WORKING PAPER

The water and sanitation service provision in Peru

Gisella ARAGÓN & José Luis BONIFAZ

CIRIEC N° 2013/06

CIRIEC activities, publications and researches are realised with the support of the Belgian Federal Government - Scientific Policy and with the support of the Belgian French Speaking Community - Scientific Research.

Les activités, publications et recherches du CIRIEC sont réalisées avec le soutien du Gouvernement fédéral belge - Politique scientifique et avec celui de la Communauté française de Belgique - Recherche scientifique.

This working paper is indexed and available in SSRN and RePEC

Ce working paper est indexé et disponible dans SSRN et RePEC

ISSN 2070-8289

The water and sanitation service provision in Peru[*]

Gisella Aragón[**] & José Luis Bonifaz[***]

Working paper CIRIEC N° 2013/06

[*] This case study was presented at the Seminar "Public enterprises in the 21st century: Various issues from regulation, pricing, CSR to marketing and others – Reflections and case studies", Université Libre de Bruxelles, Solvay Brussels School of Economics and Management, September 9-10, 2013, Research Project of CIRIEC International Scientific Commission on Public Services/Public Enterprises on "The Future of Public Enterprise - Mission, performance and governance: Learning from success and failures".

[**] Assistant Research, Universidad del Pacífico, Perú (Email: aragon_gs@up.edu.pe).

[***] Associate Dean of Economy, Faculty of Economics and Finance, Universidad del Pacífico, Perú (Email: jbonifaz@up.edu.pe).

Abstract

Public services in all countries are related to the basic needs that people should satisfy in order to warranty a worthy quality of life. The water and sanitation services provision is one of these services.

Through this study, the case of water and sanitation provision in Peru will be analyzed. Data evidences that by 2004, the 71% of Peruvian population had access to water services, while the 63% of Peruvian population had access to sanitation services. Then, it can be inferred that the performance of the provider enterprises of water and sanitation services and the tariffs scheme has not been good enough.

In order to understand the problem beyond the provision of water and sanitation services in Peru, it is necessary to investigate the political economy of Peruvian water and sanitation sector and its tariffication scheme.

Keywords: Incidence, Business Taxes and Subsidies, Public Goods, Infrastructures, Economics of Regulation, Government Programs, Provision and Effects of Welfare Programs, Economic Development, Human Resources, Human Development, Income Distribution, Migration.

JEL-codes: H22, H25, H41, H54, L51, I38, O15.

Introduction

Public services in all countries are related to the basic needs that people should satisfy in order to warranty a worthy quality of life. The water and sanitation services provision is one of these services.

From an economic perspective, Stiglitz (1989) argues that since the perfect competitive market does not happen in its prime definition, the government intervention is a crucial instrument to prevent the detrimental effects that *market failures* can determine in an economy.

The provision of public services is normally configured as a *natural monopoly*, which defines the importance of its analysis and periodical revision in order to get an accurate feedback of the performance of the supplier enterprise. Worthington (2010) explains that the main problem with the public services is that the quantity provided is insufficient for the consumers. Then, an inevitable consequence is the social efficiency loss, which justifies the government intervention through public, private and mixed supplier enterprises, formulation and regulation of pricing schemes and quality standards.

The case of water and sanitation provision in Peru will be analyzed in this paper. The importance of the provision of water and sanitation services is crucial, as it is expressed by the Millennium Development Goals (MDGs): "The reduction of half the population of people who do not have a sustainable access to water supply before 2015".

Globally, in the last 20 years, more than 2,400 million and 600 million people have acquired the access to water and sanitation services, respectively. In terms of the developing countries, by 2004 the 79% of the population of Latin countries[1] had access to both services. Focusing on Peru, data evidences that by 2004, the 71% of Peruvian population had access to water services, while only 63% had access to sanitation services. Then, it can be inferred that the performance of the provider enterprise of water and sanitation services and the service tariff schemes are not optimal.

In order to understand the problem beyond the provision of water and sanitation services in Peru it is necessary to investigate the political economy of Peruvian water and sanitation sector and the tariffication scheme.

The *political economy of Peruvian water and sanitation sector* is complex. On the one hand, an important problem that resembles within all is the absence of right incentives for the economical agents that form part of the sector, which are most of the time conditioned to political interests. Therefore, the structure of water and sanitation sector is based in unstable foundations.

On the other hand, other problems in the sector are related to its atomization (there are many supplier enterprises that are owned by different municipalities),

[1] Unicef (2007).

the deficient development of operative plans, tariff formulation and tariff schemes determination and the settlement of ineffective sanctions and fines.

In summary, most of the problems are related to the structure of the sector and the scope of the regulatory agency. Consequently, it is important to understand the sector structure and dynamics, the roles of the agents who form part of the sector and to recognize the main challenges over the implemented regulatory scheme.

The *tariffs and tariffs scheme* in this structure is the core of the provision of the services and it should be analyzed in two perspectives. The first perspective is related with the "political economy" of the sector. The services tariffs must cover the costs of providing the services and ensure the financial sustainability of the enterprises along time. The main problem is that politic interests interfere in the tariffs determination, which determines low tariffs and hinders the supplier enterprises' achievement of goals.

The second perspective is based on the fact that tariffs should allow users to get a sustained consumption of water and sanitation services. Therefore, tariffs of water and sanitation services are defined considering a cross-subsidy scheme with the goal of helping the most vulnerable population, which is composed by poor and extreme poor households. The problem of this cross-subsidy scheme is that it is exposed to a high level of targeting errors. As a consequence, users that are not the main target of the cross-subsidy scheme are being helped (error of inclusion), while other users that should be consider as potential subsidized consumers are not (error of exclusion).

Consequently, in order to evaluate the efficiency and accuracy of the tariffs scheme, a methodology to determine the targeting errors and how can them be avoided will be applied in the analysis of SEDAPAL's[2] particular case.

Then, the rest of the paper is organized as follows. Section 1 reviews the political economy of water and sanitation in Peru. Then the targeting errors under tariff and subsidies schemes are presented in Section 2. Finally, Section 3 shows the study's conclusions.

