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WATER RESOURCES MANAGEMENT:
Crisis vs. success: success factors for water management through the examples of São Paulo and Paris

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In memory of my stepfather Philippe Pelosi.
I also dedicate this work to my family
who always supported me.

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Abstract

Water is a specific good, economically, socially or environmentally speaking. Different and opposed theoretical points of view have already been developed to describe good water management models, from the Integrated Resources Management of the World Bank, to a humanitarian vision of the management of water. The first part of this dissertation tries to synthesize the different existing models, discussing the hypothesis that the traditional public/ private distinction is not enough relevant to explain the efficiency of a specific water management model.

Then, we chose to compare two cities: São Paulo and Paris. São Paulo faced a severe water crisis whereas Paris' water management has been very successful with a new remunicipalization of its water and sanitation services. The second part of this dissertation provides a good example of factors that are crucial for the success of any water management model, underlining the role of governance and new management practices.

This dissertation aims at giving new insights for governments in understanding efficient water management models, especially in the case of the water crisis in Sao Paulo. Also, other actors dealing with water issues, such as multinational companies, could have new tools to improve efficiency in this field.

Key Words: Water, water management, sustainability, Sao Paulo, Paris, sanitation

Resumo

Água é um bem específico, tanto do ponto de vista econômico, social quanto para a proteção do ambiente. Diferentes pontos de vista teóricos já foram explorados, por exemplo *the Integrated Resources Management* do Banco Mundial ou uma visão humanitária da gestão de água. A primeira parte dessa dissertação tenta sintetizar os modelos já existentes, e desenvolve a hipótese de que a tradicional distinção público / privado não é pertinente para explicar a eficiência de um modelo de gestão de água específico.

Na segunda parte, comparamos duas cidades: São Paulo e Paris. São Paulo enfrenta uma grave crise de água, enquanto o modelo de gestão de água de Paris é um verdadeiro sucesso com a remunicipalização dos serviços de água e saneamento. Essa parte da dissertação traz um exemplo dos fatores necessários para o sucesso de qualquer modelo de gestão de água, sublinhando o papel e a importância da governança e de novas formas de gestão e administração.

Essa dissertação tem por objetivo trazer perspectivas novas para governos, especialmente para a crise de água em São Paulo. Ainda, outros agentes econômicos que lidam com os desafios de água e saneamento, como as empresas privadas, podem também encontrar novos instrumentos e idéias, para melhorar eficiência nesse setor.

Palavras chave: Água, Conservação, Sustentabilidade, meio ambiente., abastecimento de água,São Paulo, Paris

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Introduction

Water has very specific economic characteristics. The demand for this good is very high (a quasi universal consumption), and not sensible to variations of prices – relatively inelastic. The precedent characteristics of water and the scarcity of this resource should imply a high profitability of the good. However, instead of being very profitable, water is an asset really risky. It is a specific good that cannot be traded and managed as easily as any other good.

Water is a very specific good, as its consumption is necessary for human life. From an economical point of view, water cannot though be considered as a "public good". A public good has to be "non-rival" (Cowen, 2008), and this characteristic cannot be applied to water. The social importance of water has many implications in terms of prices and accessibility, and has justified for a long time a public management of water.

Water is essential for all, and at the same time more and more countries will face water crisis and will have difficulties in providing this basic access to all. The purpose of this dissertation is the Water and Sanitation sector. This includes water extraction (from superficies or ground), water treatment to remove water contaminants, distribution to consumers and water waste management. Based on both precedent assumptions, it seems relevant to study the Water and Sanitation sector from an economic point of view. The main objective of this thesis is to put light on the main components of an efficient water resource management.

How comes that São Paulo faces a severe water crisis, knowing Brazil's huge water resources? On the other side of the Atlantic Ocean, what criteria explain the huge success of the water management in Paris? The comparison of both cities, of crisis and success examples, is all the more interesting since both water managements are public ones. Our dissertation will overpass the classical debate around water management between public and private management.

What criteria can be established for a better water resource management through the examples of São Paulo and Paris?

1. Literature Review

1.1. Presentation: water, a specific good

1.1.1. Social and societal implications of water consumption

1.1.1.1. Access to water: from a fundamental need to a human right

> *"The children who have no clean water to drink, the women who fear for their safety, the young people who have no chance to receive a decent education have a right to better, and we have a responsibility to do better.* ***All people have the right to safe drinking water, sanitation****, shelter and basic services."*
>
> Ban Ki-Moon, Speech at the Fifth Session of the World Urban Forum (2010)

In April 2015, the Gambian Siabatou Sanneh participated to the Marathon in Paris wearing a traditional dress with 20 kilos of water on her head (Toussay, 2015). She was carrying a placard saying "In Africa, women walk this distance every day to collect water. Help us shorten the distance". This initiative was launched by the organization Water for Africa in order to raise public awareness of the issue of access to water, especially in Africa. According to the World Health Organization (WHO, 2015), 1.1 billion of people do not have access to water in the world, whereas 2.4 billions do not have access to a sanitation installation.

One cannot simply survive without water. It is therefore and first of all a vital and fundamental need, a physical requirement for human survival. This belongs to the category of “Physiological needs” in the pyramid developed by Maslow (1943) to organize into a hierarchy or prioritize human needs. In 2013, Jean-Baptiste Descroix Vernier (Fondation Descroix-Vernier) condemned in a tribune a worldwide situation in which developed countries flush the toilet with drinking water whereas thousands of villages in Africa do not have access to a drop of it without walking kilometers every day. According to the United Nations Department of Economic and Social Affairs (UNDESA, 2014), women in Africa and Asia have to walk on average 6 kilometers to get water. Yet, the international community has engaged a process of recognition of access to water as a “right to water” in the last years.

The General Comment No.15 written by the UN Committee on Economic, Social and Cultural Rights (CESCR) in 2002 stated that "*the human right to water is indispensable for leading a life in human dignity. It is a prerequisite for the realization of other human rights*". Eight years later, in 2010, this right to water and sanitation has been declared as a human right by the United Nations General Assembly with the Resolution 64/292: "[The General Assembly] *recognizes the right to safe and clean, drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights*". A human right means that all humans should have access to it, equally and without discrimination.

What does this right mean concerning access to water? This right is defined in the same General Comment No.15 (2002) as the right for "*everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses*." The WHO (2015) has estimated that a "sufficient" amount of water to ensure basic needs (drinking, sanitation, hygiene, food, washing of clothes…) is between 50 and 100 liters per person and per day. The same WHO has defined Guidelines for drinking-water quality to help ensuring that this water is at the same time "safe", that is to say free from unhealthy substances. Apart from being safe, water should also be "acceptable", meaning that taste, color and smell should be appropriate. Also, water has to be "physically accessible". According to the WHO, people should not spend more than 30 minutes to get water, and the distance from home to the water source should not exceed 1,000 meters. Lastly, water should be "affordable". According to the United Nations Development Programme (UNDP), costs related to water should be inferior to 3 per cent of household income (2006).

This human right, recognized by the General Assembly in 2010, does not only imply water, but also sanitation. Sanitation is defined as "*a system for the collection, transport, treatment, disposal or reuse of human excreta and associated hygiene*" (The Rights to Water and Sanitation, 2015). The same year, the CESCR detailed this "right to sanitation" in its Statement on the Right to Sanitation (2010, p.1), considering that "*2.6 billion people do not have access to improved sanitation and over a billion people still have no option but to practice open defecation*". It is for instance particularly important to underline that the right to sanitation has specific characteristics. Sanitation implies privacy and dignity – people

would probably not go in a toilet where there is no privacy or no dignity. Sanitation cannot therefore be reduced to a simple water-borne system.
Water and sanitation have always been considered as basic and fundamental needs. However, this definition has evolved in the last years within the international community towards recognition of water and sanitation as human rights, implying and involving new responsibilities for the international community and states.

1.1.1.2. Societal implications of the lack of water

Water is nowadays considered as a human right because it is vital and necessary for survival. A lack of water or sanitation has huge individual consequences, but also societal implications. What are the consequences of a lack of water or sanitation for the society as a whole?

The first devastating consequences of a lack of water and sanitation are health-related issues. Water is a cause of diseases not only when it lacks, but also when it is unsafe. In developing countries, the lack of sanitation explains that around 80% of wastewater is not treated but directly thrown back into the water sources. Water is therefore mostly unsafe, and causes directly a huge number of diseases and deaths, caused by water-related diseases like for instance typhoid, cholera or malaria. Numbers are dramatic: according to the WHO, around two billions of people, and mostly children younger than five, die every year because of diarrhea-related diseases.

A second point is that no public policies aiming at improving other human rights can be efficient without tackling the issue of water and sanitation. They are necessary for the realization and the implementation of other human rights (The Rights to Water and Sanitation, 2015). As mentioned in the precedent paragraph, a lack of water and sanitation can prejudice the right to health. How can the right to food exist without water, since agriculture uses almost 70% of the planet's available freshwater or since irrigation represent one third of global food production, according to National Geographic? It is also common that girls drop out of school because they do not have menstrual hygiene facilities (The Rights to Water and Sanitation, 2015): how can therefore be programs promoting education for girls effective? According to the Water Project (2014), water-related diseases are responsible for 443 million school days lost every year.

According to Rosenstein-Rodan's poverty trap theory, a lack of water would also be one of the objective factors that could block a country's economic development, together with the lack of collective infrastructures or a lack of savings. The theory explains that a country could also find itself in a "poverty trap", a vicious circle that it would not be able to escape in the absence of objective factors that can be developed by the State (Baechler, 2012). Even being fatalist, such a theory clearly shows the impact that the lack of water can have on the economy of a country.

Yet, investments to improve this situation would have great positive impacts on the society and the economy. According to the CESCR (2010), "*for every dollar invested in sanitation, there is about a nine-dollar long term benefit in costs averted and productivity gained*". The return on investment of such expenditures is therefore high. The WHO (2015) claims that investments in clean would ensure children more than 413 million days of health. Improved health means less state spending and costs for health, but also improvement of productivity for instance.

1.1.1.3. Water: a common good that should not be tradable?

Because the right to water and sanitation has been recognized as a human right, and because of the huge social and societal implications of water, some argue that water should be considered as a common good. Neoclassical economists generally define common good as rivalrous and non-excludable goods. A good is said rivalrous when its consumption by someone will alter the consumption of it for someone else. A non-excludable good means that it is possible to exclude the person that would not pay for it: the consumer cannot therefore have access to it. In the case of water, it can be clearly stated that it is a rivalrous good, knowing that the consumption of water by someone will pollute it or reduce the amount of it for the next consumer. Things get complicated tough when dealing with excludability. Considering water as a common good means that it would not be possible to prevent people from consuming or using water.

Another vision pushing for declaring water as a common good is that it could protect the resource in a more efficient way. Garrett Hardin developed in 1968 the idea of "the Tragedy of the commons", explaining that individuals when acting independently will do so according

to their self-interest and therefore deplete common resources, which is contrary to the interests of the society. For instance, if a society relies on the self-conscience of individuals to protect common resources, in our case water, it won't work and selfish comportments will appear. Hardin's first recommendation to avoid this tragedy is to recognize that the resource as a "common". His theory is often applied nowadays to offer an alternative solution or vision to avoid over-exploitation or degradation of resources.

Various organizations try to defend this idea of water as a common good, and the impossibility to exclude someone from consuming it. The Alternative World Water Forum (AWWF) has been organized in 2012 in Marseille to offer an alternative to the World Water Forum (WWF) organized by the World Water Council, composed mainly of the World Bank and water multinational companies. Various organizations (NGOs, associations, trade-unions…) have participated to this forum aiming at offering an example of an alternative vision of water. A focus has been made on the idea of "commodification" or "commoditization" of water, a concept that will be further developed in this literature review. The organizations cited before are clearly opposed to this vision of water as a commodity, as claimed in the Final Declaration of the Participants (2012): "*water is a commons, not a commodity*."

The neoclassical economists define a commodity as a product that can be traded on a commodity exchange market. Considering water as a common good means in conclusion that water should not be tradable. Water could therefore not be used or sold as merchandise, because it would be in this case possible to prevent someone from consuming it, water being excludable. This was the principal claim of the "water war" that happened in Bolivia in 2000, that will be more deeply explained later in the development of this dissertation (The Economist, 2000). The example from the Bolivian city Cochabamba represents the passage from a situation in which water was free of use mostly from local rivers, to a situation of "excludability", what led to a local crisis. Prices increase represented this phenomenon of commoditization of water, and had not been well accepted by the local population. However, despite a growing concern expressed about the "merchandization" of water, it is difficult today to define water as a common good, since it is clearly more and more excludable, and the price to pay to have access to it is more and more increasing. However, the vision of water as a common has implications on the water management model that is chosen: as it will

be further developed in this dissertation, common goods should lead to a public management, and supporters of this vision of water are clearly opposed to privatizations.

1.1.2. Between scarcity and value

"*Water promises to be to the 21st century what oil was to the 20th century: the **precious** commodity **that determines the wealth of nations***."

Shawn Tully, Fortune Magazine (2000).

1.1.2.1. Environmental issues

After having described the specificities of the demand for water, the other side of the coin should be presented: water supply. According to Baechler (2012), our planet is mostly composed of water: 72%, around 1,300 millions of km^3. However, several limits have to be showed. First, water takes different forms that evolve with time and that have an impact on the accessibility of the resource. For instance, 97.2% of those 1,300 millions of km^3 are unusable since it consists in salty water, 2.15% are stuck in polar ice. The amount of available water for human consumption is therefore much lower. When calculating the number of precipitations and adding it to the water reserves, studies find that the amount of available freshwater is around 12,500 km^3 every year. That means that the available freshwater amount per person and per day on a worldwide scale is 5,000 liters. Knowing that Americans, the biggest water consumers, use around 1,800 liters per day, it could appear that water is over-abundant (Baechler, 2012).

However, the territorial allocation of water needs also to be taken into consideration. Water is unequally distributed over the world. According to the Food and Agriculture Organization of the United Nations (FAO, 2003), nine countries own 60% of freshwater resources (Brazil, Colombia, Russia, India, Canada, the United States, Indonesia, Congo and China). On the other hand, lots of countries suffer from water stress, or even water scarcity (cf. Appendix 1). According to the United Nations Department of Economic and Social Affairs (UNDESA, 2014), water-stress is experienced when annual water supplies are inferior to 1,700 m^3 per person. Below 1,000 m^3 per person, the area is under what is called "water scarcity". "Absolute scarcity" is reached when annual water supplies are below 500 m^3.

Moreover, distribution is also often very unequal within a national territory. The example of Russia is striking. According to the Centre for climate adaptation (2009), Russia possessed one fifth of the world's fresh water resources. But the central and southern regions of Russia only concentrate 8% these resources, whereas they represent around 80% of the Russian population. The same example will be developed further in the dissertation concerning Brazil. However, this distribution and the natural lack of water resources do not entirely explain why countries are having issues with water supply. As it will be showed this thesis, the issue deals also very often with the mismanagement of resources.

When considering environmental issues and risks relating to water, it should also and lastly be taken into consideration that even if water is supposed to be an infinite resource through the water cycle, it can strongly be damaged by human intervention. Water is more and more contaminated by domestic, agricultural and industrial consumption. Water pollution is defined as "*the contamination of natural water bodies by chemical, physical, radioactive or pathogenic microbial substances*" (Hogan, 2014). Rapid industrialization and innovations in agriculture have contributed to an increasing number of pollutants in water sources, such as chemical and radioactive water pollutants. For instance, pesticide, fertilizer or pesticides belong to agricultural practices that resulted in higher pollution. According to Hogan (2014), 75% of the Chinese population has no access to unpolluted drinking water. A lack of sanitation coupled with a growing population is also an additional factor of pollution: waste and dirty water are thrown back into water sources. Water is more polluted when waste collection systems or purification of wastewater are lacking. One of the well-known consequences is that the main consumers of bottled water after the United States are developing or emerging countries. Mexico, China, Brazil or Indonesia belong to the ten first consumers, an absurdity knowing that it is the form of access to water that is the most expensive (Baechler, 2012).

As Rose George summed up in 2008: "*We are wasting our water mostly by putting waste into it*" (Institute of Medicine, 2009). As a result of this, it can be said that problems of access to water are more qualitative than quantitative (Baechler, 2012).

1.1.2.2. The commoditization of water

As clearly opposed to all the theories considering water as a common good, a "commodification" or commoditization of water has begun. "Commodification" of goods is a term derived from the Marxist theory. It explains that a good that did not have any economic value but strong social or societal values attached to it becomes a commodity, that is to say a good that can be exchanged for something else. Therefore, supply and demand are managed by market mechanisms; the price is determined by those mechanisms.

Peter Brabeck-Letmathe, ex-CEO and actual President of Nestlé, has particularly supported this idea (Portal Metropole, 2015). According to the President of the company that is leader in the bottled water market, water should be treated as any other alimentary good. It should have a value established on the market, which will be the price determined by the law of supply and demand. He believes on one hand that governments should guarantee a minimum amount of water needed for survival: 5 liters of water for drinking, 25 liters for personal hygiene. But on the other hand, the rest of the consumption should be managed according to market-based mechanisms. In the same discourse, he claimed that NGOs speaking about fundamental right to characterize water were extremists. "*Water is not a basic human right*" (Portal Metropole, 2015).

According to neoliberal economists, being an economic good allows a more efficient allocation of resources. Markets will direct goods to their highest value use and are the most effective to do so. Prices defined by the market will reflect the opportunity costs of these goods. A journalist of the Economist summed up this neoliberal idea in 1992: "*Only by accepting water as a tradable commodity will sensible decisions be possible*." (McDonald & Ruiters, 2005).

