_b^*$); WSS does not cover all users.

On the other hand, tariff discrimination can make substantial improvements in resource allocation efficiency. Instead of setting up unique target tariffs for WSS, tariff structures could be designed as different tariffs for distinct users, e.g. poor users could pay tariffs covering only their variable/operational costs, which would lead to subsidy only fixed-costs tariff component for this group of users, reducing impact on service sustainability.

In Figure 5, users from community A have willingness to pay a tariff (P_a), which is higher than the tariff (P_b) paid by users in community B for the same amount of service. In a universalized scenario, WSS can be financially sustainable for community A, but requires some subsidies for community B. Any surplus (gain) from the service provided in community A could be used to subsidize the service in community B (cross-subsidy). Thus, tariff discrimination should be considered as a more financial and social efficient resource allocation, which could reduce the need for additional public funding.

4. Universalizing WSS in developing countries: the Brazilian case

Expanding WSS through the existing infrastructure entails a straightforward strategic plan, because it should be materialized within economy-of-scale range (diminishing marginal and average costs) with lower comparative investments. In developing countries, the situation is habitually diverse because most WSS expanding initiatives require large investments for developing nonexistent or insufficient infrastructure. Thus, this Brazilian case is limited to WSS expansions that involves infrastructure development.

Over the last decades, the Brazilian government has neglected investing in WSS, significantly impacting human health and the environment. Historically, public funds have been the major support for infrastructure development. However, repeated economic crises have imposed severe financial restrictions demanding original sources for complying with the Brazilian universalization plan by 2033.

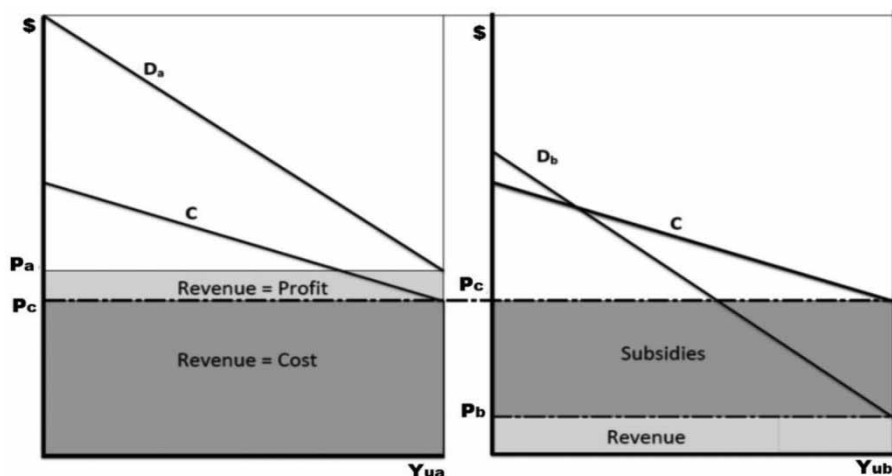


Fig. 5. WSS demand and supply equilibrium with tariff discrimination.

Brazil is a socially and economically unequal country, in which the population of 212 million people, disproportionately, occupies a continent-sized area of 8.5 million km². Economically, the top 1% of the population concentrates 30% of the whole country's income. Socially, 36% of the population lives in poor regions (Northeast and North), which represents 64% of the total area. The rich regions (Southeast, South, and Midwest) encompass 64% of the population living in the remaining area (36%), but with double the average income *per capita*. The Covid pandemic has drastically impacted the Brazilian economy, GDP, and domestic currency (Brazilian Reais – R\$), as indicated in Table 1. In December (2019), 1US\$ = 4.0R\$, and in January (2021), 1US\$ = 5.5R\$ (IBGE, 2021).

Brazil has abundant natural resources; domestic water sources correspond to 12% of the planet's available freshwater. However, water basins are not balanced within the country's area; while the North region concentrates 80% of available freshwater and holds 5% of the population, the Atlantic region holds over 45% of the population with less than 3% of the country's water sources (ANA, 2019).