1. The political economy of water and sanitation in Peru

1.1. The theory and practice of water and sanitation services provision

There are two ways to ensure the provision of water and sanitation services: to provide water service through house connections; and, to provide the service by direct supply. In the first case, the provision of water requires the installation of tubes, which are an important part of the sunk costs that supplier enterprises take into account. In contrast, the second way of water provision is through an

[2] Sedapal is the most important public company in Peru and it provides water and sanitation services in Lima and Callao.

intermediary agent that supplies water, for example by tankers, or carrying the water from water wells or rivers.

The development of countries has made tube-connection system the predominant water and sanitation supply system in urban areas, while various forms of direct provision predominate in rural and poorer areas. However, this structure should change since the average cost per cubic meter supplied through pipes tends to be much lower than the costs derived from the direct supply system.

Theoretically, public services supply can be characterized as a *natural monopoly* since there are great investments and sunken costs that an enterprise has to incur on in order to provide the service. In the case of potable water and sewage services, the supplier enterprises require to do a great invest in order to enable the tube-connection red system. As a consequence, it is more efficient for society that a single agent provides the service. Another important reason for this relies on the existence of economies of scale for the relevant range of demand[3]. In this case, the government intervention on the development of natural monopolies is through *pricing*, which also implies the fixation of quality service levels. These actions are conducted by a regulatory public agency; and, the pricing scheme and the quality standards are imposed on the supplier enterprise.

An alternative government intervention is the *constitution of public enterprises*, which limits the use of market power of the natural monopoly supplier and lowers the prices of water provision. The public enterprises are not motivated by profit maximization. Instead, these enterprises can set prices so as to maximize the expansion of the service and any other criteria considered relevant by the government. Under this structure, it is usually unnecessary the presence of a regulatory agency.

Even though the regulation of tariffs and the creation of public enterprises appear to be alternative instruments of government intervention in order to restore efficiency, there are reasonable justifications for the coexistence of both. On the one hand, the larger the monopoly enterprise, the greater its delegations problem may be. Therefore, the creation of public enterprises is favorable. However, since there are cases were the public enterprise does not represent the interests of the users (the interests of elected politicians influence them), it is necessary to have a regulatory agency that can represent consumers' interests.

On the other hand, the definition of quality standards is important and it should be regulated and supervised because of its significant impact on population health. That is, whether the service is provided by a monopoly enterprise or multiple enterprises.

[3] The scope of the economies of scale tends to be geographically located in the production and distribution of water and the establishment of the drainage system.

Summing up, the regulator's attention should be primarily on the determination of tariffs and the determination of the service's quality.

Finally, the corporate governance framework of the supplier enterprise is extremely important and can be understood as a principal – agent problem, were the organization's management takes the place of the "agent" that executes the orders of the "principal", which is represented by the enterprise's board. This problem relies within an asymmetric information context. Therefore, the subjects employ the information they have in a strategical way.

1.2. Main features of the regulatory framework of water and sanitation provision in Peru

1.2.1. Water and sanitation sector structure

The distribution of the supplier enterprises of water and sanitation services in Peru is conditioned to its geopolitical division. The country is divided in 24 departments, which are subdivided in 196 provinces and 1,832 districts.

By 2012, about 1,521 districts were supplied of water and sanitation services through different agents: municipalities, the service administration boards or other kind of operators. The remaining 311 districts were supplied of water and sanitation services through one of the 50 supplier enterprises that form part of the sector.

The supplier enterprises are regulated by the regulatory agency in Peru and are an important component of water and sanitation sector. Even though these enterprises should serve 18,6 million water connections, they just provide water services to 16 million users and sanitation services to 14,9 million users.

The supplier enterprises have been classified by the regulatory agency taking in consideration the correlation between the number of water connections served and the cost of production per cubic meter for each supplier enterprise. The classification is defined as follows:

- *The small supplier enterprises*, these enterprises supply water and sanitation services to less than 15,000 water connections;
- *The medium supplier enterprises*, these enterprises supply water and sanitation services to 15,000 – 40,000 water connections;
- *The large supplier enterprises*, these enterprises supply water and sanitation services to 40,000 – 200,000 water connections; and,
- SEDAPAL, is the largest supplier enterprise that serves water and sanitation to Lima and the constitutional province of Callao through more than 1 million water connections.