1.1.2.3. Should water have a price?

Considering water as a commodity means that the price should be determined on the market exchange. How can be found the right price for water?

If Peter Brabeck (Portal Metropole, 2015), the actual President of Nestlé, defends the idea of water as a commodity and not a basic human right, it is also because the society should become aware of the importance of it. According to him, if people have the perception that

water is free of charge, they won't understand the value of it and will waste or pollute water. Being aware of water scarcity, as developed in the part related to environmental issues, a price should therefore be determined to give a value to water. According to Brabeck, water should not be free, and the price should be determined by the market exchange. Is it the best option?

The price determined by the market takes into consideration the cost of production and the value granted by consumers. Suppliers will produce until the marginal cost, that is to say the cost of an additional unit of production, is higher than the price of it. On the other side, the consumer will buy until its marginal benefit, that is to say the benefit of an additional unit of production, is lower than the price of the good or service. In Appendix 2, a figure illustrates these concepts. A market is said to be well functioning when producers and consumers get all the benefits and costs of the activity. The issue concerning water is that water markets are usually not well functioning because of this last characteristic: producers do not bear all the costs of their production. For instance, when someone withdraws water from a river, it will not bear all the costs associated with this consumption. The fact that the person located downstream the river will have to higher costs to pump water because of the declining aquifer won't be taken in consideration. Water will therefore tend to be used more than it should be. Water markets are therefore markets that would especially not be able to offer a market price fully reflecting the economical value of the good.

Another critical point is that there is indeed a huge difference between the value and the price of water. "*The price you pay or cost of water may not reflect the value of water to you or others*" (Zetland, 2012). Adam Smith illustrated this economic paradox with the following example of water and the diamonds:

> *"Nothing is more useful than water: but it will purchase scarce any thing; scarce any thing can be had in exchange for it. A diamond, on the contrary, has scarce any value in use; but a very great quantity of other goods may frequently be had in exchange for it."*
>
> *The Wealth of Nations*, 1776

The value of water is considered higher than the value of diamonds, especially because it is necessary for human survival. On the opposite, what more useless than a diamond? The price does not reflect this difference of value, but the scarcity associated with the resource. Since

water has been for a long time considered as an abundant resource, price associated with it is really low. Unfortunately, as developed in a precedent paragraph, water is becoming a scarce resource due for instance to its intense pollution or because its availability decreases with global warming. And since "*I can refill an eight-ounce glass 2,500 times with water from the tap for less than the cost of a single can of soda*." (Stavins, 2009), there is almost no incentive to try to reduce my consumption and preserve water supplies.

Several economists consider therefore that the price of water is too cheap in a context of water shortage (Lam, 2015) "*We Americans are spoiled, we wake up in the morning and we turn on the tap and out comes as much water as we want for less than we pay for cell phone service or for cable television. So we take water for granted*." claimed a water expert at Arizona University, Robert Glennon. Without a minimum price for water, there is no incentive for the consumer to conserve water, an incentive being defined as something that motivates an economic action. This price functions therefore as a signal for the consumer to understand to value of the good, or to understand that the good has a value.

In reality, water is most of the time not managed according to these principles. In many places in developing countries for instance, water is directly accessible and withdrawn without knowing exactly the amount taken. It is globally estimated that water prices represent 10 to 50% of the operating and maintenance costs (Baechler, 2012). As previously evoked, the price of water is considered as very low, and should be multiplied by 4 to 100 to get the balance between supply and demand, a political suicide.

Considering that right to water has been defined as a human right (United Nations General Assembly, 2010), everybody should have access to a minimal amount of water necessary for survival. Economists suggest that this minimal amount, around 15 gallons a day, should be subsidized (Lam, 2015). But should the price for water be the same for swimming pools or agriculture? The more important is developing incentives for higher levels of usage (Stavins, 2009). Some municipalities have studied the idea of a water pricing differentiated according to the use of water, or according to the quantity (Lopez, 2012). For instance, professional users would pay more than individual consumers.

Water pricing involves several issues, in terms of economic efficiency and cost recovery, but also in social and societal terms. It is therefore an issue that should be carefully be looked at

when dealing with the different water management models, and that should be taken into consideration when determining the characteristics of a good water management.

1.1.3. Water economic characteristics

1.1.3.1. A fixed commodity

> *"Water is a fixed commodity. We are using the same water that the dinosaurs drank, and this same water has to make ice creams in Pasadena and the morning frost in Paris".*
>
> Rose George (2008)

Talking about rarefaction or scarcity of the resource in a global sense does not make much sense (Baechler, 2012). The geophysical identity of water explains that the resource cannot be destroyed neither created: the water cycle allows an infinite renewal of the resource. It also explains that water is kept under different forms. Climate change will probably have an impact on the water cycle, since the cycle is very sensitive to the phenomena, and therefore on the accessibility to freshwater and the quality of available freshwater (Baechler, 2012).

The economic result of this is that the supply of water does not react to the market signals like other primary resources. It is not possible to adjust water to the demand by increasing water supply. Improvements or adjustments can only be made on the margin: better dealing with the available amount of freshwater by avoiding waste or having a better use of the resource, by increasing the productivity of the use of water (Baechler, 2012). Water would therefore appear as "fixed commodity" (George, 2008).

An exception to this economic rule could however be underlined with the development of new technological processes. Desalinization could for instance increase incredibly the amount of available freshwater, knowing that the amount of salty water on earth is incredibly high and available in much more places than freshwater (Baechler, 2012). It would therefore be like renewable energies for the energy sector that would be able to produce an almost infinite amount of energy in a sector in which the limitation of traditional sources of energy represents a critical issue.

In order to improve the supply and availability of freshwater, only two actions can be efficient: a better management of the existing resources or technological innovations, like desalinization, to improve the amount of available freshwater. Since the cost of desalinization is nowadays still very high, especially in terms of investments, this thesis will focus on the other side of the coin: a better management of the resource to increase the productivity of the utilization of the resource. That means increasing the capacity of creation of wealth for a given amount of water.

1.1.3.2. A local issue

The unequal distribution of water that has been described in a precedent paragraph is a critical issue because the management of water is mainly a local issue. In Algeria for instance, 75% of the renewable resources are concentrated on 6% of the territory. This unequal distribution of the resource requires strong town and country planning.

1.1.3.3. Importance of externalities

As developed in a precedent paragraph, water consumption by consumer A can have an impact on the consumption of consumer B. The sector of water works as a closed system: pollution from one consumer has implications for the next one. After having using freshwater resources for vital uses, the amount available has to be allocated to the most productive uses possible in a market economy. The price of water cannot fully reflect the environmental costs or the value of existence of the resource. This phenomenon describes the presence of externalities. Externalities are "*the consequence of an economic activity that is experienced by unrelated third parties. It can be either positive or negative*" (Investopedia). Those consequences cannot be resolved by the mechanisms of the market itself, and would be in favor of an intervention of the state to develop a stronger regulation to avoid bad consequences of negative externalities. Measures should be implemented to "internalize" these externalities: the costs due to the negative externalities (or benefits in case of positive externalities) will be reintegrated into the global costs of the consumer withdrawing water for instance.

The presence of externalities highlights another characteristic of water that is the absence of propriety rights or rights of use that would be clearly identified. Mark Twain has been

attributed the following quote "*Whiskey's for drinking, water's for fighting"*(Washington State University Extension Fact Sheet, 2013), underlining that water needs clear property rights. Otherwise, the global benefit for the society will be clearly below what would be possible and wanted.

1.1.3.4. Is water demand inelastic? Implications for pricing.

Water is vital, and has no substitute. According to Moffatt, the price elasticity of demand (or price elasticity) will measure how much will the demand change if the prices changes (on the margin). In the case of a good with no substitute, demand will not change if the price changes. Demand is said to be price inelastic. Is it the case for water? Knowing that water has no substitute, demand should be relatively inelastic. For instance, if the price of water for domestic use increase, people would continue using it, having no other choice, and would be willing to pay more.

However, Stavins (2009) explains that an inelastic demand does not mean being "unresponsive to price". A demand that would be truly unresponsive to price would not change for any price: the amount of water would remain exactly the same. Empirical analyses published in the last 50 years have not proven that fact concerning water. An inelastic demand means that an increased price of one percent corresponds to a decrease inferior to one percent of the demand. A truly unresponsiveness to price would mean that it would absolutely not affect the amount of the demand of water. Statistical studies have on the contrary not found zero percent for the decreased amount of demand for an increased price of one percent.

What does it mean? According to Stavins (2009), water customers are aware of and sensitive to prices. Prices could therefore be used to manage demand for water. This idea supports price-based approaches, opposed to non-price techniques, to help reducing water consumption. Water demand is responsive to a change in prices. In the short term, people will adjust and reduce their consumption. In the long term, they will use new technologies to have a more productive use of the resource at home or workplace for instance.
However, an increased price will not automatically lead to a decreased demand. The elasticity takes into consideration the marginal price and the marginal demand of water, expecting

everything else to be constant. Of course, everything does not remain necessarily constant: population growth or climate change can for instance impact this relation.

To sum up, water has several specific characteristics and cannot be compared to any other good. Vital, its implication of both social and societal dimensions cannot be denied. However, the resource becomes less and less available, and decisions have to be taken in order to protect it. Both last allegations have consequences on water pricing: how can a fair price be determined in order to combine both issues?
Water pricing is one of the responsibilities of water management. As described in the precedent paragraphs, water has specific economic characteristics: local, creating externalities… These specificities explain why water cannot be managed as any other good. Based on this assumption, what models of water management have been developed, and how do they deal with these issues that are specific to water?

1.2. Models of water management: between public and private organizations

"*This debate would deserve less emotion and more rationality*."
Minarchiste, 2013, p.1

The Water Tribunal of the plain of Valencia in the Valencia area in Spain (Tribunal de les Aigües de València in Catalan) has been created more than a thousand years ago. Around 960, the Caliphate of Cordoba decided to develop a juridical authority that would organize and regulate water production. Every week, judges that had been elected by farmers met in front of the Cathedral to provide dispute arbitration about irrigation issues. This Tribunal still operates today, and has pacified the management of the resource in the area, crucial issue for agriculture. It shows the importance of determining water management models, but more especially, highlights the importance of regulation.

1.2.1. Water management models presentation

Privatization can be defined as a cession of more than 50% of the company to private actors. Real privatizations do not often occur in water management. The United Kingdom sold

entirely its water supply systems in the 1980's, but historically real privatizations did not happen very often (Hall, 2010). Instead of this, contracts with private companies have been developed. As a misuse of language, privatization is often used to describe a private management or a situation in which a private company is involved directly or indirectly in the distribution of water.

Different types of contracts exist and can be classified in five categories (Minarchiste, 2013):

- Service contract: the private company takes care of the network's maintenance.
- Operation contract: the private company operates but is not owner of the network.
- Leasing contract: the private company rents the infrastructure for a fixed-term.
- Concession contract: a contract similar to the leasing contract, with additional objectives: price, number of connected households, quantity of available freshwater, quality of freshwater etc. A concession contract is usually during a period of 25 to 30 years, according to the World Bank.
- Real privatization: definitive ownership of the infrastructures.

A specific type of concession contracts has particularly drawn the attention in the last years: build-operate-transfer (BOT). According to the World Bank (2015), in a BOT project, an "*operator finances, owns and constructs the facility or system and operates it commercially for the project period, after which the facility is transferred to the authority*." When operating commercially during the project period, the company aims at covering its operating costs, maintenance, financing costs, but also returns for the shareholders. The contract is usually long enough to amortize initial investments. Public authorities can set targets to private companies while keeping the propriety of infrastructures, unlike a real privatization in which there is an ownership transfer.

Lastly, it has to be underlined that service contracts, leasing contracts, concessions, PPPs or water privatization "*refers to the transfer of management control to the private sector, at various degrees"* (Kishimoto, Lobina & Petitjean, 2015). Debates therefore often simplify by opposing "privatization" to public management. It needs to be kept in mind for the rest of this dissertation that privatization stands for all the precedent types of contracts and private management defined previously.

1.2.2. A rising number of privatizations

1.2.2.1. History of the movement of privatizations

As explained in a precedent paragraph, a process of commoditization of water has begun a few decades ago. Water is nowadays considered as a commodity, an abundant and profitable one. Investors have taken a growing interest in this sector. Calvert developed for instance a water-oriented investment fund, Calvert Global Water Fund, which has been pretty much a success, with returns on investment above the average (Randall, 2014). The infatuation of the private sector for the market of water is increasing. Among the main reasons used to support this growing interest: an increasing demand for fresh and clean water in developing countries, impacts of climate change or aging pipes and infrastructures in Europe and in the United States. This fund will for instance invest in desalination, companies promoting leak detection or working on improving water quality. But the interest of the private sector for water is not new: private companies have since a long time been interested in being responsible for national water management, from production to distribution.

Public organizations were responsible in 2002 for around 95% of the production and distribution of water, and wastewater services. However, private companies have known a great expansion of their activities, knowing that the number of people that was providing water from private companies has increased from 51 million in 1990 to about 300 million in 2002 (Wolff & Palaniappan, 2004). In 1990, the six major water companies covered 12 countries; in 2002, they covered more than 56 countries. Private water management is not a new idea. In the United States for instance, the norm in terms of water management was private ownership. Municipalisations took place in the 19th century because it required huge investments in investments that private companies were not doing. However, a new wave of privatizations in the water sector occurred in the world after that the English government of Margaret Thatcher decided to put forward the concept of privatization in the beginning of the 1980s (Toure, 2006). The expansion of water multinationals has also been supported and encouraged by the World Bank, as part of economic liberalization policies for developing countries. As a reminder, privatizations concerning water means in most cases contracts of concessions to the private sector. There is not lack of examples: Buenos Aires, Manila or Jakarta. In 2000, at the Second World Water Forum at The Hague, the World Bank presented water privatization as unavoidable, claiming that there was no other alternative (Hall, 2010).

Results were mixed. However, examples of success and improvements thanks to privatizations exist. As previously evoked, Margaret Thatcher sold in 1989 ten water systems because they were loosing more than one quarter of their water through leaks and did not meet expectations in terms of drinkability (Minarchiste, 2013). Thanks to privatization, water quality has greatly improved and has reached European standards. Prices rose by 21% in constant dollars between 1989 and 2005, but they had risen by 22% during the seven years before privatization. One of the greatest positive impacts has been that from this day forth companies have to pay fines when they damage the environment or when breakdowns happen, what was not the case when networks were under public control (Minarchiste, 2013).

1.2.2.2. Justifications for privatizations

The liberal theory has always wanted to show that public companies were by essence less competitive and less efficient than the private ones. The lack of pursuit of profit would lead to a diminished efficiency. On the contrary, knowing that private companies' first interest is the maximization of profit, this would therefore require a higher productivity. In the case of concessions or leasing contracts for instance, companies have to face competition at the end of the contract. A good performance is therefore a crucial issue for them. Concessions contracts like BOT ones allow public authorities to realize infrastructure investments in a timelier manner and at a lower cost. They would therefore contribute to a modernization and more efficient public services.

The theory of Public choices developed in particular by James Buchanan consists in "politics without romance" (Shughart, 2008). People would traditionally think that political actors work to promote the common good and the general interest. But in reality, their decisions are driven by their own self-interests. Public companies have therefore been used and exploited by politicians for non-economic purposes, that is to say political patronage. Politicians' main self-interest is to be reelected: their decisions will therefore not be driven by efficiency purposes, but they will try to make decisions that will convince electors to vote for them. Private management would clearly reduce this risk and thus improve efficiency. The theory of organizations developed by Simon (1947) developed another dysfunction related to public management: it will favor the emergence of bureaucracy. Bureaucracy would have several

negative consequences: difficulties to allocate responsibilities or lack of realism when making decisions or a lack of responsiveness for instance.

Another critical point justifying privatization is competencies. Today, the major water multinational companies like Suez or Veolia have an expertise that many municipalities still lack. Water production or sanitation technologies required differ from a place to another. In some places, the technologies required are very complex and municipalities do not always have the competencies to deal with these advanced technologies.

1.2.2.3. Failures of privatizations

Since the beginning of the 1990's, the number of private organizations has increased in Latin America. Water management in Latin America at that time was the following: public water supplies were not able to give access to water to all, prices were very low, and massive investments needed to develop and improve it. New forms of water management have therefore been developed, especially through private/ public partnerships. These new forms of management have often faced different forms of resistance from local populations. Tucuman (Argentina) in 1995-1996 and Cochabamba (Bolivia) are both extreme examples of local resistances to privatization of water (de Gouvello and Fournier, 2002).

In Tucuman, objectives were very ambitious. Connection rates to freshwater were around 81% before the partnership: the objective was a 100% rate after six years. Connection rates to wastewater systems were about 44%: the objective was a 100% rate after eleven years (de Gouvello and Fournier, 2002). Objectives targeted were probably too high, and miscommunication or bad communication created a frustration for the population that did not understand why water became so expensive. Three months after the beginning of the contract, inhabitants began stopping paying their water bills, putting forward as a pretext that water was too expensive. In the beginning of 1996, a few months later, water became suddenly brown and stayed so during ten days because of drainage works. Everybody began to think that water was unsafe and that the private company, owned by foreigners, had the control of it: the control of the population's health, the power to decide death or life (de Gouvello and Fournier, 2002)! The situation got worse until 1998: a public organization took back control of water management in the city.