The Brazilian Constitution holds municipalities responsible for providing WSS. However, 90% of the 5,570 municipalities have less than 50,000 inhabitants and do not have technical or economic viability for local solutions due to diseconomy of scale, inadequate infrastructure, and lack of adequate funding mechanisms (IBGE, 2021).

According to the National Treasury Secretariat (STN), federal and state transfers demanded by the Constitution accounted for more than three quarters of the local budget for 82% of City Halls and only 1.8% of municipalities had less than half of their budget tied to these transfers. In only seven richer states, their budget dependency on federal transfers was below 25% (STN, 2020).

Federalism imposes budget dependence on central government transfers, resulting in asymmetric power between different autonomous spheres of government (federal, state, and municipal). In this sense, political bargains are favored, and the obstacles of the municipalities (e.g. low institutional capacity and socioeconomic heterogeneity) are enhanced, limiting the possibility of cooperative schemes (Abrúcio & Sano, 2013).

In Brazil, 16% of the population does not have access to drinking water; and 54% of the population does not have their domestic sewage collected. Table 2 shows these variances through the National System of Information on Water and Sanitation (SNIS), where an inadequacy of water-related services and great regional inequalities can be observed. Most of WSS access gaps occur within the poor regions of the country (SNIS, 2020).

Table 1. Brazilian data.

Region	Area (km ²) (×1,000)	Population (×1,000)		Population per km ²	GDP (US\$) (×1,000,000)	GDP (US\$) <i>per capita</i>
		Urban	Rural			
Brazil	8,516	179,370	33,250	24.97	1,400,000	6,585
North	3,858	13,001	4,681	4.58	75,600	4,275
Northeast	1,558	43,274	15,898	37.97	200,200	3,383
Southeast	928	83,260	6,315	96.50	744,800	8,315
South	579	25,922	4,601	52.71	238,000	7,797
Midwest	1,610	13,913	1,754	9.73	141,400	9,025

Source: IBGE (2021).

Table 2. Access gap, and investments made – Brazil – 2003–2017.

Region	Population access gap (%)		Public investments made (%)	
	Water	Sanitation	Water	Sanitation
Brazil	16	54	71	29
	Relative access gap and public investments made by the region (%)			
North	28.5	13.4	5.0	3.0
Northeast	31.5	32.9	22.0	13.7
Southeast	33.0	28.4	51.8	58.0
South	4.8	16.5	12.5	16.7
Midwest	2.2	8.8	8.8	8.5
	100	100	100	100

Source: SNIS (2020) and Plansab (2019).

The deterioration of public budget created public funds scarcity for financing WSS expansions. Over the last decades, the different spheres of executive power (federal, state, and municipal) have not made sufficient investments to reduce the WSS access gap and regional distortions, as shown in Table 2.

The National Plan for Basic Sanitation (Plansab, 2019) estimated that it would be necessary to make investments of US\$4 billion (R\$22 billion equivalent to 0.3% of GDP) each of the following 15 years to universalize WSS in urban areas. These amounts of WSS investments have never occurred, indicating funding discrepancies.

Table 2 shows the disconnections between access gap and investments made. In the poor North region, the relative participation on access gap was five times greater than the investment made. In the rich Midwest region, the investment participation was four times greater than the access gap. The investment participation in poor regions (Northeast and North) was smaller than required. On the other hand, in rich regions (Southeast, South, and Midwest), investment participation was larger than the access gap. This scenario indicates political power guiding the prioritization of WSS investments (SNIS, 2020).

From 2010 to 2017, the average amount invested per year in water and sewage was US\$2.47 billion (R\$13.6 billion), smaller than required investments to meet universal coverage by 2033 of US\$4.0 billion (R\$22 billion). If an unlikely 60% increase in WSS investments occurs, the universalization target would only be met in 2053, indicating 20 years of delay. Frequent economic crises suggest that extensions on WSS investments should not come from non-reimbursable public budget funds. The finance challenge would be finding alternative sources and/or attract the private sector (CNI, 2018).