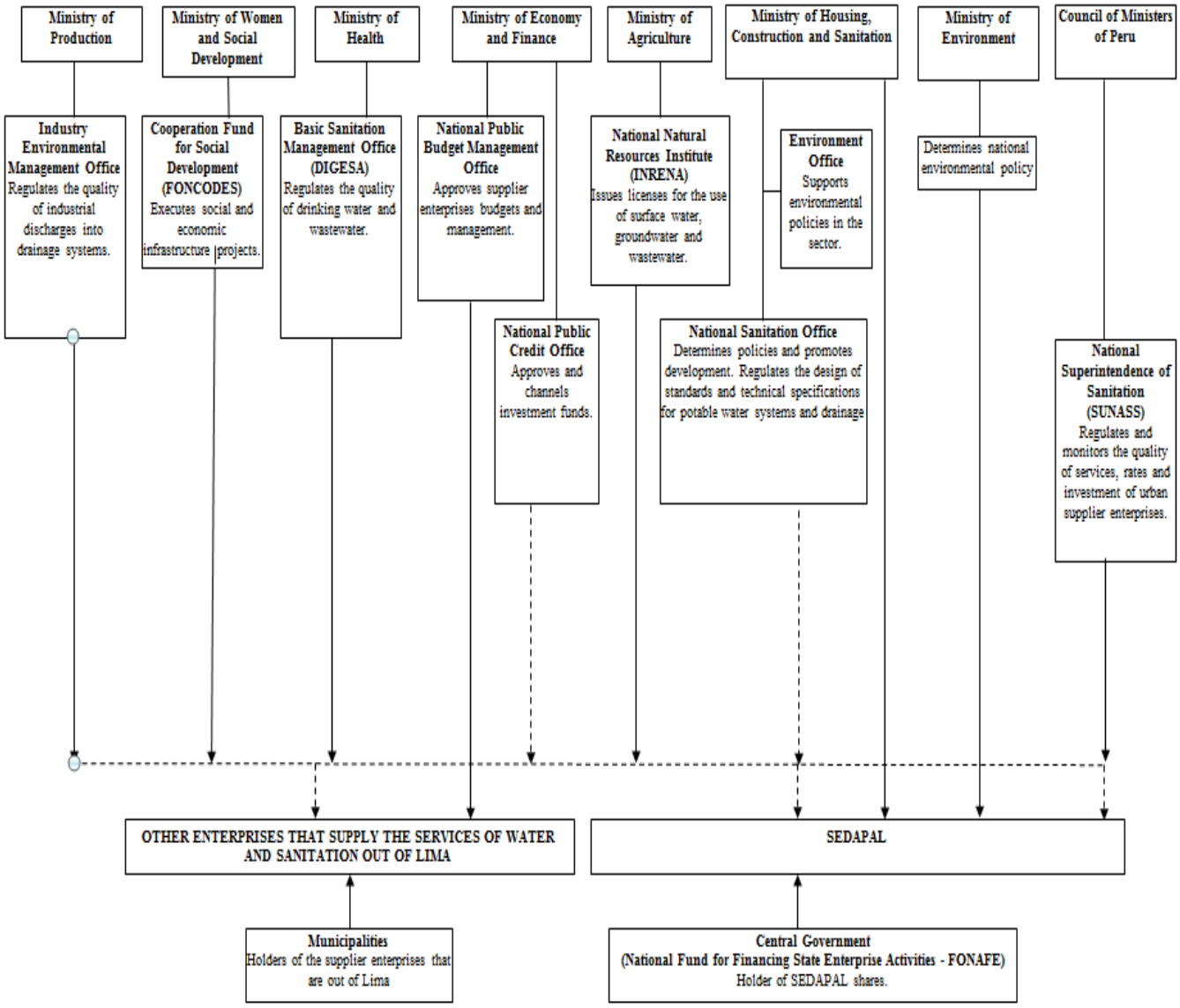
Currently there are 13 large supplier enterprises, 15 medium supplier enterprises and 21 small supplier enterprises of water and sanitation services. It is important to highlight that SEDAPAL and the groups of large and medium enterprises serve 95% of total water connections.

Finally, 48 of the total number of supplier enterprises of water and sanitation services are public and municipal-owned enterprises. The 2 supplier enterprises remaining are: (i) SEDAPAL, which serves the capital of the country and is under the responsibility of the Central Government; and, (ii) ATUSA, which serves the city of Tumbes and is a private company operating under a concession arrangement.

1.2.2. Main actors, roles and incentives

Taking in consideration the main characteristics of the provision of water and sanitation services, it is important to identify the stakeholders and the roles they have assigned in this sector. The Peruvian water and sanitation sector is composed by the following entities (See Figure 1).

Figure 1 – Actors and Roles in the water and sanitation provision in Peru



Source: SUNASS.

Next, the roles and incentives of the most important agents that compose the water and sanitation sector are detailed.

The municipalities. The municipalities are public institutions responsible for the provision of water and sanitation services. They grant "the right of operation" to supplier enterprises through the creation of municipal-owned enterprises.

The municipalities' mayors have an important role. From a political perspective, municipalities' mayors rule the municipal government for a determined period. On the other hand, from the perspective of water and sanitation service provision, municipalities' mayors are important because they are in charge of approving the supplier enterprises' proposed tariffs.

Therefore, in order to get the political approval of their voters, most mayors try to please them by maintaining water and sanitation services' tariffs. Consequently, this produces some difficulties for the supplier enterprises' financial sustainability. As the possibilities of getting a complete funding for the supplier enterprises are limited, its ability of expanding the service and ensuring a right quality standard of the services provided diminishes.

The water and sanitation supplier enterprises. The water and sanitation supplier enterprise (EPS) can be public, private or mixed. The public supplier enterprises are municipally-owned companies governed by the General Law (*Ley General de Sociedades*). The mayors of each municipality name the directors of these enterprises. Therefore, the board members do not necessarily belong to the same political group, which makes harder getting to agreements.

An important requirement for public supplier enterprises is to be enrolled in the register of the regulatory agency (Recognition Policy). When an enterprise is registered by the regulatory agency it is mandatory for that enterprise to respect the quantity and quality of water and sanitation service standards and, must define the services' tariffs considering the principles set by the regulatory agency. Once the supplier enterprises boards get the approval of the regulatory agency and the mayors, the tariffs can be applied in order to define the services' tariffs. Additionally, in order to raise their public funds, public supplier enterprises should ensure the accomplishment of certain goals.

In summary, public supplier enterprises have to respond to several *principals* (such as the mayors of the municipalities, the Ministry of economy and finance, and the National superintendence of sanitation) in order to provide water and sanitation services. This task may be complicated in some instances because each entity has its own goals.

The Ministry of Construction and Sanitation. Specifically, the General Sanitation Office of the Ministry of construction and sanitation has a promotion role. The Office main task is to formulate and execute the national water and sanitation policy. Even though this might lead to think that the municipalities and the Ministry of construction and sanitation are natural allies, it is only true when the authorities of each institution belong to the same political group.

The National Superintendence of Sanitation (SUNASS). SUNASS is the regulatory agency that is in charge of approving the master and financial *plans* of the supplier enterprises and determine the tariffs formula setting that supplier enterprise should take into account when proposing their tariffs schemes. SUNASS has technical, economic, administrative and functional autonomy. SUNASS is headed by an executive president elected by competition, and has a board of directors, which is the highest level of decision-making.

Regarding to its regulatory function, SUNASS has full jurisdiction over the supplier enterprises, which are *recognized* in the system. The *recognition of the firms* is a legal obligation, and requires the development of different types of plans (master, financial and investment plans as part of a Master Plan), the regulation of tariff formulas, the payment for the regulation rate and other interventions in the local interactions.

SEDAPAL. This is the largest public company that supplies water and sanitation services to Lima, the capital. Therefore, it is the principal water and sanitation supplier company that is regulated.