In 1995 in Cochabamba, Bolivia, the situation was also very critical: only 54% of the urban population was connected to the freshwater system. More than 40% of the urban population had access to water through alternative systems: wells directly excavated by the population or water supply by tankers. An increasing urbanization coupled with the scarcity of available resources had already led to a conflict in 1985 between the rural and the urban world: "the first water war". In 1999, a call for tenders is realized for the management of water and sanitation in Cochabamba. Only Aguas del Tunari, a company created in particular by the American Edison and Bechtel, made a proposal. A concession contract for duration of 40 years was signed the same year. The local population began rebelling against the private company in 2000, when receiving bills that increased sometimes until 150%. In April, after months of protestations and negotiations, a so-called "final fight in the water war" began with both following watchwords: "Aguas del Tunari, out!" and "Water is not a commodity". 50000 persons invaded the Plaza de Armas, and the government decided to cancel the concession contract.

Both examples show the difficulties faced by water companies to integrate the market of water. In both cases, they were prejudiced against even before beginning having tried anything. However, other examples of failed privatizations can be found, knowing that they had had time to implement new strategies. For instance, Manila and Jakarta are two main Asian cities under private control for water management. Both have water losses levels higher than most comparable Asian cities under public control (Hall, 2000). It has to be mentioned that there are many examples of successes in privatizations. Only 4% of the privatization projects financed by the World Bank have generated a termination of the contract (Minarchiste, 2013). Nevertheless, the previous examples of privatization failures show the way not to be taken and the errors to be avoided.

The following reasons are usually given to justify privatizations failures. First, private companies did not invest as much in infrastructures as it has been hoped (Hall, 2010). Public regulation was not strong enough to control private companies' performance. Politicians also lacked the needed authority to punish private companies' excesses for instance in terms of price, or when private companies did not meet the expectations in terms of objectives.

1.2.3. Public management of water

1.2.3.1. History of public water management with a focus on remunicipalizations

"This is a response to the false promise of private operators and their failure to put the needs of communities before profit."

Emanuele Lobina, 2015, p.6

It has been mentioned in a precedent paragraph that private water management was not a new idea. However, apart from a few exceptions, privatizations had not been envisaged until the 1990s (Hall, 2010). In the developing countries, during the 1980's, public structures have showed themselves unable to allow access to water and sanitation to everyone, what helped justifying privatizations policies in the 1990's. Increased prices with privatizations would therefore be the price to pay for years of public under-investment. However, the failures of the public sector in the 1980's do not reflect incompetence of the public sector by essence, but deficiencies in the democratic process. At that time, many corrupt governments and dictatorships had no respect for human rights or transparency. They were not accountable to anyone about their water management, and neglected therefore this aspect of universalization of access to water (Hall, 2010).

In 2015, Jakarta decided to cancel the ongoing contract with a private company for its water management, on the grounds that it would constitute a breach of the right to water for the 9.9 million of inhabitants. In quantitative terms, it constitutes the biggest remunicipalization in the world. Remunicipalization can be defined as public governance regaining control over water and sanitation management that had been in the past entrusted by municipal authorities to private companies (Kishimoto, Lobina & Petitjean, 2015). This example confirmed the actual trend against water privatization and in favor of remunicipalization of water. Studies showed that between March 2000 and March 2015, 235 remunicipalizations have occurred in 37 countries, which is equivalent to 100 millions of people. This trend is fast growing: the number of remunicipalizations on the 2010-2015 period is twice as big as for the period 2000-2010. It also looks that this trend will stay. This global remunicipalization trend feeds

itself by offering numerous of examples of successful cases that can give inspiration to other cities. The Appendix 4 shows more precisely this trend.

1.2.3.2. Public water management justifications

First, justifications for a public water management have been developed in opposition to privatizations. What are the usual issues faced when dealing with private water management? Privatizations are associated to increasing prices that have been noticed during with the privatizations that had begun in the 1990s (Buenos Aires, Jakarta, Kuala Lumpur). Also, private water management is often characterized by some opaqueness (Grenoble, Stuttgart). It appears that it is more difficult for governments to control private companies than public ones or municipalities. This lack of transparency can lead budgetary excesses, and it can be difficult for politics to verify that targeted objectives have been achieved (Hall, 2010). An under-investment in infrastructures has also been observed in countries such as Berlin or Latur (Kishimoto, Lobina & Petitjean, 2015). In Rennes or Cameron, a deterioration of the quality of water has been showed.

Also, as developed in the first section of this literature review, water is a very specific good in societal and social terms. Some therefore argue that economic as well as social criteria should be taken into account when managing water. Because water would be a common good, public authorities should manage it. It requires that public authorities engagement, because private organizations would be focused on their own return on investment or rate of return (Hall, 2010). Markets are not the most efficient enough to maximize the well being of society. Public involvement would on the contrary "promise a public water future in which community development comes first" (Kishimoto, Lobina & Petitjean, 2015). For instance, in public companies, profit can be reinvested entirely within the company itself for water development projects, whereas it will constitute a gain that has to be in part redistributed to stakeholders in private companies (Kishimoto, Lobina & Petitjean, 2015).

Remunicipalizations would therefore constitute a passage from "profit-oriented water companies" to "people-oriented water companies". This is possible if public water companies promote practices aiming at more community development and social justice. Remunicipalisation movements are driven by the idea of promoting a more sustainable and social development. Public water services would therefore offer a better environment for

present and future generations, completely in line with the ideas of a human right to water (Kishimoto, Lobina & Petitjean, 2015).

1.2.3.3. An outdated debate?

"Public versus private' is not the bright line that separates efficient from inefficient management. Like Alexander the Great, who "untied" the Gordian Knot with one slice from a sharp knife, we believe that the real solution to water problems worldwide has been overshadowed by the ideological debate between advocates and opponents of privatization."

Wolff & Palaniappan, 2004, p.1

As developed by Wolff & Palaniappan in an Editorial in 2004, what matters is not that the organization providing water is private or public. Deciding whether private or public organizations are better to manage water does not make much sense and prevent from dealing with the real elements allowing an efficient water management for a country. The two following points will present characteristics that are necessary to guarantee an efficient water management, and that do not depend from the fact that the model of management is private or public.

One of the issues is linked to the quality of management. It cannot be claimed that public or private organizations have in essence and imply a better management. For instance, the Singapore Water Board, the Dutch Water Companies or Australian State Water Authorities are often cited as well managed public organizations. On the other hand, many cities in Argentina are hold up as examples for successes in private management of water. A "perverse value" cycle will happen when dealing with poor management, because no one will be ready to pay for additional or new investments. In the case of private companies, private investors for instance would not like to invest in a company whose management is bad. In the public sector, politicians, customers or taxpayers will act in the same way. Of course, underinvestment undermines service quality: a vicious circle therefore appears therefore.

The second point is the existence of conditions that will facilitate the success of a public or private management. The Dialogue on Effective Water Governance, a project of the United Nations Development Program (UNDEP), the Global Water Partnership (GWP), and the International Council for Local Environment Initiatives (ICLEI) explained: "*The water crisis*

is mainly a crisis of governance" (Wolff & Palaniappan, 2004, p.2). That means that a model of water management, private or public, cannot succeed without strong institutions and governance. Institutional reforms are therefore very often necessary to guarantee the success of the implementation of a concession contract with a private company. For instance, according to the World Bank (2015), in France there is an obligation in concession contracts to provide what is called continuity of services ("la continuité du service public"), to offer an equal treatment for all consumers ("l'égalité des usagers"), and to offer a quick adaptation of the service in case of changes in needs ("l'adaptation du service").

There cannot exist a well-functioning water management with private organizations if the public sector is not involved. Regulation, monitoring and control of the private operator are essential; otherwise, the privatization cannot work. It is indeed usually seen that problems related to water management occur in the private sector more often when the government is weak or the instruments of regulation and control non-existent. For instance, in the case of a concession, objectives can be added to the contract (price, number of connected households, quantity of available freshwater, quality of freshwater etc.). Prices can therefore be fixed or regulated by the government, thus avoiding excessive price increases that have occurred with recent privatizations. In a context of fixed or regulated prices, companies' profits would depend from their capacity to reduce costs, eliminate water leaks or connecting the maximum number of persons to the network.

To sum up, two main water management models have been developed in the last decades to deal with the issues previously mentioned and specific to water. Opposing private and public management is however mainly ideological and lead to a simplistic vision of water management. Instead of trying to find out which one of both models would be the more efficient, it appears more relevant to develop characteristics of a good water management. The role of regulation has been underlined in the last paragraph to show an example of characteristics that can explain why a privatization or a remunicipalization can be successful. Two other factors will be studied in the last parts of this literature review: the role of competition and water management performance indicators.

1.3. Water as natural monopoly and the role of competition

1.3.1. Water: a natural monopoly

1.3.1.1. Presentation of the water and sanitation sector

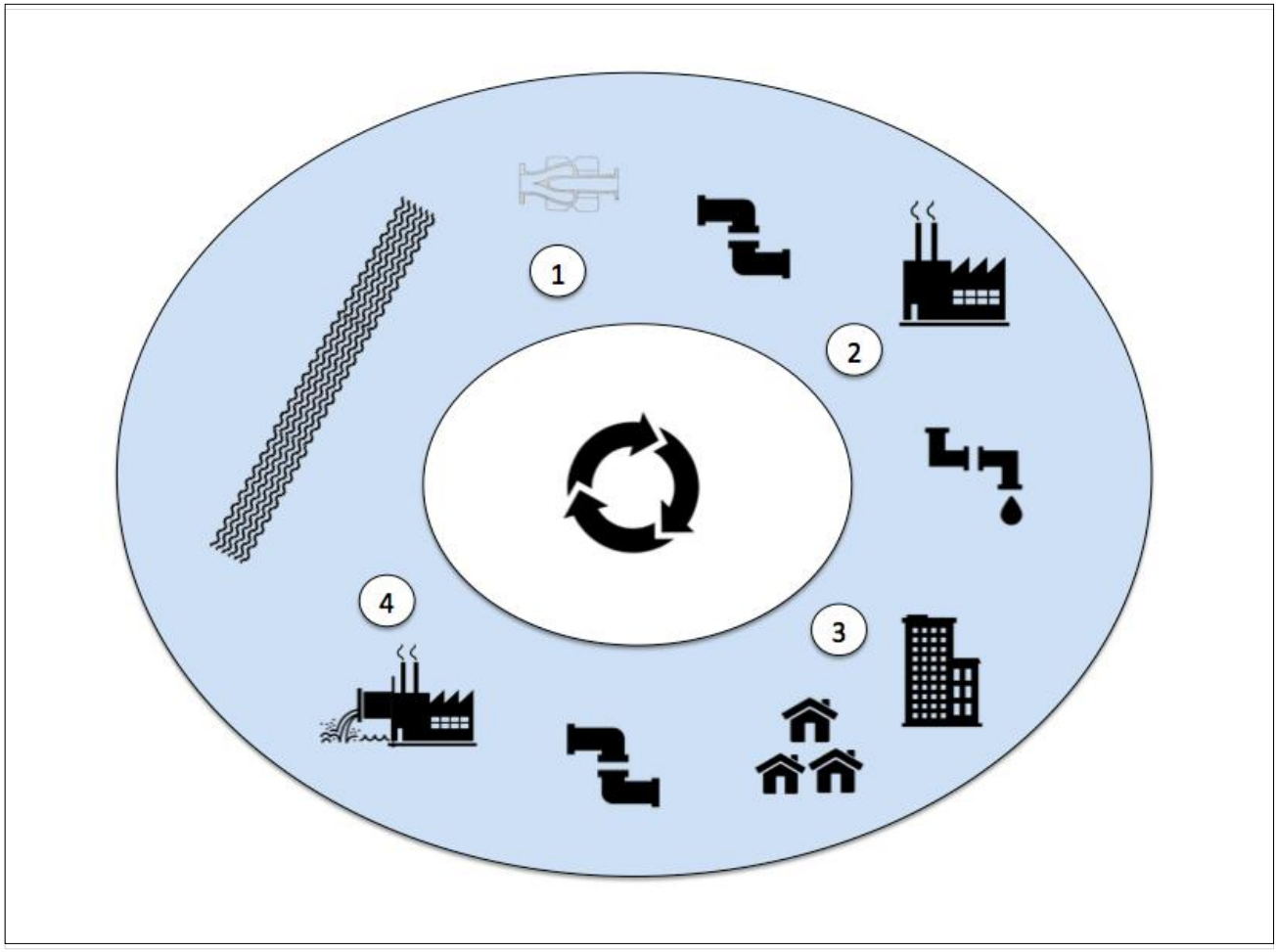


Figure 1: Water local cycle. Source: Laurène Branaa (2015)

The previous figure presents the four major steps in the process of water and sanitation:

1. Water catchment. Withdrawals can be done on two types of resources: surface waters, and groundwater. Groundwater will require less treatment, but more investments for the catchment part.

2. Water treatment. After having being pumped, water has to be treated to become safe, for instance for domestic consumption. Natural and chemical pollutants have to be removed. Three types of treatments exist depending on the complexity level.
    a) Filtering and light disinfection.
    b) Mechanical and chemical treatment.
    c) Chemical, mechanical treatment and refining operations.
3. Water distribution. Water is then distributed among three main areas: agriculture, industry and for domestic uses.
4. Sanitation network. The sanitation network includes wastewater collection, wastewater reprocessing in a wastewater treatment plant and wastewater disposal.

The main characteristic of the water and sanitation sector is that it belongs to the economic category of "network services", like electricity or rail transportation (Penard, 2003). A typology developed by Economides (1996) has distinguished two types of network services: the ones that consist in communication networks (transports, telecommunications) and those that consist in distribution or diffusion networks (energy, television, or water). In the first case, services work in both directions: a subscriber to a telephony network can receive or make a call. Distribution or diffusion networks are on the contrary one-sided networks. A subscriber to an electricity network can only receive electricity (Penard, 2003)!

1.3.1.2. Natural monopoly

According to Sharkey (1982), an industry is considered as a natural monopoly when the production of a determined good or service **by a single company** minimizes the total cost for the industry, no matter the amount of the demand for this good or service. If two firms are competing on the market, their total costs will exceed the costs of a single one for the same quantity. In such a situation, it is not profitable for another company to enter the market. The average costs of this new company will be superior those of the existing one: there will be no economies of scale. It is therefore more efficient to have a unique producer company (Grigolin, 2007).

One of the main explanations is that the cost structure of monopolies is different from the ones of other industries. Usually, the marginal cost will decrease until a certain amount of quantities produced, thanks to economies of scale, and will then increase because of issues

linked to the size of the company, like bureaucracy for instance. A natural monopoly's marginal cost will on the contrary be constant or decrease. When comparing average costs in both situations, it can be found that the average cost without monopoly will decrease and then increase as the quantities increase, whereas it will decrease in the case of monopoly (Boundless, 2015). Another reason to explain the existence of natural monopolies is that they occur in industries with a high level of fixed costs. A large demand is therefore needed to divide the fixed costs among the highest number of consumers, and have a consequent return on investment. It is thus very difficult for other companies to enter the market. Large initial costs are required to enter, and constitute high barriers to entry. It would be indeed difficult to recoup the cost of these investments with a large number of customers, in order to achieve low costs as the firm already on the market (Boundless, 2015).

J.S. Mill had developed in his book *Principles* (Numa, 2010) the concept of natural monopoly for the first time. Public services are profoundly related to this concept. Mill uses the example of the Post Office, which has to execute several operations. If the Post Office was divided into five or six competing companies, instead of being centralized in a single company, each of them would have to have an office in every city to receive all letters. Mill uses the expression "practical monopoly" to describe what it called nowadays natural monopoly, and takes the example of water distribution. To sum up, economies of scale are realized in this sector in the case of a monopoly for two reasons: more efficiency in the use of work thanks to a greater centralization, and a better repartition of fixed costs, especially for infrastructures, on larger quantities.

According to the economic literature, the water and sanitation sector can be characterized as a natural monopoly. Fixed costs, like costs of infrastructures, represent a large part of the total costs. It is therefore difficult for a potential competitor to enter the market. That would require a duplication of these fixed costs, what would not be profitable. In the case of water, it would for instance mean duplicating the water distribution network with twice the numbers of pipes! Concerning water, it is theoretically economically nonviable to have a second company entering the market, knowing that an incumbent company already owns the network, has a longer experience, and information about the consumers' habits, for instance (Grigolin, 2007). Even physically, it seems impossible to develop a parallel water supply network. Also, the sector is characterized by a high level of fixed costs, especially because of the infrastructures required to set up the network (laying pipes). On the other side,

operational costs, such as the cost of the resource or the cost of transporting this resource into the pipes, that would represent variable costs because it would depend on the number of consumers, is really low. The network therefore mainly explains the price paid by the consumer, and a duplication of infrastructures would constitute a useless waste. According to Baumol (1982), because this is inefficient from an economic point of view, the water and sanitation sector constitutes a natural monopoly.

1.3.1.3. Monopolies' excesses

A risk in a situation of natural monopoly is however than the unique company abuses the situation and fixes prices higher for a smaller quantity. In Europe, according to the Article 102 of the Treaty on the functioning of the European Union (2007), a dominant position, that is to say a really high market share, is not illegal *per se*. However, an abuse of dominant position will constitute a breach of the Treaty. It is more relevant to define a monopoly by its market power than only its market share. For instance, a company with 80% of the market share can have more power than a company with 100% of the market share.

The perspective of profits in a situation of monopole can encourage some companies to spend real resources to get a monopoly situation: this is situation is called "rent-seeking". A monopoly is viable only if no company entering the market will bring positive profit, knowing that the monopoly won't change its prices following the entrance of the new company.