The Brazilian WSS Privatization Plan conducted by the Brazilian Development Bank (BNDES) designed a tariff structure based upon compulsory cross-subsidies within users from arranged municipal clusters (voluntarily and compulsory grouping). BNDES has targeted economic sustainability through grouping sustainable and unsustainable WSS from rich and poor municipalities in clusters. As incentives for participating in the privatization plan, municipalities are attracted by a share participation on the assets accumulated through the taxes incorporated in the WSS tariff structure (BNDES, 2020).

These taxes have two components: flat rate (paid upfront as a counterpart for signing the contract) and variable rate (based upon contractors' future revenues). These taxes are cash transferred from users to public office as an incentive for them to outsource WSS to third parties. The participation of rich municipalities to guarantee financial sustainability has been compulsory, which has raised legal concerns on

municipal constitutional autonomy. This innovative compulsory source of income directed from users to municipalities (poor and rich) does not improve service economic sustainability or raise affordability for the users. These ineffective incentive strategies have created economic, political, and legal insecurity on WSS expanding initiatives (BNDES, 2020).

Table 1 indicates that the population density in the Southeast region is 20 times higher than in the North region. The average sanitation cost per capita in small cities (population of less than 50,000) is remarkably high, while in larger cities (population of more than 200,000) it is lower. The National Water Agency (ANA) compared required investment in sewer collection and treatment in different regions. In the North region, the required investments for collection are 4.1 times greater than for treatment, while in the Southeast region they are only 30% greater ($1.3\times$). In Brazil, due to the massive costs for expanding services within small communities, the expected investments for improving sanitation collection through centralized systems are 2.7 times greater than for treatment. WSS investments in rural areas and low-density regions have been assumed to have low economic viability (ANA, 2017; Plansab, 2019).

In poor regions (North and Northeast), the users' affordability and WTP are lower and the service costs are higher, which makes service sustainability even harder. In addition, part of the costs to supply water-related services are electricity with over 50% tax burden (state, federal, and subsidy provision). Thus, federal and state governments will get a hold on a huge part of the revenues from municipal WSS expansions. According to the Brazilian law, public income into the general budget cannot be guaranteed to specific public services, e.g. water and sanitation. Therefore, the greatest struggle for public service providers remains, ensuring specific sources of financing.

Frequently, in the presence of the fiscal scarcity scenario, attracting private investors has been an alternative. Private organizations are business-oriented and there is pressure for subsidized funds from public and/or development banks to risk venture capital with long-term return, particularly when high political and legal stakes are involved. Historically, less than 20% of WSS investments came from the private sector, indicating minor contribution in Brazilian WSS expansions.

As a result, it is unlikely that universalization of WSS would occur in Brazil and in most of the developing world without public financing support. This scenario is aggravated by the existing restrictive economic scenario, especially within low-income and rural communities. Consequently, governments might not be able to provide enough resources to influence private investors, but they should not gain from universalization initiatives, which would entail searching for larger WSS funds.

5. Pricing for profits in WSS universalization initiatives

WSS can result in gains or losses for service providers, considering revenues and costs, requiring efforts from local governments to improve sustainability (technical, economical, and legal). Sustainable services are attractive to both public and private organizations and should not trigger major challenges for funding. In contrast, WSS universalization within poor communities implies expanding unsustainable services, which should materialize through inclusive social public policies.

There are several strategies on tariff design for balancing economic sustainability, and environmental, social, and political goals. Typically, social tariffs for services supplying essential human needs enhances equity, but cannot cover incurred costs, which cause bad consumption behavior and generate efficiency losses (Pinto & Marques, 2015).

A flat connection fee could facilitate economic sustainability but could also disincentivize low-income users to connect to the service. A volumetric-based tariff could promote conscious water consumption, motivating water-saving in scarcity scenarios. Moreover, it can elevate business risks due to seasonable variability of revenues. Thus, in terms of water and sanitation policy, there is no one size fits all solution; there will always be some tradeoff to balance (Pinto & Marques, 2015).