Being a public company, a natural alignment between the business interests of the company, the ministry and the regulatory agency might be expected since all serve to the same *principal*. However, there is not such connection between these institutions; in fact, the public company and the ministries tend to align their interests against the regulatory agency. Most of the conflict arises from the regulatory requirements that SUNASS makes to SEDAPAL in terms of the efficiency goals and management costs.

Finally, being a public enterprise, it is important to consider the political pressures that affect SEDAPAL.

The Ministry of Economy and Finance (MEF). The Ministry of economy and finance influences the industry through two main fronts. The first front is the National Fund for Financing State Enterprise Activity (FONAFE), which controls SEDAPAL. The second front is the National Public Budget (DNPP) involved in the budget process for the municipalities and the supplier enterprises. This budget is defined according to the achievement of goals that supplier enterprises' reach.

The Services Management Committee (JASS). The JASS are voluntarily organizations chosen by communities with the purpose of managing, operating and maintaining water and sanitation services of one or more rural population centers.

The General Office of Environmental Health (DIGESA). DIGESA shares the responsibility with SUNASS for setting the quality of water. The dirtier and untreated is water, the greater the cost of treatment and the higher the average level of tariffs. In other words, the lower the effectiveness of DIGESA, the greater the costs of water that users have to incur on, and the lower the

possibility of maintaining financial sustainability through the tariffs for the supplier enterprises.

Finally, an important group of economical agents that form part of the water and sanitation sector is the group of *consumers*. The current consumers, who already have home water and sanitation connection, are not the only agents that compose this group. The potential consumers are also part of it. Therefore, the consumers in total have different interests and that is a fact that the sector policy makers should take in consideration.

1.3. The regulation scheme implemented and its problems

The regulation scheme of the water and sanitation sector is a complex labor since several agents (that have their own goals and interests) compose the sector and most of them are involved in the regulatory activities SUNASS develops.

There can be identified five problems: (i) the scope of competence of the regulatory office, (ii) the *recognition policy*, (iii) the complex tariffication scheme, (iv) the quality of the services provided; and, (v) the audit and imposition of sanctions.

1.3.1. The scope of competence of the Regulatory Agency SUNASS

One of the most important issues for the SUNASS is related to its sphere of competence. In order a strong regulatory agency can be able to accomplish its objectives efficiently and effectively, it is important that another institutional agent establishes the organisms that are "managed" by it or the criteria that defines which agents are under its supervision. Otherwise, their actions could fall into arbitrariness, which increases uncertainty and reduces investment in the sector.

In the water and sanitation sector this is crucial since it also implies the determination of the roles and responsibility of the municipalities, who are in charge of provision of the services (through the supplier enterprises), are owners of the public supplier enterprises and have to supervise the management of the supplier enterprises. Then, SUNASS regulation mission would not have competence power over the municipalities but over the supplier enterprises.

Another issue in the regulation scheme is whether the jurisdiction of SUNASS includes the provision of sanitation services in rural areas. The General Law establishes that rural water and sanitation provision is made by the Service Management Committee (JASS), while the regulatory agency SUNASS, regulates its operation and develops the tariff determination criteria in rural areas, and also fixes the family rates.

Nevertheless, in rural areas, regulatory intervention is not necessary as the possible problems that would justify its intervention are not present. Rural localities have been historically supplied by formed groups of villagers in the highlands, around the rural communities, which to date are regulated by a special law and have a different regime to govern and access to the property.

Since it is difficult to identify the welfare loss that causes the action of private agents (that could justify regulation) and if the increase in welfare would be higher than the cost associated with state regulatory intervention, the scope of the regulatory agency would have to be restricted to companies that provide sanitation services in urban areas. It is only in these cases that are clear signs of market failures that justify regulation: the problem of delegation and the abuse of market power.

1.3.2. Recognition Policy

SUNASS has the obligation to keep a record of the supplier enterprises (EPS). In order to do that, the EPS should be recognized. The "recognition" status is aimed to achieve the formalization of the supplier enterprises. This formalization contemplates the incorporation of the companies and their respective classification according to the number of connections.

In practice, the recognition policy replaced the obligation to sign the operating agreement between the EPS and the respective provincial municipality. The rule of recognition is complex and requires a set of documents and plans for EPS. Once the EPS's are recognized they are required to pay the regulation contribution, to provide information (this information will then be published which, opens the possibility of being audited and eventually sanctioned), etc.

All this process the EPS's have to undergo may not bring them enough benefits since after fulfilling all the requirements they just earn the access to external financing to improve their performance in the provision of the services. From this perspective, this scheme needs to be reviewed in order to align the incentives of the EPS (covering their costs and maintaining financial sustainability) with the objectives of the regulatory office (increase the consumers' welfare by supervising the EPS's).

1.3.3. The complex tariffication process

The water and sanitation tariffication scheme is complex. The water and sanitation supplier enterprises serve to different types of consumers. The consumers are classified in two main categories: (i) Residential consumers; and, (ii) Non-residential consumers. In general, *domestic consumers* (households) and *social consumers* (social public programs, churches, etc.) compose the total population of residential consumers. On the other hand, *commercial, industrial* and *public* consumers compose the total population of non-residential consumers.

The tariffication scheme considers the consumers' structure; and, as a consequence it sets a *cross-subsidy scheme* grounded in an *increasing stepped block tariff*. In order to define the block tariffs, the system is based on the consumption level of the users. This structure is aimed to help the *domestic users* that belong to the first block of consumers (the consumers that have the lowest level of consumption of water and sanitation services).

In that sense, SUNASS's regulation merely provides the criteria to be considered in the definition of consumption blocks by water and sanitation supplier enterprises, including the setting of the upper limit of the first block of domestic consumers, which is established according to the volume of water required for a family to satisfy its basic needs in a month. Therefore, *SUNASS'S Tariff Structures Reorganization* provides the following basis for the determination of the rates,

- In a *first stage*, the rate defined for the first block of domestic consumers can only be greater than the corresponding rate of the social category; and it should be necessarily inferior to any other rate defined for other user categories.
- In a *second stage*, the rate for the first block of domestic consumers must be equal to the corresponding rate of the social category; and less to those applied to any other rate defined for other user categories (including the rates defined for the higher blocks of domestic consumption).