1.3.1.4. Implications in terms of regulation

There exist two ways of dealing with the issue previously described, meaning an excessive market power of the monopoly. First, introducing competition into the market, a point that will be further developed in this dissertation. Second, introducing regulation to prevent the company from fixing prices the way it wants (Grigolin, 2007). According to Farina (1997), prices regulation is a way to guarantee the sustainability of the monopoly. But regulation authorities can also establish quality norms for instance to control monopolies. Regulation can take both following forms: external and internal regulation. An external regulation means that the governmental regulator will fix and control prices, define if new firms can enter the market, will audit costs. An internal regulation consists in creating incentives systems for the

administrators, deciding on the debt or investment required level. This regulation aims at achieving both following objectives: the greatest efficiency for the industry and equity in the service offer.

However, it is sometimes difficult for the regulating authorities to control efficiently monopolies, since information needed are incomplete. Information asymmetries are defined as situations in which one of the stakeholders is better informed than the others. For instance, a car seller will know the weaknesses of the car he wants to sell, but won't reveal them to the potential buyers, hoping them not to notice (Alternatives Economiques, 2010). In the case of water monopolies, the company will be clearly better informed about the costs and the market than the authorities. It could therefore be difficult for them to fix a "fair" price, guarantying a price allowing access to water for the poorest, and guarantying at the same time a minimum return rate for the private operators and investors (Grigolin, 2007). A type of regulation that can be developed is "price cap". The authorities fix a maximum price, and companies can choose the price they want, lowest than the maximum price that has been fixed. An escalator clause is usually added, allowing adjusting the prices during the determined period. In this situation, the regulating authorities also need to have a good knowledge of the industry's cost structure and of the demand. An upper price limit too highly determined would not be able to control monopolies' excesses. On the other side, a too low upper price limit would lead to the non-viability of the business. A major advantage of this solution, compared to a price fixation is that companies have the flexibility to reduce their prices (Grigolin, 2007).

It is therefore necessary to have regulating authorities that are strong and independent enough to withstand external pressures: political, economical, but also from consumers and private operators. The following conditions can help setting up this positive environment: a transparent and public decision-making process, consultation from external auditors (also called "watchdogs"), having its own financial capacity, fixed mandates and wages. These conditions aim at reducing risks of corruption or cooptation.

1.3.2. Competition

1.3.2.1. Competition in the water sector: operator approach

Assuming that the water sector, as a network infrastructure, is a natural monopoly, does not mean that not competition is possible. If water management is not publicly managed, it means that private actors have to face competition at least to obtain the contract. Competition is therefore not in the market, but for the market (Audette-Chapdelaine, Tremblay & Dupre, 2009). As previously mentioned, regulation has to be developed to control monopolies' potential excesses. However, it can also be claimed that competition is a way to reduce the power of monopolies, and therefore the need for regulation. An excess of regulation can indeed lead to an under-capitalization and a need of public financing.

A first way of viewing water supply is by considering a single operator for the whole network. Public or private, this single operator manages the entire water cycle previously described, from water catchment to wastewater disposal. A competition can only occur if public authorities decide to delegate to the private sector or privatize the entire cycle. In this case, there is a competition for the contract through negotiations or calls for tender. However, regardless of the status of the operator, public or private, there will then exist a monopoly situation, and the final consumer will have no other choice but buying this water, unless buying bottled water, what will be further developed (Lorrain, 2003).

Concessions contracts require introducing competition among suppliers. In Manilla for instance, more than fifty companies responded to a call for tender for a contract (Minarchiste, 2013). There are enough companies in this sector to avoid any oligopoly situation.

1.3.2.2. Competition in the water sector: engineering approach

After having presenting network operators, which manage the entire water local cycle and represent a large part of the management of the water sector, other industrial actors have to be presented to get a clearer and more pertinent picture of the sector. These actors represent other competition possibilities. Another private water supply can indeed be presented by using the concepts of industrial economy. Let's look at the different steps of the water local cycle: water catchment, water treatment, water distribution, wastewater collection, wastewater treatment and wastewater disposal. Three types of actors can play a role and intervene on specific parts of the technical cycle (Lorrain, 2003). In all cases, there is a potential competition "within" the market:

- Engineering and construction approach: environmental engineering. Environmental engineers will conceive and realize treatment equipments, and will sometimes run them for a determined period.
- The industrial approach: heavy engineer and plant contractors. They take place in a context of outsourcing, for the parts of the water cycle that concern heavy industry.
- Bottled water market. Competing with the distribution part of the water cycle system.

The role of environmental engineering will be even more important that the sector will be publicly managed. In the case of a public water management, the public operator can use specialized firms, what generates competition. Selection procedures will indeed be based on the strict rules of "public procurement", that is to say the process that governments use to purchase goods or services from the private sector. Such strict rules aim at encouraging competition between suppliers and avoiding corruption while choosing a supplier. "Competitive bidding" can also be mentioned, referring to transparent methods for procurement of suppliers. Suppliers' bids will include terms and conditions, any specification of the contract for instance: these procedures aim at avoiding favoritism and getting goods and services at the lowest prices. Environmental engineering appear as partner of public authorities, helping them to modernize their infrastructures for instance. Their entry on the market is therefore facilitated.

Also, as a result of an increase in the number of environmental norms, more and more externalization processes appear: outsourcing. Major industries with polluting activities are held to more and more rigorous and restricting standards. Because of competition, they usually focus on their principal market, and they outsource their fluid management. Instead of completing this portion of the cycle internally, the company transfers this work to external suppliers. This strategy aims at saving costs. Today, there is not only a single and traditional technical water system as before. This growing market of industrial fluid management paves the way for the entry of new companies. The following companies are examples of potential competitors for traditional operators: Air Liquide in France, Halliburton or General Electric in the United States, Chyoda in Japan (Lorrain, 2003). In the beginning, these companies were specialized in the management of processes, which had nothing to do with the management of local public services. However, sectors evolve and urban networks operators are more and more interested in the industrial market. On the other hand, industrials

specialized in environmental remediation are really tempted to use their competences for the local public services sector. They represent therefore a real source of competition within the market.

1.3.2.3. Competition within the market: bottled water

On the distribution part, an important competition occurs for the domestic consumption with the bottled water market. High numbers achieved by this market show the growing importance of bottled water. Main distribution multinationals use their marketing methods to make this market grow (Lorrain, 2003). In the past, nobody could think that bottled water could represent a threat for the public service vision of water. But the progress of this market cannot be denied: according to Lorrain (2003), the bottled water segment has the highest growth for the beverage sector.

Companies fight to innovate in the bottled water sector. According to Arnaud (2014), Danone launched in 2014 “La Goutte d’Evian” (the Drop of Evian), a new water bottle with a practical format (a 20cL bottle), and a specific distribution method, for a price of 1€ (5€ per liter!). The idea behind was to meet a new demand: for instance, it will be sold in places where consumers are usually given a free glass of water, for instance the French hairdressing salons Dessange already signed a contract with Danone. This small bottle can be charged, and if not charged, the place will appear as a luxury one. Danone claimed that this would not represent a competitor for tap water. According to the brand, tap water and mineral water are different products that do not compete with each other. Mineral water would be chosen for its taste, its appearance and its own qualities such as the presence of healthy minerals (Arnaud, 2014). Health, youthfulness, taste, or mineral quality: companies spend astronomic sums of money to convince consumers of the benefits of bottled water (Sircome, 2012).

	Mineral water	**Spring water**	**Tap water**
Origin	Groundwater	Groundwater	Multiple sources (groundwater, rainwater, surface water)
Natural protection	Compulsory	Compulsory	Not compulsory
Chemical treatments	No chemical treatment	No chemical treatment	Chemical treatment required to get safe water

Mineral composition	Compulsorily constant	Not compulsorily constant	Flexible
Allegations of health	Established benefits for health	-	Inappropriate for infant feeding

Table 1: Characteristics of mineral, spring and tap water. Source: Duval, S. (2010).

There exist three types of water according to the European legislation: mineral water, spring water and tap water. In 2009, a water brand for Danone, Taillefine, had to be taken off the market because it did not match with any of the three categories described below. A new European regulation had forbidden in 2006 the addition of any mineral, and Taillefine was calcium and magnesium-enriched (Duval, 2010). The main differences between the three following types of water are due to the origin of the water, their chemical treatment and their mineral composition. Historically, mineral water bottles were sold in pharmacies in France because of their mineral composition that was considered as therapeutic and beneficial for health.

This situation lasted until the 1950's in France: a decree authorized manufacturers to transport water by pipeline, allowing them to move away from the source, and to create treatment and bottling plants. At the same time, the commercialization of mineral water was authorized in other places than pharmacies, like in supermarkets (Sircome, 2012). Massive communication, advertising and marketing campaigns have since been developed to promote mineral and spring water, but also tap water! Indeed, tap water would have other benefits: low cost, environmentally friendly or quality. To sum up, there has been said in a precedent paragraph that water had no substitute. However, it can be seen that a competition can occur in the distribution part of the water cycle for the domestic consumption part, that is to say when water is used to be drunk. In developing countries, this new type of competitor represents a serious threat, since water networks are often unsafe and not sufficient to meet the demand.

1.3.2.4. The example of the electricity market

In this last section dedicated to the role of competition in the water and sanitation sector, another example of network services will be taken: the electricity market in France. In 2007, a large part of the chain has been opened up to competition (Cour des Comptes, 2015).The electricity market can be divided in four parts: production, transport, distribution, and

commercialization. Transport and distribution are still regulated monopolies, and price is determined by regulating authorities. However, production has been opened to competition in 2000. Companies can therefore produce energy that will be sold through trading, over-the-counter agreements, brokerage or stock markets. Since July 2007, commercialization is completely opened to competition. Commercialization means that any company can sell electricity to final consumers. They can choose market or regulated prices.

A production opened to competition for the water sector does not seem realistic, duplication of costs being too costly from a rational point of view. However, opening competition for the commercialization part is an option that could be applied to the sector of water and sanitation, this part of the cycle not implying any fixed costs. No country ever developed such an approach, but it could be an idea to introduce more competition, thus avoiding monopolies' excesses.

1.4. Determining a good water management performance

1.4.1. Objectives to be determined

1.4.1.1. Specific objectives related to water management performance

Before identifying performance indicators necessary to improve water management, main objectives that we want to achieve have to be determined. Three main categories of objectives have to be taken into consideration when studying performance for water management: efficiency from an economical point of view, objectives of social justice and environmental impacts on the long-term.

It is generally accepted that water services are public services, and have therefore to be politically acceptable, socially fair and economically viable at the same time. According to Mazouz and Tardif (2006), "*public services, without being confused with private services, are comparable in terms of delays, costs and value for beneficiaries*" Criteria of equity and efficiency have to be studied in order to evaluate a public service's performance. According to Le Lannier and Porcher (2012), the most efficient services from an economical point of view would be the ones who manage their water service by minimizing their incomes, that is to say that they cover their costs but they limit their operating margin. High prices can reflect

high costs or too high margins. As for a private service, costs have to be lowered as much as possible; but the specificity of this sector is that margins should also be limited to achieve the second objective, social fairness. Public services' specific characteristics include: continuity, quality and access to service. A universal access to service is often claimed as necessary because water is vital and access to water for basic needs is a human right, as described in the first part of this Literature Review.

Quality of service does not only include the quality of immediate service for clients, but also the impact of it on the long-term. Both first objectives are usually taken into consideration when considering performance in the water sector. However, this last objective is often set aside because impacts are less visible and not immediate. In the first part of this Literature Review, it has been showed that water is a resource that becomes scarce. The situation gets worse with a bad water management, or when it is not taken into consideration. Human intervention is indeed very often the main cause explaining serious damages to freshwater, for instance through pollution. To sum up, performance indicators measuring long-term impacts made on the resource are necessary to give an overview of the global situation, and in the end to improve water management.

1.4.1.2. Symptoms and causes of a bad performance in water management

How recognizing a bad performance in water management? Wolff and Hallstein (2005) identified five symptoms of a bad performance for water services:

- Unsatisfactory quality or extensiveness
- Difficulties to conform to the standards
- Insufficient local control
- Too high prices
- Anticipation of a too high price increase

After having identified a poor performance, Wolff and Hallstein (2005) present five causes to explain why an organization, publicly or privately managed, can reach this performance, and give examples of measures to be taken to remedy to this situation. A particularly interesting cause is an inefficient performance measurement. It clearly shows that no objective can be efficiently achieved if it has not be precisely determined, together with the way to measure it,

an indicator for instance. The following table has been realized by Audette-Chapdelaine (2008) to synthesize Wolff and Hallstein's presentation.

Inefficient staffing	**Insufficient funds**	**Poor asset management**	**Inefficient performance measurement**	**Lack of transparency and of public participation**
- Improving training - Hiring more employees - Clearly communicating with employees and unions	- Seeking subsidies - Achieving economies of scale - Borrowing money - Increasing prices or taxes	- Managing assets according to risks - Establishing a clear limit between maintenance and investment - Assessing assets periodically	- Setting standards and precise indicators - Rewarding according to performance - Developing performance monitoring	- Constantly informing clients of costs and benefits - Third-party assessment of technical aspects - Third-party assessments of allegations

Table 2: Causes and solutions of a poor performance in water services management.
Source: Audette-Chapdelaine. (2008).

Elnaboulsi has developed another model in 2001, identifying several factors explaining the poor performance and the low productivity in the French water management. This bad performance led to a growing number of contracts of delegation to the private sector in France in the 1990s, because the private sector's management was said to be more efficient and more stable. Costs savings can be used to invest in infrastructures, for instance. The following categorization characterizes the specific French case at that time, but it will be helpful and used further in this dissertation to classify the different indicators chosen to measure the performance in the water and sanitation sector. There are three categories of factors:

- Technical and operational. This category includes a poor asset management: lack of preventive maintenance, lack of a renewal plan for infrastructures or a bad knowledge of the infrastructures condition. Negative environmental impacts can also be explained in part by a lack of investment programs, for instance to comply with the European regulation.

- Commercial and financial. This category includes inefficient water pricing because it is not based on individual consumption but on collective consumption (water meters are not individual but for a whole building for instance). Prices are based on past accounting average prices instead of economic costs and are not representative of future economic costs. Planning is difficult because of a lack of data concerning changing demands.
- Human and institutional. This category includes a labor surplus, a lack of discipline, a lack of incentives to attract competent managers. Another factor affecting performance is the politicization of decisions.

Several factors described by Elnaboulsi will be clearly showed in the example of Paris' water management before remunicipalization, explaining a huge failure, such as lack of investment programs.

Lastly, Heather and Bridgeman (2006) presented a model based on the premise that current activities have to help meeting the future needs, thus underlining the importance of considering the future in water management as a key performance objective. A lack of vision can lead to a poor water management, even if it is not easily visible or immediate. According to them, it is essential to draw a parallel between the changing needs' evaluation and the deterioration of infrastructures. Actual performance should be adapted to the performance required in the future. The following figure illustrates the importance of the consideration of present deterioration for the future production and distribution capacity.

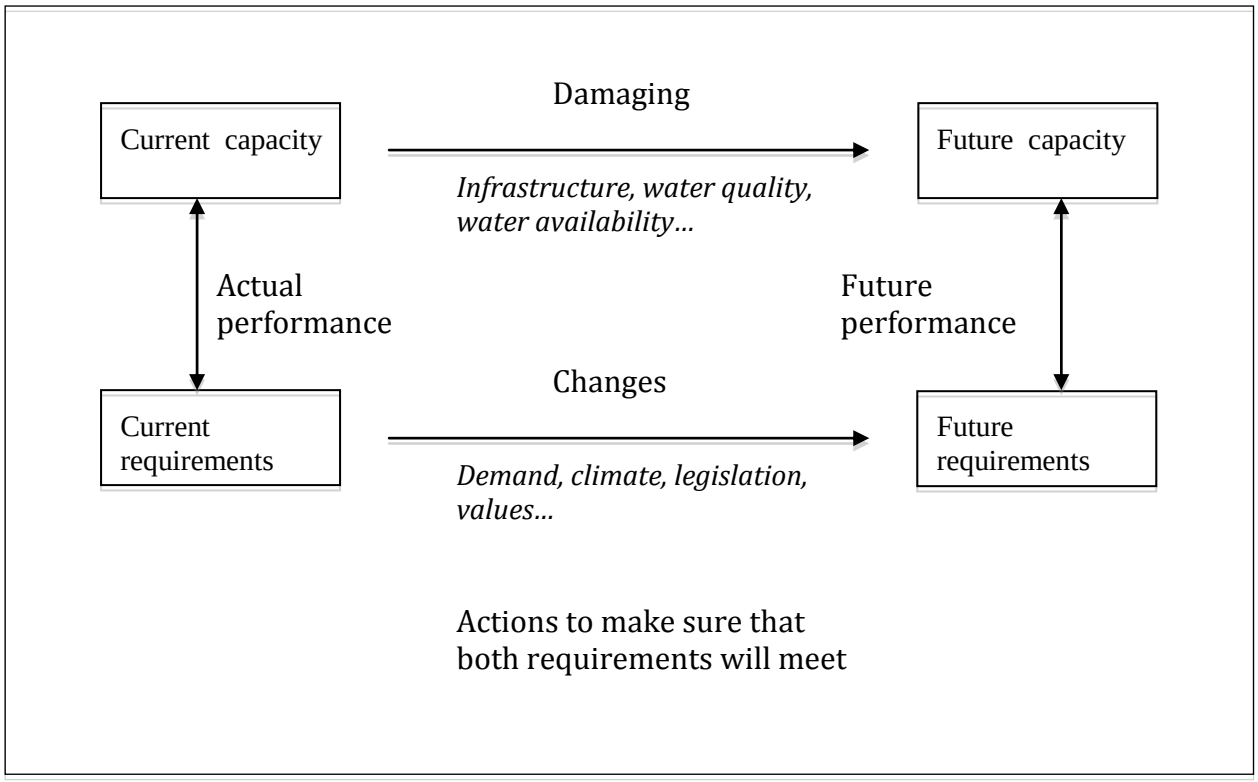


Figure 2: Heather and Bridgeman's performance model.
Source: Audette-Chapdelaine. (2008).