The predominant strategy for enhancing financial viability on potential unsustainable services has been through cross-subsidies among different classes of users; high-income users should pay more than their own costs, so low-income users can pay less. Cross-subsidization implies that someone should bear an extra burden without receiving the corresponding benefit. Thus, cross-subsidies are undesirable externalities that interfere on resource allocation, create economic distortions, and generate market inefficiency.

In this regard, collaborative schemes among different municipalities can improve governance and incorporate win–win cooperative decisions, with collective benefits and minor individual losses. These collaborative rational choice arrangements can improve governance, promote economic development, reduce inequality, and address social, economic, and environmental externalities (Feiock, 2007).

The main motivation for municipalities to cooperate is mutual benefits. The dilemma arises when a small number of stakeholders (rich cities or neighborhoods) are compelled to subsidize several poor municipalities without any benefit, just to make the service sustainable. This strategy has immense political costs, which executive offices would not be willing to bear. A sound governance in a cooperative cluster should balance all stakeholders' perspectives and would not indulge only a proportion of the group partners.

Furthermore, federal and/or state governments might try to impose social agreements within unequal municipalities. This is a common strategy for expanding public services to low-income communities without providing proper funding. In this sense, legal and political problems can occur, because service sustainability would be guaranteed solely based on cross-subsidies between users from different municipalities. It is awkward to suppose that an elected executive official would rather assist other municipalities as opposed to improving or supporting local underfunded services. Thus, this intermunicipal cross-subsidy paradigm requires coercive power to avoid users from richer municipalities backing off from forced 'collaborative schemes' (Motta & Moreira, 2006).

In the current global downturn, local governments are struggling to balance their budgets and are looking for novel sources of steady income. Consequently, public officials may look at existing service gaps as opportunities for uncomplicated cash inflow. Hence, WSS universalization initiatives through private sector involvement can be the ideal setup for increasing public revenue via additional service taxes and tariffs.

Taxes/tariffs are an additional cost burden on public service stakeholders. Ad valorem taxes incur in most capital (CapEx) and operational (OpEx) expenditures. These obligations create cost loads to service providers, as they are applied on resources (e.g. electricity, property, value-added, and income taxes) and/or on the service itself (e.g. public service tax). Usually, private service providers will not bear tax burdens; they transfer tax expenses to users, which can become an obstacle for universalization initiatives.

Figure 6 shows the previous situation (Figure 4) of a target tariff (P^*) applied per unit of service provided for the two communities (A and B), but without ad valorem tax costs (T). The marginal cost curve shifts clockwise ($C-T$), and there is no tariff discrimination. Only in community B, the tariff (P^*) leads to a total revenue that is lower than the total cost incurred, requiring some subsidies for financial

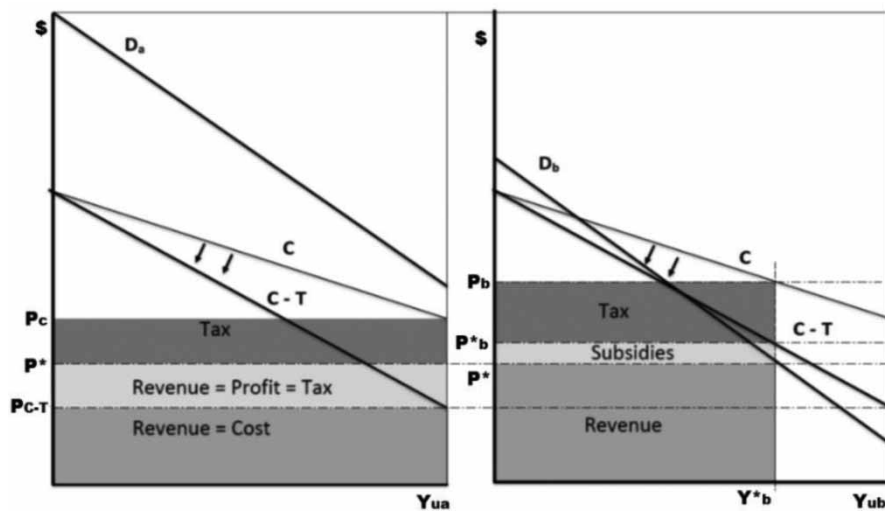


Fig. 6. WSS demand and supply equilibrium – without taxes.

sustainability and for organizational WTS. In community A, the service is financially sustainable, and the extra revenue (gains) could be used to subsidize a smaller difference from community B. Note that the sustainable tariff for community A is (P_{C-T}) , while $(P^* - P_{C-T})$ is the amount overtaxed.