Conversely, the water and sanitation supplier enterprises following the directives of SUNASS, first determine the average rate that should apply to the consumption of their services and then, taking into account its particular consumers' structure, it defines their tariff structure (including the cross-subsidy scheme) so that the total average rate per cubic meter consumed equals the users' weighted average rate in the company.

Once the tariff structure is determined, the financial funding for the subsidy of the first block of domestic consumers comes from non-residential consumers and from domestic users that belong to the highest block of consumption. Finally, it is important to mention that unlike other Latin American countries, the supplier enterprise's total subsidized amount is not constraint by the regulatory agency.

Even though the tariff scheme seeks to focus the cross-subsidy scheme on those users that don't have enough purchasing power (under the premise that users with lower consumption have lower income), the targeting system is not working as expected.

While it can be recognized an inverse relationship between the level of consumption and the ability to pay of users, there are other factors besides the economic resources of the user that explain their level of consumption of water and sanitation services. For this reason, it is recognized that the consumption level of the users as a stratification method involves errors of inclusion and exclusion in identifying the subsidy's beneficiaries.

1.3.4. The quality of the services provided

It is impossible to set a price for a service without knowing the quality levels associated with it. The quality of service can have multiple dimensions in the case of water and sanitation: supplied water quality, quality of connections,

quality of supply (continuity, pressure, etc.), and, use conditions (information provided by the company on terms of the transaction).

If another institution sets the service quality levels with primary responsibility for health, it is possible that this institution will not consider the standard costs it implies. On the other hand, if the levels are set by the regulatory agency, it is probable that they will not have enough knowledge in order to define the quality levels; or, they may be willing to tolerate relatively low quality levels in order to avoid high impacts on the costs of providing the service and, therefore, in the tariff's rates.

Therefore, there is a problem in the service quality levels determination based on the incentives of the agents that form part of the sector. One approach to solve this problem is to minimize transaction costs, thus leading to establish that the monitoring of service quality levels and the determination of them should depend on the regulatory agency, which is primarily responsible for pricing and tariff determination.

In practice, in Peru there are some relevant institutions that direct the regulatory agency in order to settle the water and sanitation quality standards: (i) The Ministry of Health, through DIGESA, is responsible for setting the parameters, and (ii) the Ministry of Production, which is responsible for controlling industrial discharges. The final quality standard determined has effects on the costs of supplying the service of water and sanitation; and, on the tariff's determination.

1.3.5. The audit and imposition of sanctions

By definition, a regulatory agency has the capability to use coercive state power to simulate the conditions of competition in the market. It is impossible to sustain the regulation without sanction threats. Nevertheless, this tool is ineffective and meaningless unless regulation schemes promote an environment of compatibility of incentives and all the agents agree to comply rules.

The regulatory framework of water and sanitation sector does not exactly foment the compatibility of incentives within the agents who participate in the sector. Consequently, it is imperative that the regulatory agency has effective coercion mechanisms in order to achieve the compliance of current regulations.

Since the promulgation of rules and regulations regarding the sector, the regulatory agency has had a weak monitoring of rules compliance and the correspondent penalties on the evidence of non-compliance. On one hand, there is a problem when identifying the subject of sanction. On the other hand, there is a problem derived from the fact that sanctions are perceived as weak.

Regarding the subject of sanction, the dilemma is related to the *recognition policy*. Who should be punished for not complying regulatory agency rules: The municipality or the EPS's? In its dual role of responsible for the provision of service and owner of the public supplier enterprise, the municipality should be responsible.

On the other hand, regarding the deterrent power of sanctions, Creation Act in 1994 provides only three types of sanctions: warning, fine (up to 30% of revenues) and intervention. Furthermore, there are only two standards of events classified as violations of the rules: (i) Failure to comply deadlines established by law or by order of the SUNASS; and, (ii) The reluctance to the adequacy of the legal framework, which implies operating without *recognition* of SUNASS.

Then, it can be inferred that coercive measures and the determination of who is the subject to be supervised and fine are unclear and are generating incorrect incentives to the agents that form part of the sector.

2. The cross-subsidy scheme and the targeting errors

As it has been stated previously, in Peru the water and sanitation tariff applied by all the provision enterprises are approved by SUNASS, which is also in charge of its application and supervision.

The current tariffs are determined in order to set a *cross-subsidy scheme* that is based in an increasing stepped blocked tariff. This scheme works charging higher rates per cubic meter consumed to users of water and sanitation services who have a large volume of water consumption, and subsidizing those users who have a lower volume of consumption (who are charged with a much lower rate per cubic meter).

The main purpose of this scheme is to generate a cross-subsidy to benefit users unable to pay for the service (poor and extreme poor households) and, in addition, to maintain the resources needed by the supplier enterprises to operate and expand their networks, promoting the rational use and preservation of water resource.

However, even though the aim of this scheme is to improve the social welfare of water and sanitation consumers, this structure has problems in determining which consumers should be subsidized and which consumers should be charged with a higher rate in order to finance the subsidy. As a consequence of this problem high errors of inclusion and exclusion affect the cross-subsidy scheme.

These targeting issues should be corrected in order to improve results of tariff and water administration. The principal reason that explains these problems is that the scheme settings do not necessarily consider the supplied household socioeconomic characteristics in order to determine which are the groups of consumers that should be subsidized and which are not.

This section of the document is intended to evaluate the targeting issues that affect SEDAPAL's tariffs and cross-subsidy scheme. SEDAPAL is in process of expanding water access for Lima through a program called "Agua para todos" in order to help the poorest population in Lima who lack of water. Since the public budget SEDAPAL relies on is limited, the investment in such projects and other infrastructure activities requires the adjustment of water provision tariffs.

Nevertheless, the tariffs instability affects current users, who are charged a flat fee[4] equal to S/. 4.583 and a variable fee that depends on the cross-subsidy system described before. Therefore, solving the targeting errors is a priority.