All models presented above are complementary and highlight precise characteristics that will be very useful when studying Sao Paulo and Paris' cases. A special attention should be paid to Heather and Bridgeman's model for the focus made on the importance of the future as a key concept to analyze the relevance of water management models, knowing the special characteristics of water on the long-term, especially on a environmental point of view.

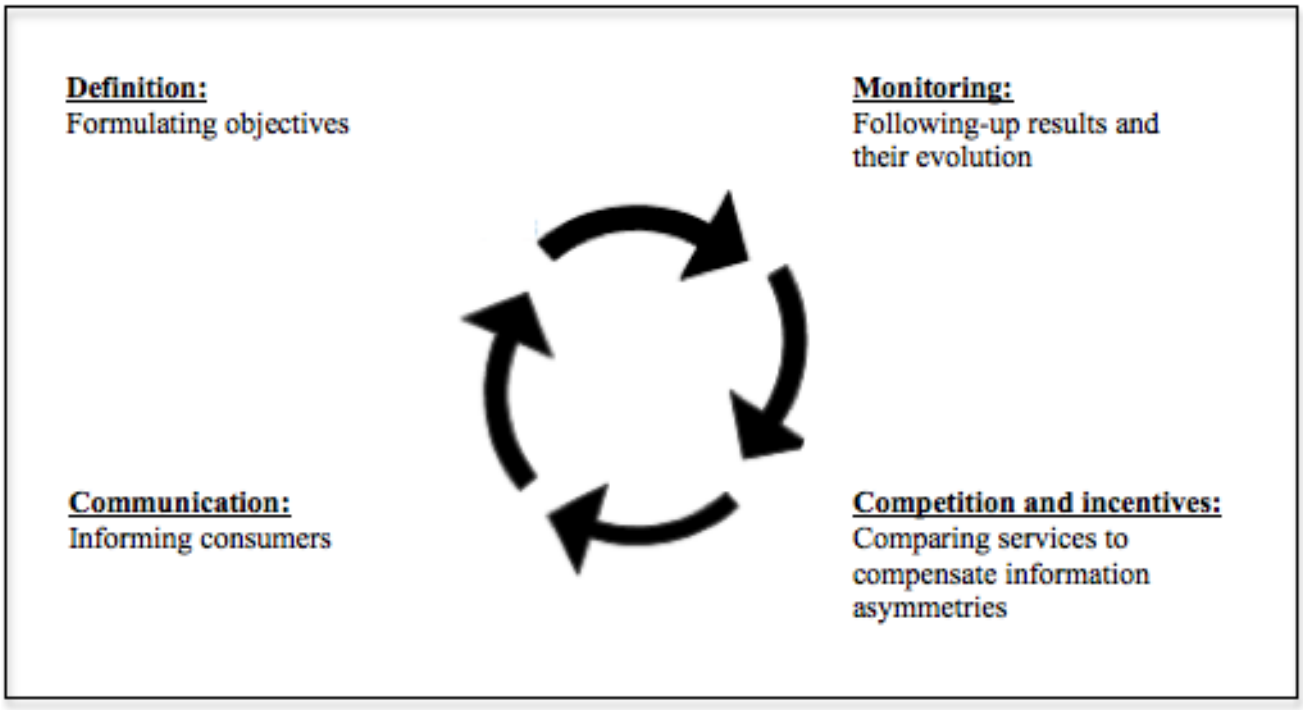
1.4.2. Key performance indicators

1.4.2.1. Why would a company use performance indicators?

Companies operating in the water sector, whether public or private, are accountable for their activities, and for meeting their commitments not only in terms of price, but also in terms of service content. Regulation and transparency reinforcement in the last years have increase the need for efficient and easy-to-understand tools. This is even more important because price increases have been hard to accept for consumers (Guerin-Schneider, 2002). Quality certifications have been developed, like ISO 9000 for quality in France. But they usually are

process-oriented, that is to say that they consist in a control of the means adopted. Commitment does not cover results. Performance indicators that are results-oriented are therefore very useful to improve water management, because employees therefore orientate their actions towards greater results, and do not only focus on the means and the processes chosen.

How should performance indicators efficiently be used? The following figure developed by Guerin-Schneider highlights four uses of performance indicators. They can open new perspectives in terms of service content definition, steering, incentives or communication with consumers.



Source: Guerin-Schneider, 2002

1.4.2.2. Construction of operational tools

Operational tools developed for water management are numerous. We will provide the example of an operational tool developed by Guerin-Schneider and Bonnet (2001). This tool shows us that a high number of performance indicators can be chosen when dealing with water management. They have chosen six main criteria. Within these categories, several indicators are presented, some are recommended, and others are optional.

- Service delivered to the customer. This criteria concerns the service quality perceived by the customer. It concerns mainly the operational side. Examples of recommended indicators: response rates in a 15-days period.
- Claims. This criteria gives an overall vision of the customers' satisfaction. Examples of recommended indicators: analysis of the claims number for 1000 customers.
- Resource management (quantity and quality). This criteria concerns the balance between resource and demand, water sanitary quality, security. It concerns mainly the operational side and the conservation of the resource. Examples of recommended indicators: compliance rates.
- Network management and continuity of service. It concerns mainly the operational side and the conservation of the resource, and deals with service's interruptions and the state of the network. Examples of recommended indicators: index of primary losses.
- Wastewater treatment plants management. Examples of recommended indicators: rates of release without treatments.
- Financing capacity. Examples of recommended indicators: self-financing rates.

To sum up, the precedent tool is very operational, and would be more efficient for a company. In order to analyze water management in a city, we will therefore study the following criteria, divided in six categories, and that will be converted into performance indicators:

- Access to water and sanitation
- Quality
- Price

- Planning and financing capacity
- Network maintenance and investments (Losses and infrastructure)
- Resource preservation (Ex: resource reuse)

Access to water and sanitation, quality and prices are usually criteria that are studied and companies or governments often communicate about it to show that a water management model is successful, especially because they are clearly related to social and societal issues. Another important aspect is that water management has to be viable: the capacity of planning and financing will be therefore analyzed because no water management model can be successful without a strong economic vision. A last category is not that often highlighted, because consequences are both less visible and less immediate. However, network maintenance and investments, and resource preservation have both a direct impact on the future results of the company, and an impact on the long-term on the availability of the resource. For instance, a company in an area with a great amount of available water supplies offers water at a very attractive price, and almost all inhabitants have access to it. However, the sanitation system does not function very well and water is almost not reused, but polluted. Because repairing leakages is less expensive than investing in new pipes, almost no additional investment is planned. Very often, this model will be considered as a good one, because the second part of this model's description is not visible by the inhabitants and the consequences are not immediate. Can we say tough that it is an example of good water management?

2. Methodology

The previous Literature Review gave us an overview of theories aiming at improving water management and existing water management models.

The case study methodology is used to clarify concepts previously described and to offer an application of water management models within a specific context. There exist two types of case study: the single-case study and the multiple one. The multiple case study has been preferred. Two cities have been chosen: Sao Paulo and Paris. First, as a French studying in Brazil for one year, it makes sense to focus on countries that have coherence according to personal preferences. In terms of methodology, speaking both French and Portuguese is also an asset to have access to a greater number of documents related to water management in both countries, or to have the opportunity to converse with French or Brazilian specialists. Last but not least, it seems more interesting to study water management model at a city level. Business opportunities are indeed greater in the case of water management at a city level – to provide a specific service. Paris and São Paulo appear to be comparable since they both

represent an economic and political hub in their respective countries. It seems necessary to mention that the dissertation does not aim at comparing water management models in both cities to classify them or to point out a better system. The dissertation aims at highlighting practices or examples that can be useful in other cities, if adapted.

A research is traditionally based on two types of methods: the qualitative and the quantitative ones. The data collection has mainly focused on secondary data from various sources, from academic papers to newspapers' analysis or official documents from the Sabesp or Eau de Paris. Also, visits of both the *Pavillon de l'Eau* in Paris (a space dedicated to the Parisian water management and created by the *Eau de Paris* Company) and of the Parisian Sewers (*Egouts de Paris*) have been made to deeply understand most issues related to water management in general.

Four specialists have been consulted through the research in order to deeply understand the political and institutional context, but also to have a clearer opinion on both following issues: Paris' remunicipalization and São Paulo's water crisis.

- In São Paulo: Gesner de Oliveira – ex-President of the Sabesp
- In São Paulo: Luiz Felipe Pinto Lima Graziano – Manager at OAS Soluções Ambientais, a company specialized in offering environmental solutions
- In Paris: Frédéric Donati – ex- Executive Board Member of the *Eau de Paris* company
- In Paris: Eric Pfliegersdoerfer – Project Manager at *Eau de Paris*

3. Case studies

3.1 Presentation of both water management models

A good water management model has to face various issues that can sometimes compete with each other: ensuring that everybody has access to water and sanitation, preserving water resources, preventing from pollution or ensuring agricultural production while limiting agricultural impacts on resources and the environment. The previous issues cannot be solved on a sectoral basis: a transversal approach is necessary. Geographic realities have to be taken into consideration, at the watershed level for instance. An adequate institutional and juridical organization has to be defined: regulation, administrative organization, financing, control etc.
This first paragraph will therefore present and describe the characteristics of water management models both in France and in Brazil, and will then focus on Paris and São Paulo's water management.

3.1.1 National water management organizations and policies

3.1.1.1 Water policy in France

The actual organization of the French water policy is mainly based on the Law of 1964 that has been later completed and modified. The Law of the 16 December 1964 (Loi du 16 décembre 1964) has organized water management by watersheds. Three main innovative principles have been chosen: a decentralized and concerted management that uses financial incentive tools. To organize this sharing of responsibilities, two structures have been created for each watershed:

- River Basin committee (*Le Comité de Bassin*): a consultative structure
- Water Agency (*L'Agence de l'Eau*): an executive organization

Two other laws have completed the Law of 1964. In June 1984, the Fishing Law ("Loi pêche") has organized freshwater fishing and the management of fish resources. The preservation of the aquatic environment has been more and more taken into consideration with this Law. In January 1992, the Water Law ("Loi sur l'eau") has developed a real integrated water management. Water has been declared as collective heritage of the French nation ("patrimoine commun de la Nation"), a balanced management between the different uses of water has been promoted, a global management of water in all its forms (groundwater, surface water etc) has been decided.

According to the French Environmental Code, the water policy's main objective is a balanced and sustainable management of water resources. It is subject to result obligations related to various European directives. According to the French Ministry of Ecology, Sustainable Development and Energy (2013), in October 2000, the European Water Framework Directive (Directive-Cadre Européenne sur l'eau) has established a framework for a communitarian water policy, thus giving more consistency to the various European directives (more than thirty directives and regulation since the 1970's!). This directive has set targets, offered a calendar and working methods for the 27 countries of the European Union. As a preamble to this directive, it is claimed that: "Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such". In April 2004, this Directive has been transposed into French Law. The Water and Aquatic Environment Law (la

Loi sur l'eau et les milieux aquatiques) has reinforced this transposition in December 2006, in order to achieve the goals set up by the European Water Framework Directive. This law also recognized the right to water for everyone, and that adaptation to climate change should be taken into account in water management.

The European Water Framework Directive focuses especially on setting objectives and defining means of action. Objectives are result-oriented: there is an obligation to produce results: for instance, discharges of hazardous substances classified as "priority dangerous" have to be removed before 2020. To achieve such objectives, different means of actions can be used. First, water management should be organized according to River Basin Districts, and objectives should be set according to mass of water. The Directive introduced the notion of River Basin Districts as areas defined according to geographical and hydrological tools, rather than administrative or political decisions. A competent authority should be designed for every District, and all districts are managed according to the River Basin Management plan, a plan that should be updated every six years. Often, rivers are not staying within national borders; states therefore have to cooperate for the management of what is then called a transboundary basin. The Directive also emphasizes on public consultation, thus reinforcing transparency for water management, and demands an active participation to the elaboration of the Management plan. To sum up, the European Water policy mainly influences the French Water policy, especially in terms of objectives (result-oriented) and decentralization according to River Basin Districts.

For the French water management, six basic principles can therefore be defined:

- A decentralized management based on watersheds. The French Water policy is defined and coordinated at a national level, but decentralized at a watershed level. It is necessary to take geographic realities into account because "water does not know administrative borders" (Office National de l'eau et des milieux aquatiques)!
- An integrated approach. All water uses are taken into consideration, but also preventive measures against pollution, control of natural risks etc.
- Consultation and coordination. This is the role of Watershed Committees.
- Specific financial resources. "Water pays for water". This principle means that consumers have to pay municipalities for the infrastructures and maintenance necessary for water production, distribution, and sanitation. Collectivities' water

expenditures have to be balanced with water's taxes. Water Agencies are responsible for collecting these specific taxes.

- A multiannual planning.
- A clear division of responsibilities between public authorities and private organizations. In France, water and sanitation services are public services that are decentralized at a municipal level. Municipalities are responsible for the management, either direct or delegated. In the case of delegation to a private operator, responsibilities of both private and public partners are clearly guaranteed through legislation and defined by a contract.

Each catchment basin's governance can be schematized in this way:

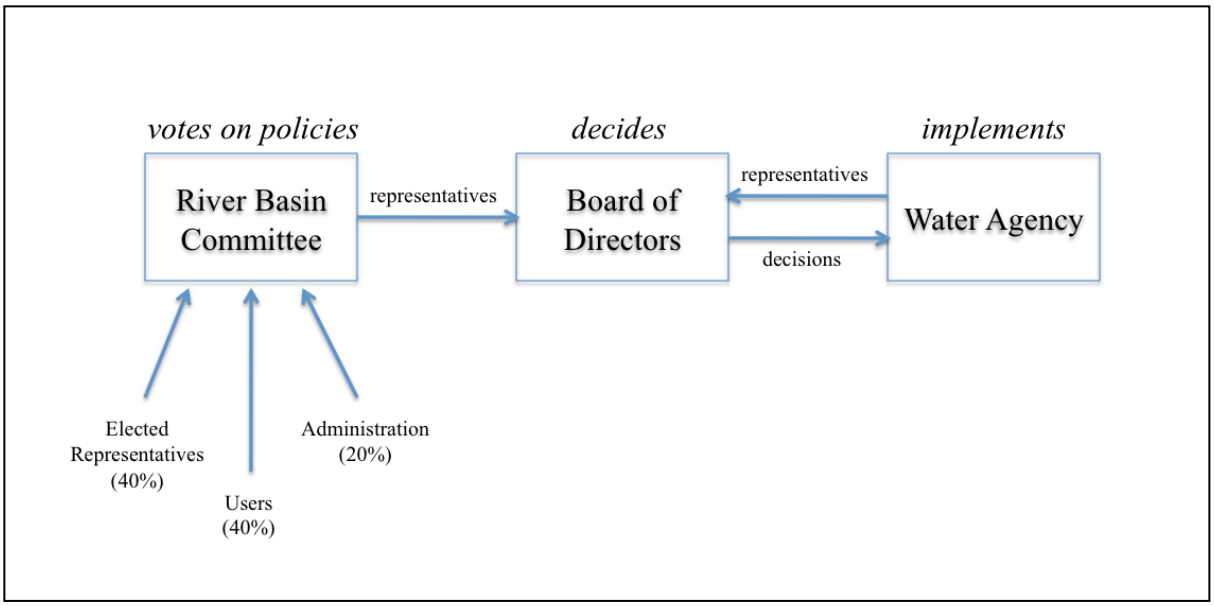


Figure 4: French catchment basin's governance. Source: Laurène Branaa (2015)

The River Basin Committee discusses and decides the broad guidelines for water policies and work projects, and control fees. For that purpose, the Committee elaborates the Water Management and Development Program (Schéma Directeur de Gestion et d'Aménagement des Eaux). The Water Agency is committed to carrying out the water policy defined by the River Basin Committee. Its budget comes from the special taxes that are collected. These taxes have a huge importance because they confer an economic value to the water, according to the polluter pays principle. This principle acts that the ones responsible for pollution have to pay for the damage done to the resources and the environment, in this case to the water resource. Many European environmental policies have developed such taxes, for instance the ecotax in order to reduce greenhouse gas emissions. This tax is necessary for the existence of Water Agencies and allows them to realize infrastructural investments.

3.1.1.2 Water policy in Brazil

It is estimated that Brazil has 12% of the world's freshwater resources. However, this wealth hides huge regional variations, as it will be further described with the example of São Paulo (Johnsson, 2001):

- The Amazonian basin (North region and a part of the Center-West region) represents 63% of the territory and holds 80% of the freshwater total, but only 5% of the global population.
- The Southeast region (or Brazil's agricultural, industrial and urban heartland) represents only 10% of the territory, 60% of the Brazilian population, and 12% of the available freshwater resource.
- The Northeast region is known for its lack of water. It holds only 4% of the available freshwater resources, and represents at the same time 13% of the territory and 35% of the Brazilian population.

Brazil is a federal state, and each state has its own legislation. The federal state establishes the main principles and laws, but the states have a certain degree of autonomy for the adaptation of the laws and their implementation. Until the 20th century, water exploitation was done without any control. After the First Republic, in 1934, a Water Code (*Código das Águas*) has been established: this Code is considered as the first attempt to regulate water

exploitation (Laurent & Hellier, 2011). It defines water according to two categories: private and public water. Water is public when nobody can be prevented from using it. Private water is fully usable by the owner of the land. Thanks to this Code, Brazilian authorities have a power of control on industrial and agricultural water uses.