In the community A in Figure 4, the demand curve (D_a) provided universal access; WSS for all (Y_{ua}). In community B, the demand curve (D_b) implied an access gap ($Y_{ub} - Y_b^*$); WSS is not for all. However, the number of subsidies required in the scenario represented in Figure 6 (without taxes) is smaller than that in Figure 4.

In the tax scenario represented in Figure 4, governments would be gaining from the services provided for both communities, because service providers are charging users a higher tariff to cover the additional tax burden. Public revenue generated from general taxes cannot be dedicated to a specific service. Due to the discretionary power of executive office, these funds might not be used to finance a specific service.

In this tax-free scenario, tariff discrimination can also make a substantial improvement in resource allocation efficiency. As the scenario represented in Figure 6, instead of setting up a unique target tariff for water-related service, the discrimination strategy can create different tariffs for diverse classes of users.

In Figure 7 (tax-free), users from community A have willingness to pay a tariff (P_a), which is higher than the incurred cost (P_{C-T}) and the tariff (P_{ub}) paid by users in community B for the same amount of service. In this universalized scenario, WSS is economically sustainable for community A (large gain), but requires smaller subsidies for community B. The extra revenue (gain and taxes) from the service provided in community A can be used to subsidize the service in community B (cross-subsidy).

Thus, tariff discrimination in a private (non-public) competitive scenario (tax-free) can be considered an economic and socially fair resource allocation for universalization initiatives in poor communities. In tax-free scenarios, funding viability of cross-subsidies is much higher, which can reduce the need for public investments. It is important to highlight that **a tax-free scenario does not mean tariff exempt service**; the main principle is that **users should pay at least a reasonable amount to cover incurred costs up to their affordability**.

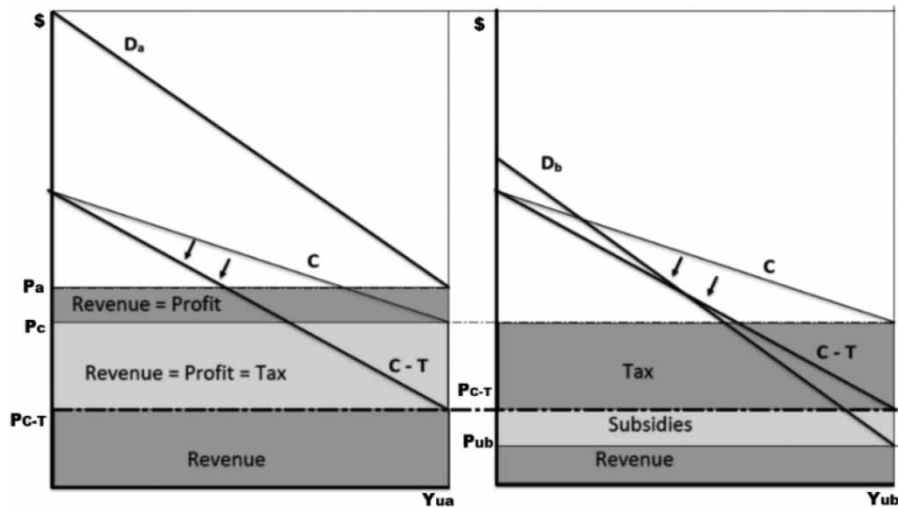


Fig. 7. WSS equilibrium – with tariff discrimination and without taxes.

The primary reasoning for existing WSS access gaps is the lack of necessary funds for financing expanding initiatives, which would demand large investments in capital and operational expenditures. WSS universalization initiatives generate public inflow from tax schemes on tariff structures. This negative political interference threatens WSS universalization strategies by introducing unnecessary burdens on service providers (public or private), impacting WTP, AFP, and WTS, and creating additional expenses to users (poor or rich). In this sense, different spheres of governments should not profit (e.g. contract-signing fees) from outsourcing public services that they are legally responsible for supplying but decided to transfer to third parties.