2.1. The current situation of SEDAPAL

SEDAPAL's rate structure is given by an increasing stepped blocked tariff. The blocks are ranged from: 0 m^3 to 10 m^3; from 10 m^3 to 25 m^3; from 25 m^3 to 50 m^3; and over 50 m^3. This tariff system works charging the user a rate according to the amount of water consumed in a stepped way.

For example, if a user consumed in a month a total of 30 m^3, the first 10 m^3 consumed are charged at the average rate of the first block. Then, the excess over 10 m^3 up to 25 m^3, would be charged at the average rate of the second block; and the remaining 5 m^3 would be charged at the average rate of the third block.

The current cross-subsidy scheme is generated in an implicit way since the discrimination of consumers is according to the volume of water consumed. In order to identify which are the subsidized blocks, the consumption patterns and tariffs are the main indicator to be examined. The structure can be seen in Table 1.

Table 1 – Consumption patterns by block tariff

Ranges of consumption (m3)	Households		Average volume charged (m3)	Average amount charged (S/.)	Average rate charged per m3 (S/.)
	Frecuency	Percentage			
0 - 10 m3	200,835	22.70%	6.35	5.77	0.91
10 - 25 m3	506,204	57.22%	17.82	17.34	1.05
25 - 50 m3	157,832	17.84%	32.93	44.80	2.32
> 50 m3	19,861	2.24%	79.45	231.18	3.96
Total	**884,732**	**100.00%**	**19.29**	**24.41**	**1.31**

The total average rate charged per cubic meter[5] is the indicator that determines the blocks of users that are subsidized and the blocks of users who are charged a higher rate in order to make the cross-subsidy scheme work. In this case it is equivalent to S/. 1.31 per cubic meter consumed.

Since the average rate charged per cubic meter of the first two blocks of consumption is below the total average rate charged per cubic meter, these blocks can be considered as "subsidized blocks". On the other hand, the resembling blocks pay an average rate charged per cubic meter higher than the total average rate charged per cubic meter. This indicates that these consumers conform the "subsidizing blocks".

The problems in the actual cross-subsidy scheme are the high levels of targeting errors because the blocks of consumers are discriminated by the *amount of consumption* instead of being discriminated by their *ability to pay*. For example, there can be poor households that are integrated by large families

[4] The flat fee defined for 2011.
[5] The total average rate per m^3 calculation considers the households percentage of each block.

and in consequence consume higher volumes of water and sanitation services and are part of the subsidizing blocks, while non-poor households that are integrated by small families and consume less volumes of water would be part of the subsidized blocks.

This problem has a negative impact in SEDAPAL's ability of recovering economic costs, its goals of expanding the access to the water and sanitation services and the provision of the services' volume that ensures a sustainable consumption for the consumers.

2.2. Methodology applied in order to identify the targeting errors

2.2.1. The alternative scheme

It is possible to improve the effectiveness of the actual cross-subsidy scheme if a variable to identify the *ability to pay of the consumers* is considered. In this case, the category of the Household Targeting System (also known as SISFOH) will be employed in order to have a proxy of the ability to pay of the consumers since it classifies households in two categories: (i) Extremely Poor (SISFOH categories from 1 to 3); and, (ii) Poor[6] (SISFOH categories from 1 to 6). This classification is made through a household registration census where information about dwellings, households and individuals characteristics is recovered.

After matching the SEDAPAL user data and the SISFOH categorization of the household, it is possible to examine the new discrimination performance and its effect in the determination of the consumption blocks. Considering the settings described before, the blocks of consumers will change from the established in the actual scheme as it can be seen in Table 2.

Table 2 – Alternative tariff scheme proposed

Ranges of consumption (m3)	Average rate charged per m3 (S/.)	Average rate charged per m3 (S/.)		
		Subsidy = 100% of the rate	Subsidy = 50% of the rate	Subsidy = 30% of the rate
0 - 10 m3	1.31	-	0.66	0.92
10 - 25 m3	1.31	-	0.66	0.92
25 - 50 m3	2.32	2.32	2.32	2.32
> 50 m3	3.96	3.96	3.96	3.96

An important fact that is incorporated under the alternative tariff scheme proposed is that the first two blocks of consumers[7] (block I, from 0 m^3 to 10 m^3 and block II, from 10 m^3 to 25 m^3) now will pay a rate equal to the average rate per cubic meter as a reference to the average cost of providing the service.

Furthermore, in order to make some comparisons between this new scheme and the actual scheme, it will be evaluated the effect of subsidizing the 100%, 50% and 30% of the average rate charge per cubic meter to the subsidy target

[6] This category includes the *non-extreme poor* and *extreme poor* population.
[7] That were subsidized before and paid a rate below the average rate.

households and form part of the first two blocks (consumption until 25 m^3). If consumers overpass the 25 m^3 of consumption, the rates that they should pay will be the rates established in the original scheme, even if they are part of the target household[8].

2.2.2. The targeting performance indicator

In order to compare the original scheme and the alternative scheme proposed, there are some indicators that are useful to consider according to Komives *et al*. (2006) and can be described in three dimensions. The first dimension reviews how well the subsidies grant benefits to poor households versus the other users, the second dimension checks whether poor households are receiving the subsidy; and, the third dimension measures the material impact of the subsidy.

The first dimension indicator, also known as *the beneficiary incidence*, will be the main **targeting performance indicator** employed in this analysis, as suggested by Angel-Urdinola and Wodon (2007). The targeting performance indicator measures the proportion of subsidy that benefits poor households in respect of the subsidy received by the total households' population (which includes poor and non-poor households). It is defined in the following way:

$$\Omega = (S_P / S_H) / (P / H)$$

Where, P is the poor household population, H is the total household population, S_P is the average subsidy received by poor households, and, S_H is the average subsidy that is received by total households' population.

Formally, if $\Omega > 1$, then the average subsidy received by the poor households is greater than the received by the total households' population; if $\Omega = 1$, then the average subsidy received by the poor households is equal to the average subsidy received by the total households' population; and, if $\Omega < 1$, then the average subsidy received by the poor is lower than the received by the total population.