In 1997, the Water Law establishes the National Policy on Water Resources and creates the National Water Resources Management System (*Sistema Nacional de Gerenciamento de Recursos Hídricos*). The Law defines the three following principles (Laurent & Hellier, 2011):

- Water is a public good
- Water is a limited natural resource, having an economic value
- Water management has to promote multiple water uses
- Watershed is the territorial unit for water planning and management

Since the beginning of the 1990's, concepts of Integrated Water Resources Management have become more and more important in Brazil, as shown with the Water Law of 1997. A complex issue exists in Brazil tough concerning interstate basins. If all waters are public domain nowadays, there exist two categories of governance for water (cf. Appendix):

- Federal waters. If a river (or groundwater) crosses more than one state, or covers to territory of other countries, the level of management is federal.
- State waters. If waters are located entirely within a single State, the management is done at a State level.

The Integrated Water Resources Management is more easily implemented in watershed that cover only one State.

This approach is clearly inspired by the French example. Both main principles related to integrated water management are included into this law: a decentralized and a participatory management (Laurent & Hellier, 2011). The governance is really similar to the French example: the Basin Committee elaborates the planning of the Basin, and the execution is attributed to the Water Agency. Another specific institution has been created in 2000, the National Water Agency (ANA, *Agencia Nacional de Águas*), the water management authority at a federal level that is related to the Ministry of Environment, having a financial and management autonomy. The following figure schematizes the Brazilians institutions at

national, state and basin level that constitute nowadays the Brazilian water's management model.

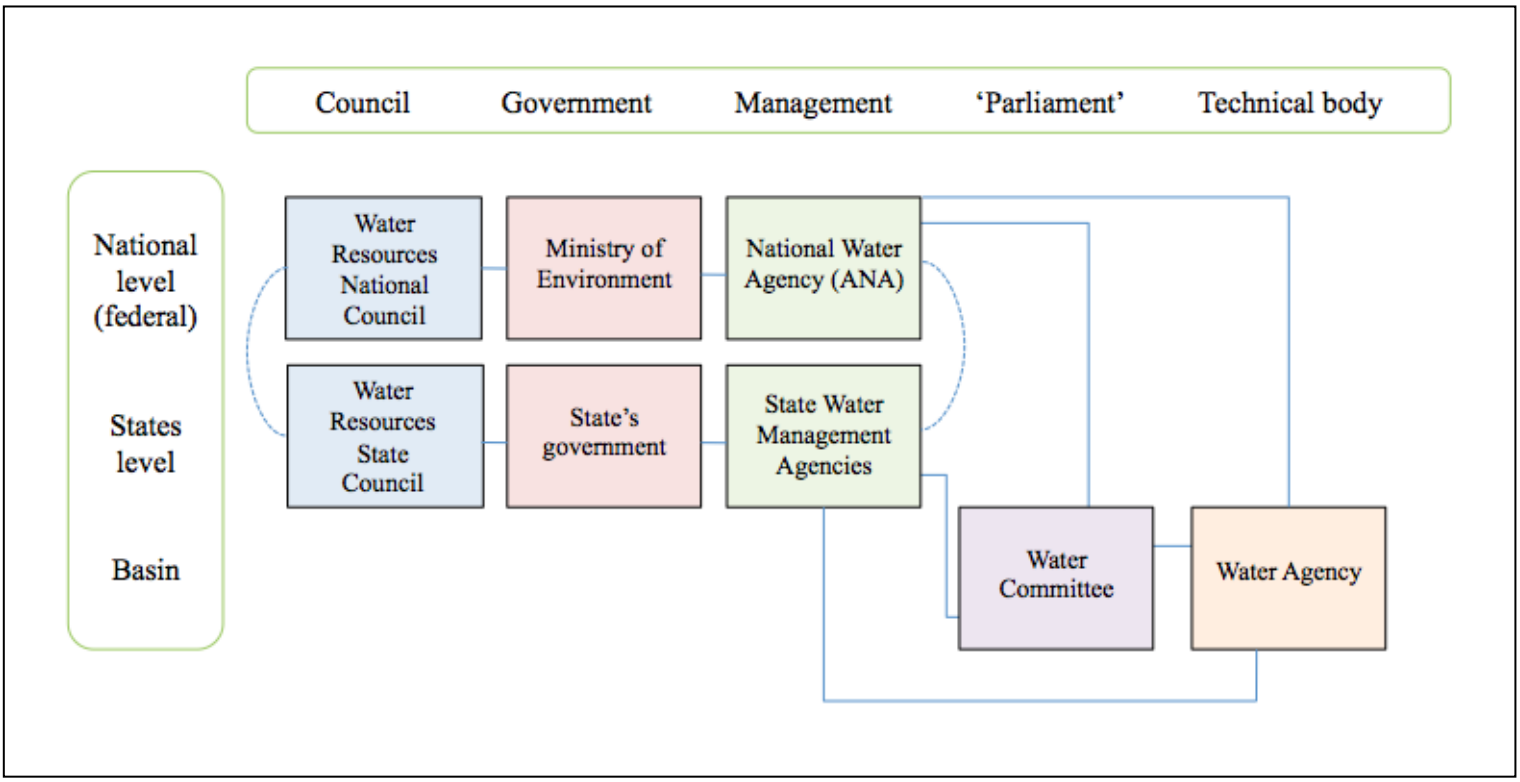


Figure 5: Brazilian water management's governance model.
Source: adapted from Tabarly, Tonneau & Rocha Barros (2010).

3.1.2 Presentation of both cities

3.1.2.1 Paris

Paris has a relatively favorable position concerning water resources because the region has various rivers and groundwater reserves. However, water supply was a major issue until the 19th-century, because of both quantity and quality concerns. With the population growth, the traditional systems such as public fountains and drawers of water have not been able to ensure a minimal level of hygiene in Paris anymore. Cholera outbreaks convinced public authorities to provide a solution to this recurrent problem. From the mid-19th-century to the 1920's, efforts have been focused on water supply through water capture from distant sources

(Avre, Vanne, Loing and Dhuis for instance). Water is then routed through long aqueducts until the main water reservoirs. These water sources still represent half of the water consumed nowadays in Paris. The other half comes from treatment plants that are located upstream, in Ivry (on the Seine river) or in Joinville (on the Marne river). Both treatment plants have been created respectively in 1890 and in 1893. The plant located in Orly and built in 1969 completes the system. Since 1930, public authorities have focused their investments on wastewater treatment. The wastewater treatment plant in Achères has been built in 1940. It is one of the biggest in the world, and is constantly modernized and expanded every time that the standards of water pollution evolve (cf. Appendixe 6).

Different players intervene to deliver the water and sanitation service to the Parisians. The town council (Ville de Paris) is in charge of the organization of the service and of its control. It is responsible for water and sanitation services' quality and performance. It defines water policy that is then implemented by the following actors. The drinking water system is managed by the publish establishment or regie Eau de Paris. The Sanitation Branch of Paris (Section de l'Assainissement de Paris) is in charge of a part of the sanitation service, the service of wastewater collection. The Interdepartmental Association for Sanitation in Paris (*Syndicat inderdépartemental pour l'assainissement de l'agglomération parisienne*) takes care of wastewater transport and treatment. The following figure schematizes the role of each actor, from water capture to wastewater discharges.

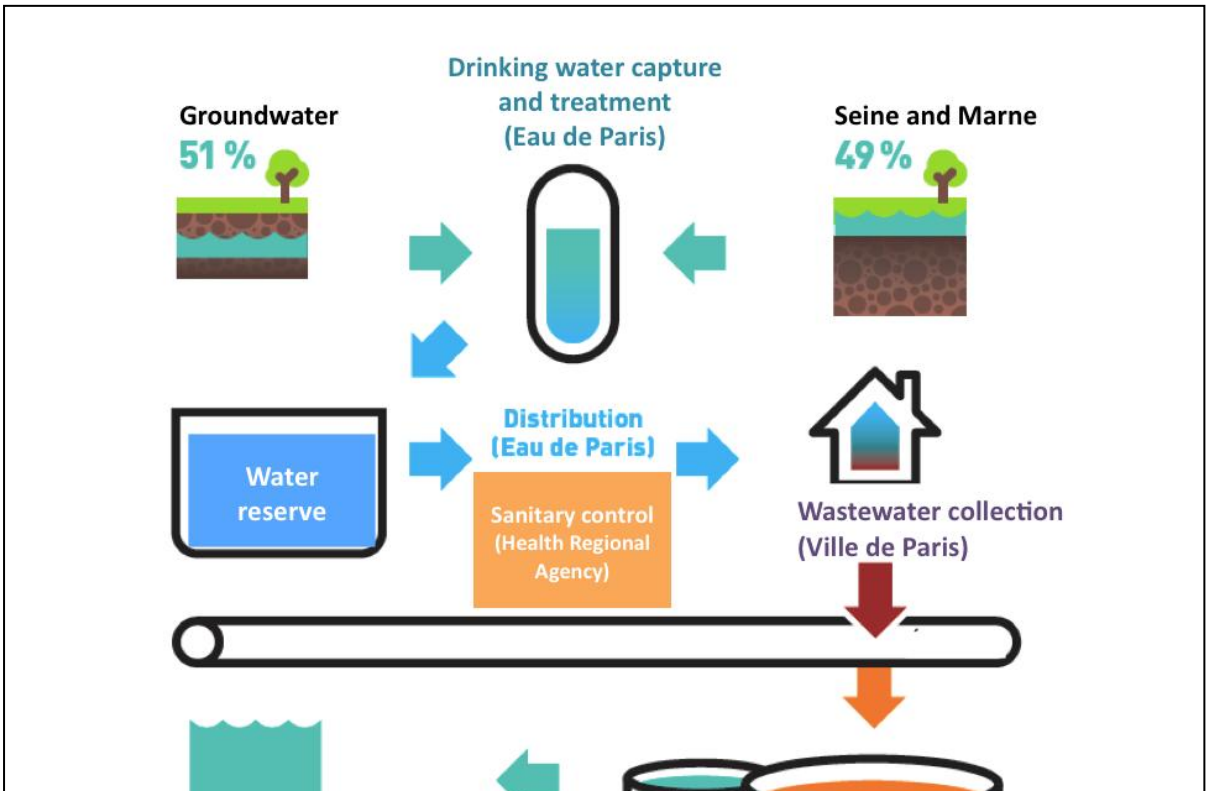


Figure 6: Water and sanitation organizational system in Paris.
Source: adapted from Eau de Paris annual report

As previously mentioned when describing the French water policy, two other actors are significant for the Parisian water and sanitation organization. First, the Seine-Normandie Water Agency (Agence de l'Eau Seine-Normandie), a public institution attached to the Ministry of Ecology, Sustainable Development and Energy (*Ministère de l'écologie, du développement durable et de l'énergie*), finances water resources protection measures. It collects specific taxes that are paid by water users in order to finance anti-pollution actions. These taxes have to be included when calculating the global price of water. The Basin Committee allows participative decisions about water policy between different users (farmer representatives, industrials etc.), local and regional authorities, and the government. Both organizations do not work only for the city of Paris, but at the Basin level. As a reminder, the basin level is said to be the optimal scale to deal with water issues.

3.1.2.2 São Paulo

As previously mentioned, Brazil is far from being a water stressed country, and owns around 12% of the world freshwater reserves. However, these reserves are not equally distributed in the country. The Amazon River basin represents almost 50% of the country's reserves, for 4% of its population. The main megacities of the East Coast such as Rio de Janeiro or São Paulo represent 80% of the Brazilian population! Our analysis will focus on the city of São Paulo, in which live 11 millions of people (World Bank, 2014). It has also to be taken into consideration for the rest of the dissertation that the Greater São Paulo ("Grande São Paulo") or Metropolitan Region São Paulo – MRSP (*Região Metropolitana de São Paulo* - RMSP) is

an area regrouping 39 municipalities of the State of São Paulo and representing around 20 millions of inhabitants. The city is the main financial, commercial and industrial capital of Latin America. The main interesting characteristic of the Metropolitan Region of São Paulo concerning water management is therefore the size of its population and its annual expansion that leads to water scarcity. As showed in the Appendix 5, some parts of the MRSP face medium to high water stress.

Another major challenge related to urbanization is pollution, for instance because drinking water reservoirs are next to slums.
According to the World Bank (2012), three major sources of drinking water supply the MRSP, approximately 70% of the water consumed by the population: the Cantareira, Guarapiranga and Alto Tietê systems (supplying respectively 8.1 millions, 3.7 millions and 3,7 millions of people).

Three main actors deal with water management in the MRSP: the state government, 39 municipal governments and the state water and sanitation company SABESP. In 1973, the Brazilian government decided to create the SABESP to implement its Sanitation National Plan (*Plano Nacional de Saneamento* – PLANASA). This program realized several investments, aiming at developing State companies for water and sewage ("companhias estaduais de água e esgotos"). SABESP has become one of the largest water companies in the world, listed on the New York Stock Exchange since 2002: it is therefore a mixed company.
In the MRSP, three types of management coexist for the water and sanitation services (Britto & Formiga-Johnsson, 2009):

- The municipality chooses to delegate water and sanitation management to the State company SABESP.
- The municipality manages itself water and sanitation services: 6 municipalities have chosen this option (Santo André, São Caetano do Sul, Guarulhos, Mogi das Cruzes, Mauá and Diadema). These municipalities are not responsible for water production; they receive treated bulk water from SABESP and are in charge of its distribution and billing.
- The municipality delegates water and sanitation management to a private company: an option chosen by the municipality of Cajamar.

As previously mentioned, a basin committee bringing together all the previous actors is also responsible for the management of the Alto Tietê basin, that supplies almost half of the water of the area.

A focus will be made on the situation of the city of São Paulo, and therefore on the role of the SABESP. It is necessary to understand that contrary to the Parisian case, SABESP is in charge of all phases of basic water and sanitation services, from water abstraction to treatment and reuse of sewage. As a reminder, Eau de Paris is not in charge of wastewater collection or treatment and reuse.

3.2 Crisis versus success?

3.2.1 Paris: a successful remunicipalization

> *"Water markets will become gold. Water is the petroleum of the 21st century. Water is a common good. We have to: 1. Preserve it. 2. Keep costs down in order to protect low-income families. Opting for public service means not subjecting a common good, a universal good to the logic of profit."*
>
> A Parisian Councilor and Board Member of Eau de Paris,
> L'eau à Paris, retour vers le public, Sinaï, A. (2014), p.99

3.2.1.1. History

In 1984, the City Council of Paris (Mairie de Paris) decided to contract two private companies to distribute water in Paris. Compagnie des Eaux de Paris, subsidiary of Veolia group was chosen for the right bank of the Seine (Rive Droite) and Eau et Force Parisienne des Eaux, subsidiary of the group Suez for the left bank (Rive Gauche). Both were in charge of several parts of the water and sanitation services: networks maintenance, billing and recovery. The type of contract chosen is revenue leasing (affermage) for a period of 25 years. In 1987, the Mairie de Paris decided to create a semipublic company (Société d'Economie Mixte) for the water production and transportation: the Paris Water Management limited

company (la Société Anonyme de Gestion des Eaux de Paris). Its main shareholders are: the City Council of Paris (70%), la Lyonnaise des Eaux (Suez, 14%), la Compagnie Générale des Eaux (Veolia, 14%). The company's main missions were water production and transportation, but also supervision and monitoring of both distributors.

In November 2008, the Council of Paris (Conseil de Paris) decided to remunicipalize water services, meaning that water and sanitation management are back under public control. The Council therefore created a public institution of industrial and commercial nature (Etablissement public à caractère industriel et commercial). This new institution began in May 2009 to take care of water production and transport. In January 2010, Eau de Paris became the municipal institution in charge of the water public service in Paris, also ensuring water distribution.

As previously developed in the Literature Review, the number of remunicipalizations examples has increased a lot in the past decades. However, the Parisian situation is a notable exception in the world of remunicipalizations. France is the country that gave birth to the main water multinational (Veolia and Suez) by giving a large space to the private initiative in the water and sanitation sector. The Parisian case is therefore a example of remunicipalization that is highly symbolic: the economic weight of the two companies and their strong lobbying could have been a major obstacle to the Parisian remunicipalization and made it very specific. Anne le Strat compared this remunicipalization to another famous part of the Parisian history: the set of reforms concerning water and sanitation services initiated by the Prefect Haussmann and the engineer Belgrand in the 19th century (Sinaï, 2014). According to her, both have tried to develop a public service that had the following characteristics:

- Not becoming slave of private interests
- With a long-term vision of the patrimony
- Caring specifically for water quality

These characteristics are the same objectives that have been chosen for the Parisian remunicipalization.

3.2.1.2. Reasons for remunicipalization

Remunicipalization could put an end to the lack of efficiency induced by the existence of several operators. First, having several operators can lead to an overlapping of functional tasks and responsibilities. Remunicipalization, by reducing the number of existing operators, would lead to an increased synergy and mutualisation between the different activities: water production, monitoring of water quality or distribution. A highest technical efficiency should therefore be noticed. Lastly, the consumer is often confused about the whole system, and cannot know easily who is responsible for the water it consumes. As Anne le Strat explained: "*At that time, a drop of water can move to another operator, and thus to another person in charge, almost ten times between the factory where it is produced and the tap of the final consumer. This does not allow the consumer to identify who takes the responsibility for the service*." (Sinaï, 2014, p.17). Water remunicipalization would lead to a better traceability of water from water withdraw and production until water distribution in consumers' taps.