6. Conclusions and recommendations

Acquiring suitable WSS infrastructure is crucial for human development and requires large capital (CapEx) and operating (OpEx) expenditures. Historically, public policies for invigorating infrastructure development have employed substantial amounts of non-reimbursable resources. However, providing appropriate public services entails more complex tasks than just offering the essential hardware arrangement. Public services should be sustainable (technical, economical, and legal) and address stakeholders' requirements. In this sense, water and sanitation involves different benefits and costs (capital and operational), which should be assessed distinctly, even though, in the transition phase, sanitation might be estimated based upon water-metered consumption.

WSS universalization perseveres as an unaccomplished basic human right. Increasing population needs and restricted public budget has made achieving this global goal a hard task because of the highly competitive nature of funding public services. In the recent aggressive financing scenario, long-term infrastructure investments have not been prioritized by most governments, which has increased WSS access gaps. Inadequate WSS has prompted severe consequences for low-income communities of developing countries. An alternative for expanding WSS in developing countries has been outsourcing services to private investors.

However, private sectors are not philanthropic institutions and are not attracted to non-lucrative socially inclusive initiatives. As mandatory business-oriented motivation, sustainable services should conciliate distinct viewpoints, tariff structure, and incurred costs. The necessary good governance requirements imply supplying a quality service, which accommodates users' WTP and providers' WTS.

Globally, the negative effects of persistent infrastructure investment neglect have soared over the last decades with recurrent economic crises, affecting funding to meet WSS universalization targets. These goals are hard to achieve, because they require secure massive investments for WSS infrastructure development in low-income communities (comparatively higher costs, and difficult to individualize benefits) that have low ATP, and even smaller WTP.

Cross-subsidy policies within different classes of users could alleviate low-income users from supporting entirely their incurred service costs, which could be beyond their ATP (affordability). Tax schemes raise tariffs and public revenues, increase investment requirements, and decrease venture capital viability. These inefficient strategies reduce the investment attractiveness for all types (public and/or private) of infrastructure development projects. Public gains impose higher CapEx and OpEx requirements for WSS investors, which could threaten the economic sustainability of universalization initiatives for the poor in developing countries.

Failed Brazilian WSS expansion initiatives and increased social inequalities stressed the negative impact of inadequate tariff structures. Different spheres of governments have profited from outsourcing basic public services to private institutions. Taxing policies are recurrent means for municipalities to boost public inflow. The Brazilian Water and Sanitation Program includes fixed (e.g. signing fee) and variable (e.g. revenue) taxes on WSS outsourcing contracts, which increases (poor and rich) municipalities inflow. In this sense, it is recommended that inefficient tax/tariff structures on WSS expansion initiatives to provide basic services for low-income communities should be averted, because they can make already unsustainable services harder to support.

Finally, tax schemes create negative market distortions, which deviate water and sanitation investments from the universalization objective. Any WSS expansions under the tax-exempt scenario (which is different from a tariff-free scheme) make it simpler to reach economic, technical, and social sustainability. It is recommended that WSS expansions to low-income users should take place in the tax exemption scenario. Governments should not gain from basic public services that they have the duty to supply but they are not willing to do so or cannot afford. If the public sector could not assist, they should not disrupt WSS sustainability.

Several themes were not included in the limited scope of this research, which was also restricted by the mandatory size of the manuscript. These relevant studies are recommended for future research in WSS expanding initiatives in developing countries: comparative taxing effects with/without tax-exempt scenarios (Veiga *et al.*, 2021); tariff structure and its link with resource scarcity and demand (Pinto *et al.*, 2021); the role of regulators in tariff structuring (Nickson & Vargas, 2002); PPPs' theoretical and/or empirical case studies; and different cross-subsidy options.

Data availability statement

All relevant data are included in the paper or its Supplementary Information.

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