Then, it is possible to measure the *progressivity* and the *degressivity* of the subsidy scheme. If the distribution of profits is directed in a higher proportion to the poor population, who are the target, rather than the rest of the population the subsidy scheme is *progressive*. In contrast, there are signs of a *degressive* subsidy scheme if these benefits do not assist the target households.

2.3. Results

SEDAPAL's user database contains information of 893,309 households. When merged with the SISFOH category, 32.26% of the households are

[8] It is important to mention that the flat fee will not be taken into account since it is not considered part of the subsidy scheme.

identified as *poor households;* and just 0.37% of these poor households were classified as *extreme poor households.*

In order to have a wide overview of the actual cross-subsidy scheme, the targeting results are in terms of two definitions of poverty: (i) extreme poor households and (ii) poor households (this category includes poor and extreme poor households).

In general, the actual cross-subsidy scheme presents quite serious results in terms of the inclusion error. Table 3 shows the main findings.

Table 3 – Targeting errors under the actual cross-subsidy scheme

Poverty definition	Targeting errors	
	Exclusion error	Inclusion error
(i) Households in extreme poverty	9.55%	50.23%
(ii) Households in poverty	12.21%	16.58%

Considering that households in extreme poverty are the target population of the subsidy scheme, the inclusion error is equivalent to 50.23% of the total non-extreme poor households that are being included in the subsidy plan. However, if we relax this assumption and test what happens when the target of the subsidy are households in poverty, the error of inclusion is equivalent to 16.58% of the total non-poor users that are being included in the subsidy plan.

On the other hand, in terms of households that were excluded from being beneficiaries of the subsidy when they should have been, the error rates show lower results. When considering the households in extreme poverty as the target of the subsidy, the exclusion error is equivalent to 9.55% of the total households that are in an extreme poverty situation. On the contrary, if the targets are the households in poverty, the exclusion error is equivalent to 12.21% of the total users in poverty.

As a consequence, the targeting performance indicator (Ω) for both definitions of poverty is very close to 1, which enhances the presence of high levels of targeting errors under the actual tariff structure and proves that SEDAPAL's tariff structure is *neutral* in terms of the cross-subsidy scheme it is based on. The results are presented in Table 4.

Table 4 – Targeting performance indicator under the actual cross-subsidy scheme

Cross-subsidy target	Targeting Performance Indicator (Ω)
(i) Households in extreme poverty	1.045
(ii) Households in poverty	1.036

On the other hand, under the alternative scheme proposed in Table 5, the inclusion and exclusion errors where diminished to zero, since all the consumers that were target of the cross-subsidy scheme were attended. In the same way, the targeting performance indicator[9] (Ω) evaluated in the alternative scheme proposed is equal to 273.35 and 3.09 when the cross-subsidy target are households in extreme poverty and households in poverty, respectively.

Table 5 – Average targeting performance indicators of the alternative scheme proposed

Cross-subsidy target	Targeting Performance Indicator (Ω)
(i) Households in extreme poverty	273.35
(ii) Households in poverty	3.09

These results in Table 4 imply that working with SISFOH category, as a proxy of the users' ability to pay is effective and that there are not targeting errors. The alternative scheme proposed for SEDAPAL proves to be a progressive cross-subsidy scheme.

Finally, an important variable in order to measure the impact of the efficiency of the alternative scheme proposed are the economical benefits SEDAPAL might get in average. SEDAPAL's income variation when the cross-subsidy targets are extreme poor households is on average equivalent to 20.74%. On the other hand, SEDAPAL's income variation when the cross-subsidy targets are poor households is on average equivalent to 5.22%.

These results show that under both poverty definitions adopted as cross-subsidy target population, SEDAPAL would increase its incomes. However, it is important to highlight that when targeting poor households, the percentage of income increase is lower since the cross-subsidy scheme would be helping a higher number of households.

Conclusion

The Peruvian water and sanitation sector has many challenges in order to obtain an optimal service for all the consumers.

First, the sector operation framework defined by the regulatory agency should be adjusted in order both supplier enterprise and SUNASS have the correct incentives to exert its functions.

Second, the water and sanitation tariffs based in a cross-subsidy scheme should be revised and updated in order to avoid targeting errors and guarantee the service expansion and its sustainability.

[9] The results are the average targeting performance indicator, considering that the subsidy could be the 100%, 50% and 30% of the average rate charge per cubic meter.

Finally, all the efforts made by the regulatory office and the supplier enterprises should be oriented to grant the access to the consumers who are not yet included in the supplying system and sustain a quality service.

References

Aigner, D., Lovell, C., Schmidt, P., "Formulation and Estimation of Stochastic Frontier Production Function Models", in *Journal of Econometrics*, 1977, 6(1), pp. 21-37.

Angel-Urdinola, D., Wodon, Q., "Do Utility Subsidies Reach the Poor? Framework and Evidence for Cape Verde, Sao Tome, and Rwanda", in *Economics Bulletin*, 2007, Vol. 9, No. 4 pp. 1-7.

Barrantes, R., *Diagnóstico institucional del sector de servicios de saneamiento y propuesta de políticas regulatorias*, 2003.

Battese, G., and Coelli, T., "A model for technical inefficiency effects in a stochastic frontier production function for panel data", in *Empirical Economics*, 1995, 20(2), pp. 325-332.

Bonifaz, J., *Definición de la visión y alcance de la función reguladora*, 2012.

Chisari, O., Ferro, G., "Tópicos de Economía de la Regulación de los Servicio Públicos", Buenos Aires, Ediciones UADE - Universidad Argentina de la Empresa, 2011.

Estache, A., Foster, V., Wodon, Q., *Cómo considerar la pobreza en las reformas de infraestructura: Lecciones de la experiencia en América Latina*, Bogotá, Banco Mundial, 2004.

Foster, V., *Hacia una Política Social para los Sectores de Infraestructura en Argentina: Evaluando el Pasado y Explorando el Futuro*. Banco Mundial, Documento de Trabajo No. 10/03, 2003.