The overlapping of functional tasks previously mentioned leads to increased costs. Indeed, this situation limits economies of scale made possible by a harmonization of activities from production to distribution on the whole chain. Moreover, costs in the case of private management are said to be greater than in the case of public management. In the case of private management, costs do not include only operating and investing costs, but also the cost of dividends paid to private shareholders. A private company needs shareholders to exist and grow: this allows companies to raise a large amount of capital that can therefore be used to develop upcoming investments. However, the remuneration required by shareholders is higher than the cost of public money. In the case of public management, this would not represent a cost; the profit that would not be paid to shareholders would be reinvested in the company itself.

It has also been noticed that in the case of water multinational companies, profits generated through the water and sanitation activities were transferred to financially balance other parts or activities of the group. Also, a crucial lack of competition for subcontracting has been criticized: the subcontracting system mainly consisted in contracts with companies' own subsidiaries. In 2001, before the decision of a remunicipalization, the City Council of Paris decided to launch an audit to analyze the commercial management of the water service in Paris and concluded that the performances at that time did not justify the high costs incurred.

According to a report from the audit firm Service Public 2000, costs if economically justified would be 25 to 30% inferior to the costs presented by both private companies. National and international comparisons also showed that the cost of the commercial service in Paris was higher than in other places in France (30€ on average) or in England (55€ on average) (Sinaï, 2014).

Another criticism made to the private water management in Paris concerned the democracy and the governance. It was said to be very difficult for the representatives to monitor and control operational activities. As a reminder, one of the main missions of the Société Anonyme de Gestion des Eaux de Paris was to control both distributors' activities. However, the supervision part of both distributors by the Société Anonyme de Gestion des Eaux de Paris (SAGEP) was said to be inefficient since both were also shareholders of the company. Users were not associated with water management in Paris. The whole situation led to a clear lack of transparency in the Parisian water and sanitation management and difficulties to identify persons in charge.

As mentioned previously, prices in the case of private water management were said to be higher than what they could or should be. Increased prices highlight a last crucial issue: access to water for the low-income consumers. This category of Parisians is therefore more likely to be excluded or prevented from consuming water. In France, giving all Parisians an equal access to water is an critical mission of water management, since it deals with a concept very dear to the French population: French-style public services ("le service public à la française").

Public services *à la française*

According to Brillet (2004), public services *à la française* is a complex notion that includes several categories of services that are different in nature, from traditional sovereign functions of the State (defense, police, justice) or providential functions of the State (education, public health, social security) to industrial and commercial networks (telecommunications, gas and electricity, water and sanitation or postal services). In the French popular imagination, public services are a great factor strengthening social cohesion. Three main principles traditionally define the notion of public services: continuity of service, equality and adaptability. The French Constitutional Council has declared the principle of continuity as a constitutional principle in 1979 and means that it is necessary to meet the needs and to be available

continuously, without stopping. The second principle of equality comes from the application of the general principle of equality proclaimed by the French Declaration of the Rights of Man and of the Citizen of 1789. Prices have to be adapted to enforce this principle, and all consumers have to be treated equally. Lastly, the principle of adaptability or mutability means that public services have to adapt to the society's evolutions: they have to adapt to the consumers' needs or to technical evolutions.

During the process of remunicipalization, several interviews with employees have shown their attachment to this notion of public service (Sinaï, 2014). The following fundamental values are related to this concept and have been adapted to the water and sanitation services:

- Importance of the general interest ("l'intérêt general"): to be in charge of the common good and of the preservation of the water resource for today and for the future, in the name of the population.
- Responsibility for water quality
- Continuity of service and reliability
- Accessibility for everyone to freshwater
- Equal quality of water for everyone: whatever the provenance, whatever the place in the city
- A "fair" price: that is to say including management and operational costs, solidarity with other territories, research and development costs, but accessible to the largest number of consumers.

Private water management have been described as lacking of transparency, having a bad governance process and offering unfair or too high prices: for all these reasons, remunicipalization has been envisaged as a way to better deal with the missions associated to public services.

3.2.1.3 Sharing the fruits of the remunicipalization success

As previously mentioned, the remunicipalization of water and sanitation services has led to a greater efficiency and productivity. Eau de Paris is in good financial health: from 2009 to 2013, the company's financial result allows it to finance its investment plan entirely, without

borrowing being necessary. The next issue has been to decide how to redistribute and to reinvest these profits. A part of it has been used to increase cohesion within the company Eau de Paris, and to promote a better integration of all employees, but we won't focus on it in this dissertation since it seems irrelevant. Instead, our attention will focus on actions that help achieving objectives that have been identified in the Literature Review as crucial for water management: the long-term preservation of the resource and equal access for everyone to water consumption and sanitation. It should tough be reminded that the very financial situation is probably temporary. Indeed, the actual context combines increasing production costs and declining revenues, since consumption is structurally decreasing since more than 15 years: this is called the price scissors.

Price reduction and social actions

In March 2011, Eau de Paris has decided a water price reduction of 8%. As a reminder, this reduction does not concern the global price paid by consumers for water. The water price is divided in three main parts, as shown in the following figure: production and distribution, sanitation and other specific taxes. The reduction only concerns the part managed by Eau de Paris, the production and distribution part. This measure in favor of consumers has had positive social consequences related to the objective of giving access to water to the highest number of consumers. Other social measures have been implemented to give access to the low-income population. For instance, Eau de Paris finances the installation of water-saving devices in social housing or has multiplied the number of public fountains and toilets for Parisian homeless.

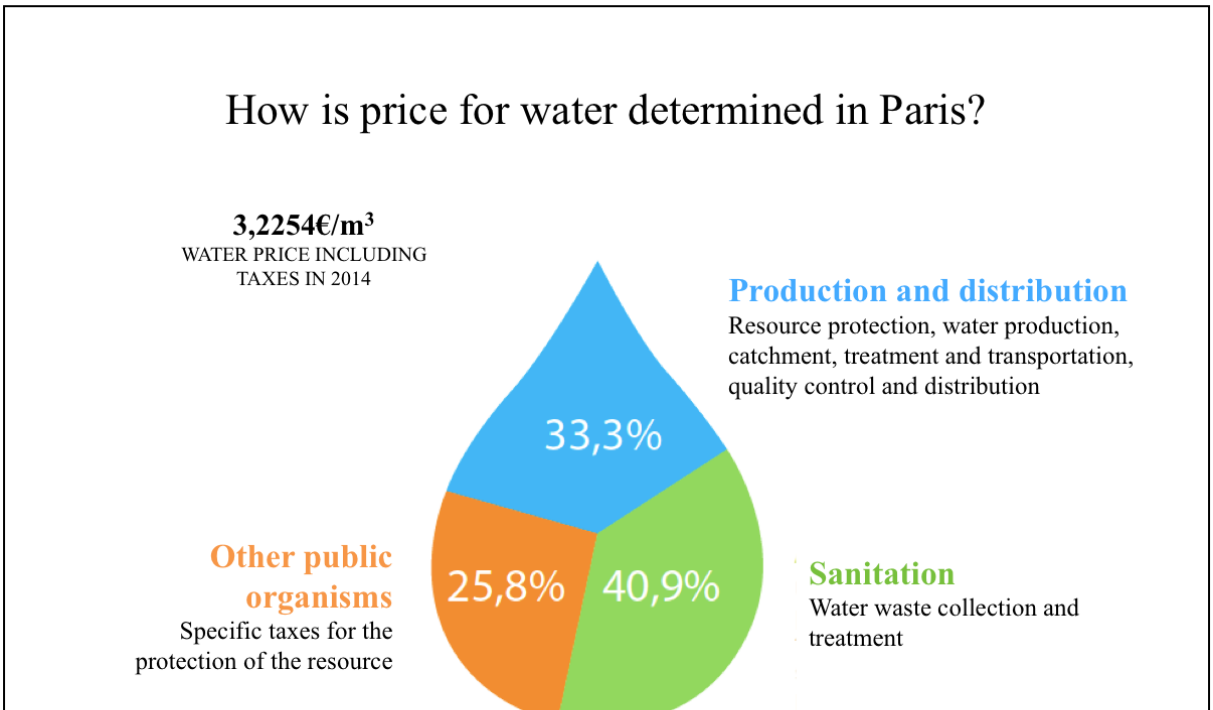


Figure n°7: water price determination in Paris. Source: Sinaï, 2014.

However, water pricing still represents an issue for Eau de Paris because the price paid by consumers is not considered as fair. Indeed, price for water is identical for all consumers and all uses. Water price could vary, either according to a progressive pricing, or according to a differentiated pricing. In the case of a progressive pricing, the cost would be higher when the level of consumption increases. In the case of a differentiated pricing, prices could be different according to uses: for instance, prices could be different for domestic uses and professional ones. However, the implementation of these new ideas of pricing is complex since water subscription is often collective in Paris: it is for instance therefore difficult to distinguish the consumption of each family!

Long-term vision

Before the remunicipalization, works on infrastructures were realized by the SAGEP. The two private distributors were responsible for the Parisian network maintenance and had to invest to realize works in order to guarantee that the network would stay in optimal working order in the future. As previously mentioned, expected and announced works have not been entirely realized. Indeed, a certain amount of money is always kept in the books for future works ("les garanties pour renouvellement"), and both distributors did not spend the entire amount for this purpose. On average, they both invested around 11M€ per year. This lack of investment occurring before the remunicipalization has been highly criticized and investment has become a major objective for the future remunicipalization. In 2011, Eau de Paris has elaborated an investment program for the next 15 years. 70M€ every year on average are dedicated to the modernization of Parisian water network. The objective of the City of Paris through the company Eau de Paris is to guarantee a level of investment adapted to a long-term management of the resource and of the Parisian heritage, including the preservation and the modernization of installations built in the 19th century! (Sinaï, 2014).

Another interesting example is the attention paid to the non-drinking water network, as a symbol of the research of alternative resources and developments for the water and sanitation sector. Paris is a specific city: since the 19th century and the construction by the engineer Eugène Belgrand of the sewerage system, Paris owns a double network providing water differing in quality: drinking water for human consumption, and non-drinking water, withdrawn from the Seine River or from l'Ourcq and used for public watering and washing. In March 2012, Eau de Paris decided to launch an investment program of more than 10M€ to adjust this network of non-drinking water and prepare it for changes in uses. Indeed, the Parisian Urbanism Workshop (l'Atelier parisien d'urbanisme), in cooperation with Eau de Paris, determined new potential uses of non-drinking water, from the maintenance of industrial areas like the Parc des Expositions in Versailles, to the washing of public streets or public transportation. This could allow consumers to do savings since the cost of non-drinking water is lower, but could also and most importantly save a large amount of drinking water. Before the remunicipalization, almost nobody was paying attention to non-drinking water since concessions contracts did not mention it. This example of investment therefore highlights the importance of developing a long-term vision for water and sanitation management, such as envisaging other uses for water or innovating to guarantee water savings.

3.2.2 Water crisis in São Paulo

3.2.2.1 History of a water crisis

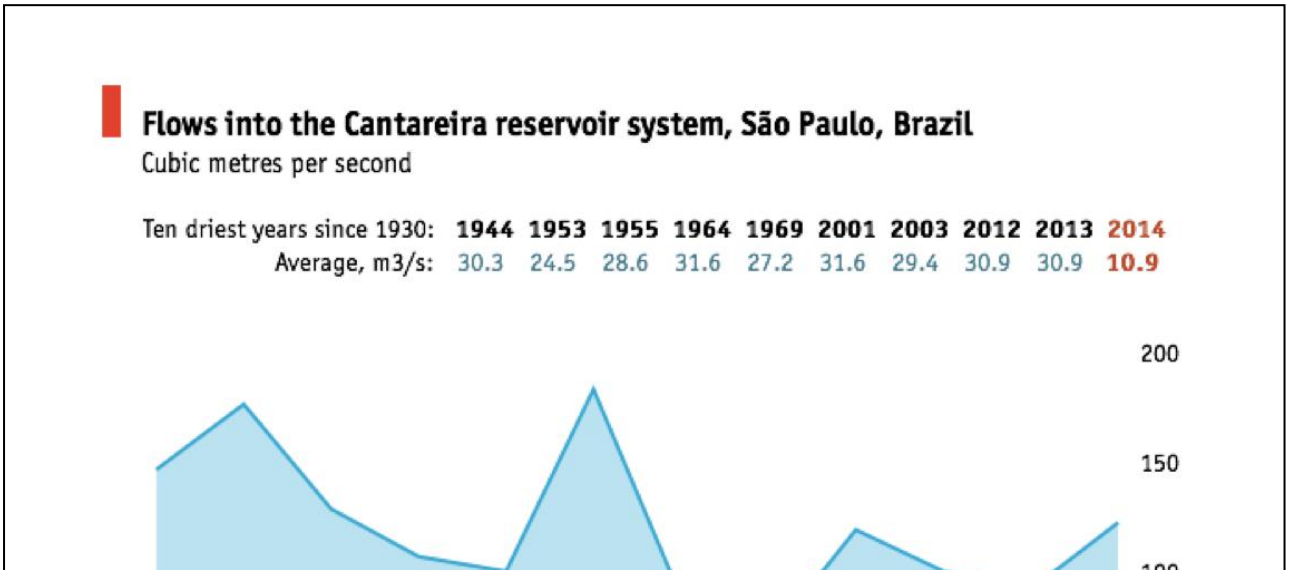


Figure 8: Flows into the Cantareira reservoir system, São Paulo, Brazil.
Source: The Economist, 2015

The previous figure is pretty clear: the drought that occurred in São Paulo in 2014 was a unprecedented natural disaster. The average precipitations in 2014 have been almost three times less important than in 2013! As Gesner de Oliveira explained, if this natural disaster had been an earthquake, it would have been rated 10 on the Richter magnitude scale. A direct consequence of this exceptional drought has been that levels in water reservoirs have dramatically dropped.

At the beginning of 2014, the National Water Agency decided to reduce the maximum flow of water catchment from March 2014. To deal with it, the Sabesp chose to use water from Guarapiranga and Alto Tietê systems to supply consumers who were before supplied by the system Cantareira. Apart from that, the Sabesp announced in February a first program of discounts, an incentive for consumers to reduce their water consumption. Consumers supplied by the Cantareira system and reducing their consumption of more than 20% in comparison to the average of the 12 previous months of 2013 would get a discount of 30% on their bill, from February to September. At the end of March 2014, this program of water discount was extended to all the municipalities of the MRSP that are supplied by the Sabesp. Other alternatives have been looked for to replace the water supplied by the Cantateira system and show the impact of the crisis. In March 2014, works were initiated by the Sabesp to catch the so-called "dead volume" ("*volumo morto*"), a 300 billions liters water reserve able to supply the MRSP during four months. Geraldo Alckmin, São Paulo's governor, announced in April that water from the Rio Grande system would be used to supply the consumers of the Cantareira system.

In May 2014, the Cantareira reservoir reached its lowest level since 1974, its creation year: 8.2% of its capacity. It was then decided that consumers from the Great São Paulo would have to pay a fine of 30% of the bill if their consumption is higher than the average of the 12 last months. In October, the level of the reservoirs reached 2.9% of its capacity, including the first part of the technical reserve.

3.2.2.2. Has the reaction to the crisis been adapted to the seriousness of the situation?

As previously developed, the first set of measures developed in the water crisis has concerned the demand for water. By offering discounts of water bills, the Sabesp tried to incentive consumers to reduce their water consumptions. The reduction of the demand was not sufficient to face the crisis, and some experts argued that rationing was an obligatory decision.

São Paulo's governor has had to manage the crisis and had to decide whether water rationing would happen or other measures would be taken. His decisions have been highly criticized because they appeared as mainly driven by political reasons. In the beginning of April 2014, the political authorities decided that they would have no rationing. Indeed, this measure could have had real consequences on the incoming elections and could have hindered the governor's reelection. Instead, it was decided among other things that the bonus of 30% on the water bill for consumers reducing their consumption of more than 20% would be maintained or that the works to catch the water "dead volume" would be accelerated to be used from June until October, beginning of the raining period. The plan decided at this time was supposed to end in October, because the raining season would end the water shortage issue. The political context is extremely interesting: this plan of actions without any rationing aimed at guaranteeing the World Cup and the incoming election of October.

Rationing is a highly difficult political decision, all the more in an electoral context. Since the beginning of the crisis, many consumers have told that they had faced interruptions in water supplies, mostly in the early morning or during the night. This situation has always been denied by Geraldo Alckmin, until January 2015 when the governor which had already been reelected admitted for the first time that São Paulo was using water rationing: a "water

restriction" ("uma restrição hídrica") to use his own words. The Sabesp then admitted more clearly that a reduction in water pressure was occurring.

Gesner de Oliveira has described the reactions of the governor and of the Sabesp as a huge lack of communication. The management of the crisis and the measures taken can be criticized and have probably not been the most efficient ones. However, measures have truly been taken, such as using the Guarapiranga and Tietê reservoirs or reducing the water pressure in the network to better control the supply. The miscommunication of the authorities and the Sabesp have made it difficult for them to highlight these measures, since they have above all tried to minimize the reality and the impact of the water crisis during an election year. This last aspect clearly highlights the importance and the role of politics in the Brazilian water management and the negative impacts that this can have in terms of transparency, without talking about potential corruption affairs that are obviously difficult to describe.

3.2.2.3 Explanations of the Paulistan water crisis and lessons learned

"We always had a culture of abundance. Because Brazil has 12% of the world water resources, we waste a lot. Apart from that, there is an ongoing crisis. The quantity of rain hugely decreased. Now it is necessary to reformulate everything: decreasing a lot the demand for water, improving governance, investing in sanitation and reuse programs, one of Brazil's major issue."