Komives, K., Foster, V., Halpern, J. & Wodon, Q., *Agua, electricidad y pobreza: Quién se beneficia de los subsidios a los servicios públicos*, Bogotá, Banco Mundial, 2006.

Meléndez, M., Casas, C., Medina, P., *Subsidios al Consumo de los Servicios Públicos en Colombia - ¿Hacia donde Movernos?*, Fedesarrollo, 2004.

Meeusen, W., and Van den Broeck, J., "Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error", in *International Economic Review*, 1977, 18(2), pp. 435-444.

Parra M., Infraestructura y pobreza: *El caso de los servicios públicos en Colombia*. Fedesarrollo, Working Paper No. 56, 2011.

Stiglitz, J., "Markets, Markets Failures and Development", in *The American Economic Review*, 1989, Vol. 79, No. 2, pp. 197-203.

UNICEF, *La meta de los ODM relativa al agua potable y el saneamiento: el reto del decenio para zonas urbanas y rurales*, Suiza, 2007, 41 p.

Worthington, A., *A review of frontier approaches to efficiency and productivity measurement in urban water utilities*, Griffith Business School Discussion Papers in Economics, No. 10, 2007.

Yepes, G., "Los subsidios cruzados en los servicios de agua potable y saneamiento". Washington D.C., Banco Interamericano del Desarrollo, Publicaciones IFM, 2003.

Web pages

Superintendencia Nacional de Servicios de Agua y Saneamiento, Peru: http://www.sunass.gob.pe (consultation date: 4th August).

This yearly series of working papers (WP) aims to publish essentially works in English or in French resulting from the scientific network of CIRIEC and more specifically its working groups. The WP are submitted to a review process and are published under the responsibility of the President of the International Scientific Council, the president of the scientific Commissions or the working groups coordinators and of the editor of the CIRIEC international scientific journal, the *Annals of Public and Cooperative Economics*.

These contributions may be published afterwards in a scientific journal or book.
The contents of the working papers do not involve CIRIEC's responsibility but solely the author(s') one.

The submissions are to be sent to CIRIEC, Université de Liège au Sart Tilman, Bât B33 (bte 6), BE-4000 Liège, Belgique.

Cette collection annuelle de Working Papers (WP) est destinée à accueillir essentiellement des travaux en français ou en anglais issus du réseau scientifique du CIRIEC et en particulier de ses groupes de travail. Les WP font l'objet d'une procédure d'évaluation et sont publiés sous la responsabilité du président du Conseil scientifique international, des présidents des Commissions scientifiques ou des coordinateurs des groupes de travail et de la rédactrice de la revue scientifique internationale du CIRIEC, les *Annales de l'économie publique, sociale et coopérative*.

Ces contributions peuvent faire l'objet d'une publication scientifique ultérieure.
Le contenu des WP n'engage en rien la responsabilité du CIRIEC mais uniquement celle du ou des auteurs.

Les soumissions sont à envoyer à l'adresse du CIRIEC, Université de Liège au Sart Tilman, Bât B33 (bte 6), BE-4000 Liège, Belgique.

Publications

2013/01 The Third Sector importance: General perspectives and analysis for Bulgaria
Julia DOITCHINOVA & Darina ZAIMOVA

2013/02 The transformation of Milan's city energy enterprise in a leading national industrial group
Laura DELPONTE, Maddalena SORRENTINO, Matteo TURRI, Daniela VANDONE

2013/03 La remunicipalisation de l'eau à Paris – Etude de cas
Pierre BAUBY, Mihaela M. SIMILIE

2013/04 Stadtwerke Köln: a market-based approach towards public service provision
Dorothea GREILING

2013/05 In Turbulent Waters: British Columbia Ferry Service Inc., 1985-2012
Malcolm G. BIRD

2013/06 The water and sanitation service provision in Peru
Gisella ARAGÓN & José Luis BONIFAZ

2013/07 La Caisse de dépôt et placement du Québec : straddling between two worlds
Luc BERNIER

CIRIEC (International Centre of Research and Information on the Public, Social and Cooperative Economy) is a non governmental international scientific organization.

Its **objectives** are to undertake and promote the collection of information, scientific research, and the publication of works on economic sectors and activities oriented towards the service of the general and collective interest: action by the State and the local and regional public authorities in economic fields (economic policy, regulation); public utilities; public and mixed enterprises at the national, regional and municipal levels; the so-called "social economy" (not-for-profit economy, cooperatives, mutuals, and non-profit organizations); etc.

In these fields CIRIEC seeks to offer information and opportunities for mutual enrichment to practitioners and academics and for promoting international action. It develops activities of interest for both managers and researchers.

Le CIRIEC (Centre International de Recherches et d'Information sur l'Economie Publique, Sociale et Coopérative) est une organisation scientifique internationale non gouvernementale.

Ses **objectifs** sont d'assurer et de promouvoir la collecte d'informations, la recherche scientifique et la publication de travaux concernant les secteurs économiques et les activités orientés vers le service de l'intérêt général et collectif : l'action de l'Etat et des pouvoirs publics régionaux et locaux dans les domaines économiques (politique économique, régulation) ; les services publics ; les entreprises publiques et mixtes aux niveaux national, régional et local ; l'économie sociale : coopératives, mutuelles et associations sans but lucratif ; etc.

Le CIRIEC a pour but de mettre à la disposition des praticiens et des scientifiques des informations concernant ces différents domaines, de leur fournir des occasions d'enrichissement mutuel et de promouvoir une action et une réflexion internationales. Il développe des activités qui intéressent tant les gestionnaires que les chercheurs scientifiques.

International Centre of Research and Information on the Public, Social and Cooperative Economy - aisbl
Centre international de Recherches et d'Information sur l'Economie Publique, Sociale et Coopérative - aisbl

Université de Liège au Sart-Tilman
Bât. B33 - bte 6
BE-4000 Liège (Belgium)

Tel. : +32 (0)4 366 27 46
Fax : +32 (0)4 366 29 58
E-mail : ciriec@ulg.ac.be
http://www.ciriec.ulg.ac.be