José Tundisi, 2015, Epoca

<u>Natural phenomenon or lack of planning?</u>

As previously developed, the water crisis is firstly due to a natural phenomenon – a severe drought - that several simultaneous situations explain. First, water supply varies hugely in Brazil: two types of variability are present, inter-annual variability and seasonal variability. Inter-annual variability is the variation of water supply from a year to the other. Seasonal variability can be defined as the variability of water supply among months of the year (Gassert et al., 2013). A high variability means that important amounts of freshwater must be stored in reservoirs when precipitations being huge, in order to sustain consumers during dry periods. Experts explain that the inter-annual variability is increasing in Brazil and will make droughts more likely on the long-term.

According to the World Resource Institute, a main explanation for the increase in inter-annual variability is deforestation. The scientist Antonio Nobre explained in 2009 that deforestation in Amazonia could "*interfere with the forest's function as a giant water pump".* Indeed, forests function as "flying rivers" (Maddocks et al., 2014), bringing moisture into the air that will then circulate in other parts of Brazil, irrigating central and southern regions for instance. Brazil's National Institute for Space Research (INPE)'s data showed that in January and February 2014, these "flying rivers" failed to go to the South. These scientific affirmations and theories are new and need further research.

Some experts argue that reports had warned the State of São Paulo against the risks related to potential severe droughts. According to Ribeiro (2015), Tundisi claimed that the Intergovernmental Panel about Climate Changes ("Painel Intergovernamental sobre Mudanças Climáticas) had already warned the authorities in 2001 about drought. Tundisi defends the idea that the authorities had more focused on water quality, and missed the issue of planning. Knowing if the State and the leaders of Sabesp could have or had predicted the disaster and especially its size is a subject of disagreement among experts. However, the previous scientific affirmations show that the Brazilian tendency towards drought is a long-term one, and that severe droughts are likely to happen more often in São Paulo. The lack of planning that occurred before the crisis cannot be excused in the future.

Governance issues

The lack of planning has been followed by a governance problem. A group of Brazilian professors reunited by the Institute of Advanced Studies of the University of São Paulo in 2014 highlighted the organization of the water management and the Brazilian legal system as a dysfunction having led to the water shortage at a national level. The Federal Constitution claims that the federal government, the states and the municipalities should take care of water management. But in reality, the little dialogue that exists between them does not lead to an optimal situation, but to a fragmented management. As Professor Ribeiro mentioned (Meckien, 2014), the participation of the population to decisions is very low, and at the same time the number of institutions managing water is excessively high. "*We have more institutions dealing with water than water itself. There are too many institutions for very little water. And civil society is under-represented within them"* (Ribeiro, 2014).

3.3. Lessons learned from both cases: crucial importance of governance

3.3.1. Regulation and monitoring

Both case studies highlight that two characteristics have to be reunited to have a good governance for this type of management. Regulation and monitoring are to be developed by the competent authorities and are a necessary condition for an optimal water and sanitation management model.

The success of the Parisian remunicipalization cannot be attributed to the public characteristic of the water management itself: it is not because water and sanitation services are public that they are better managed since 2010. The main teaching of the failure of both private distributors (Suez and Veolia) in the water and sanitation services management is that the existing monitoring tools were inefficient and led to excesses. As Donati explained about both distributors, the problem was not the existence of profits: the main problem was that these profits were "bad" profits, excessive ones, made possible by the huge return on investments of water and sanitation services. Control mechanisms of both private distributors' practices and activities were not efficient enough or non-existent; the authorities in charge of guaranteeing water and sanitation services of superior quality were not able to control the relevance of the choices that were made in terms of investments for instance. This situation led to a clear lack of transparency: managing or regulating without monitoring cannot lead to an efficient situation. In the case of both distributors, budgetary excesses have been noticed, just as a financial opaqueness.

For the remunicipalization, monitoring has been claimed as a main objective. For this purpose, an Objectives Contract ("le contrat d'objectifs") has been introduced. This contract between the City Council of Paris and the company Eau de Paris lasts 5 years and aims at creating a model of public management that would be innovative, transparent and efficient. It constitutes a monitoring tool for the municipal authorities (Property and Water Branch and Finance Branch – Direction de la Propreté et de l'Eau et Direction des Finances). It is regularly audited by the technical services and annually evaluated in order to be presented to

the Council of Paris (Conseil de Paris) and the Water Parisian Observatory (l'Observatoire Parisien de l'Eau). Indicators and data are to be produced and published monthly, quarterly or annually. Apart from that, data concerning the relationship with users, the distribution activity or the state of progress of the investment program have to be published quarterly. All the financial and social data are regularly presented to the Board of Directors, but also to the Council of Paris and to the Parisian Water Observatory: all these procedures are examples of measures that lead to a greater transparency, and thus to a better monitoring of the company Eau de Paris in the Parisian example. This in turn facilitates a more efficient regulation of water and sanitation services.

A greater transparency has been achieved in the case of the Sabesp with the opening up of the company's capital. Indeed, a first part of its stakes has been introduced on the São Paulo stock exchange (Bovespa) in 1996. Then, a listing at the New York Stock Exchange (NYSE) has been decided in 2002-2004. According to Oliveira, this brought more transparency because being listed requires the publication of regular reports. Indeed, investors are strict and give a specific attention to financial data and objectives: this has led to higher financial requirements for the Sabesp.

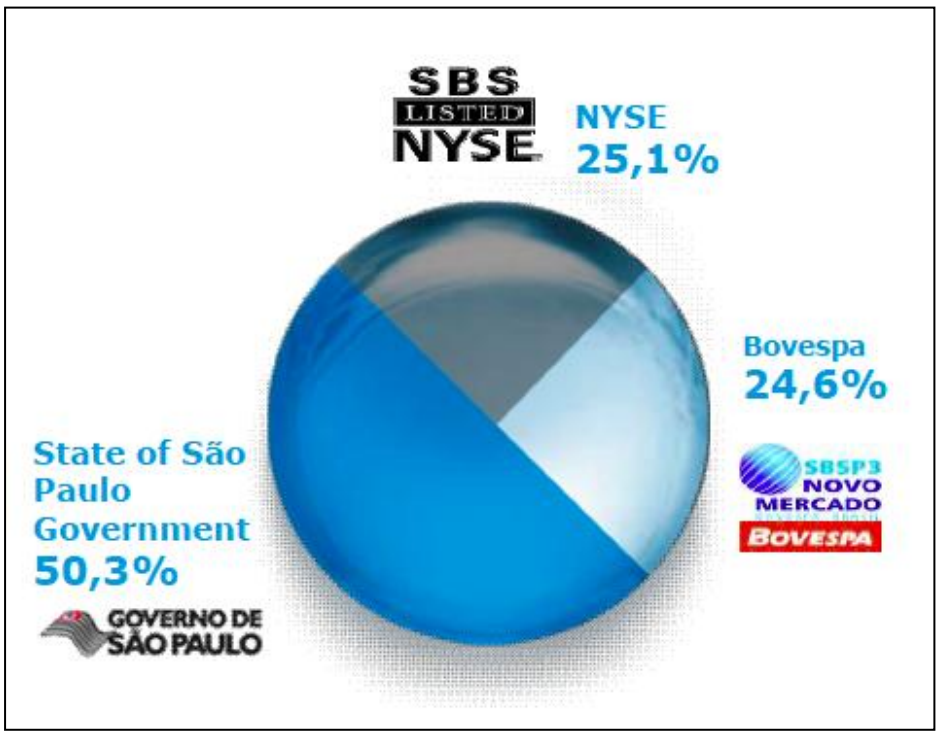


Figure N°9: Sabesp's capital composition. Source: Oliveira, G. (2008)

Conflict of interests can also hinder good governance processes. As mentioned in a precedent paragraph, the semipublic company called Société Anonyme de Gestion des Eaux de Paris was responsible in particular for the supervision of both distributors. But at the same time, both distributors were shareholders of the company! It is therefore pretty clear that supervision and monitoring were not entirely the fruit of impartial decisions.

The example of São Paulo faces the same issue, which has been clearly showed through the example of the water crisis. As explained by Felipe Graziano, the organizational configuration of water management in São Paulo is the following: a program contract ("contrato de programa") between the state of São Paulo and the Sabesp for a associated management ("gestão associada"). The state is therefore owner of the semi-public company Sabesp, and at the same time responsible for its supervision and monitoring. The political interests can easily interfere with the management and the supervision of the company. For instance, recognizing that the measures taken by the Sabesp were not sufficient relatively to the seriousness of the situation was complicated for the state governor because the state being owner of the company, it would have also been responsible for the company's inefficiency. The governor was at the same time preparing the coming elections and was candidate for his reelection – political and electoral interests have prevented authorities from taking the most optimal decisions for water management.

3.3.2 A more democratic governance model

> "*The user must become one of the players of the water service. For a long time, it has been an interlocutor not really taken into consideration by the administration, or even by the staff and the service unions. He is yet the only financial contributor to the service through his bill*."
>
> Anne Le Strat, (Sinaï, 2014).

Elinor Ostrom received the Nobel Prize in Economic Sciences in 2009 for her book called *Governing the Commons – the Evolution of Institutions for Collective Action*. In this book, she developed a theory to manage alternatively common goods, without choosing between a market and a strong State regulation. She studied the use of common goods in different countries, from the irrigation systems in the Philippines to the Californian aquifers and highlighted local auto organizational strategies, using cooperation and exchanges of information, which allowed the collaborative use of common resources without depleting them. Ostrom does not deny the role that the market and private companies or the State intervention can have to manage natural resources, but she demonstrates that creating specific institutions as a mean of collective action for the use of common goods can be an alternative but efficient model.

Elinor Ostrom has defined the eight following governance principles:

- Clearly defined frontiers
- The matching between rules of access and use of the resource on one side and local circumstances
- Collective choices allowing the participation of the majority of the users to the decision-making process
- An efficient and continuous evaluation by users' representatives
- Gradual sanctions
- Conflict resolution mechanisms that are low-cost and easily accessible
- The recognition of these organization models by superior structures (for instance governments)
- For common goods on a large scale: an organization as the Russian dolls one, embedded until the local level

In the following paragraph, we will focus specifically on the third governance principle defined by Ostrom: collective choices. It seems interesting to connect Ostrom's principles with the Parisian case. Paris is not an example of auto organizational strategy for water management. However, the city has tried to develop some of the principles developed by Ostrom. Since the Parisian remunicipalization, the public company responsible for water and sanitation management is answerable to users and to local authorities, which organize the

water public service. The Board of Directors includes several representatives of the civil society, from associations' members to users' representatives.

Another initiative to put users at the center of water management has been the creation by the City Council of Paris in 2006 of the Parisian Water Observatory. This extra-municipal commission is entirely dedicated to water and sanitation issues. It allows citizens to get information or contribute to the debate. The creation of the Observatory is anterior to the remunicipalization process but has been strengthened since the remunicipalization. It has in particular been consulted concerning the remunicipalization process itself, the reduction of water prices or the implementation of the right to water in the city. This last example illustrates the fourth principle developed by Ostrom: en efficient and continuous evaluation by users' representatives.

According to Donati, the remunicipalization's success is mainly due to the form of governance chosen that has led to a good governance. Unifying projects, existence of users' associations, monitoring and regulation tools to improve transparency: the more numerous and varioud are the participants to the decision-making process and monitoring of water management, and above all the more adapted to the local level and to the requirements of the users, the better the governance would be.

Conclusion

"Our average water loss is 37%. If the country were a bakery, it would mean that for ten breads produced, 3.7 would be thrown away. It is a lot, especially for such a vital market."

Oliveira by Barros, Veja, 2014

A good water resource management model needs to overpass a simplistic public/ private debate. The criteria described in this dissertation should give hope for private actors. The example of remunicipalization in Paris was not driven by factors of failure inherent to the private sector, and readjustments concerning investments or governance for instance would

greatly improve efficiency of private actors in the water and sanitation sector. On the other hand, the Paulistan water crisis clearly shows governance issues in the case of São Paulo that is also publicly managed.

More generally speaking, both examples are interesting to determine criteria of success for water management models. Since water is a very specific and scarce good, highlighting the importance of the long-term is necessary. Environmental consequences are often not taken into consideration since measuring them is very difficult. However, public opinion and governments become more and more aware of this reality. The way water is managed today can have great impacts on the future, which will be environmentally and socially dramatic if not taken into account.

What should be a right price for water, and how much should final consumers pay? Should competition and private actors interfere in water resource management? Management practices have to evolve in order to achieve good governance for water resources, and to be able to answer to these crucial questions. The three main following points would guarantee the establishment of a good water resource management model.

- Long-term objectives. Long-term objectives have to be fixed in order to ensure water resources for the coming years, on an environmental but also social point of view. Performance would therefore be described with indicators such as losses or reuse rates, that do not often appear as essential for countries with lots of water reserves such as Brazil, but that could become a crucial issue in the future for such a scarce resource. For instance, replacement of leaking pipes should be preferred to a simple repair, even if costs appear to be lowest on the short-term for a simple repair. (What has not always chosen by companies, especially before the remunicipalization in Paris.)
- The importance of innovations. In order to efficiently deal with the scarcity of water, water management should emphasize on technology and innovations, for instance through water recycling or reuse. Thanks to this, in Israël, it can be said that there is no water, but there is no lack of water! (Oliveira by Ribeiro, 2014).
- A crucial need for investments. In order to achieve long-term objectives and to finance innovations for water management, investments are crucial and necessary. A

point forgotten by private actors in Paris and that leaded to remunicipalization, and that could also lead to many water crisis in the future if not taken into account by public actors.

Lastly, it should be underlined the importance of governments and global organizations to ensure a protection of the resource. Private companies can deal with water management when public institutions are strong enough to ensure a good governance, control, and objectives necessary to the protection of a resource that, once more, is not a economic good like any other one.

More globally, water management should not only be viewed on the supply side (diversifying the supply side through innovations such as desalinization or water for reuse for instance), but also on the demand side (incentives in industry, agriculture or energy for instance to deal with better water uses). A more global social participation is necessary: how water operators can persuade people to change their habits? Information and education are necessary for successful strategies as it has been the case in Paris, which could be an example for Sao Paulo.

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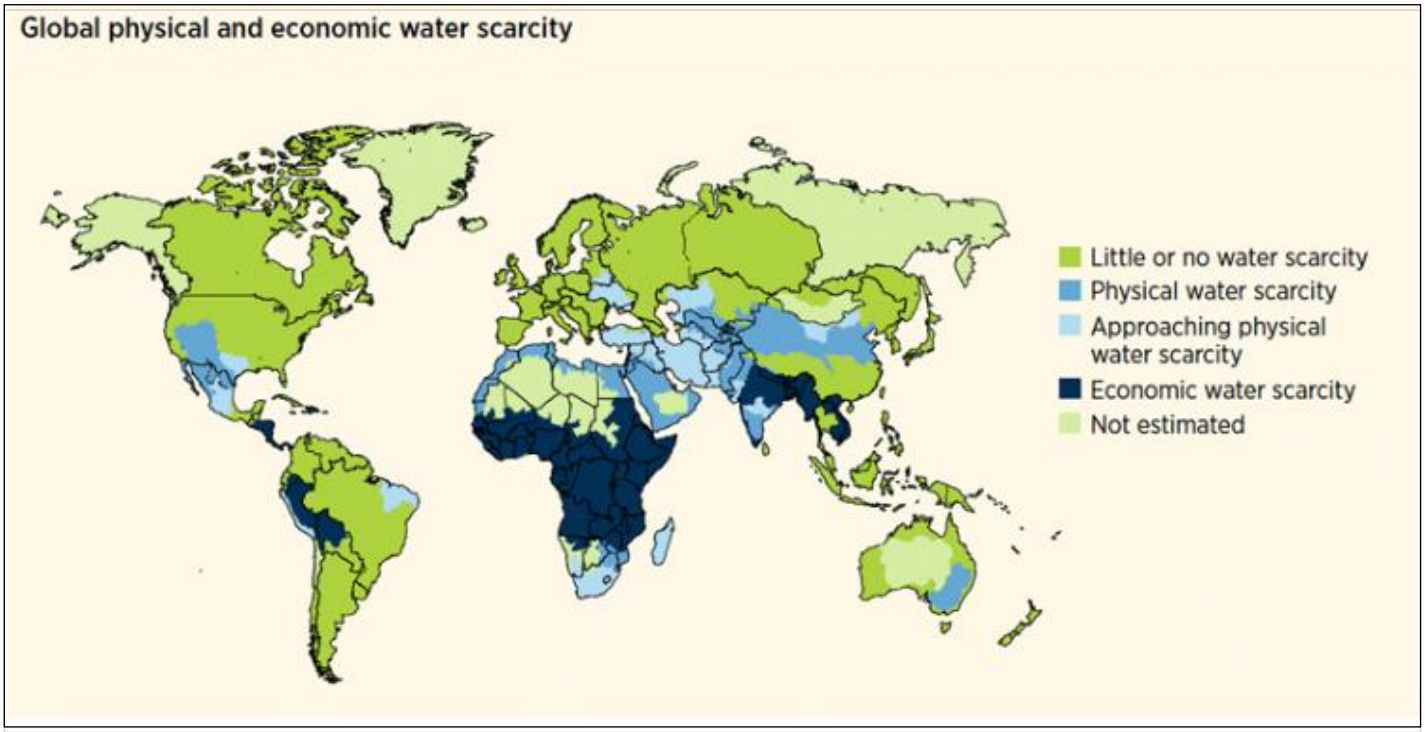
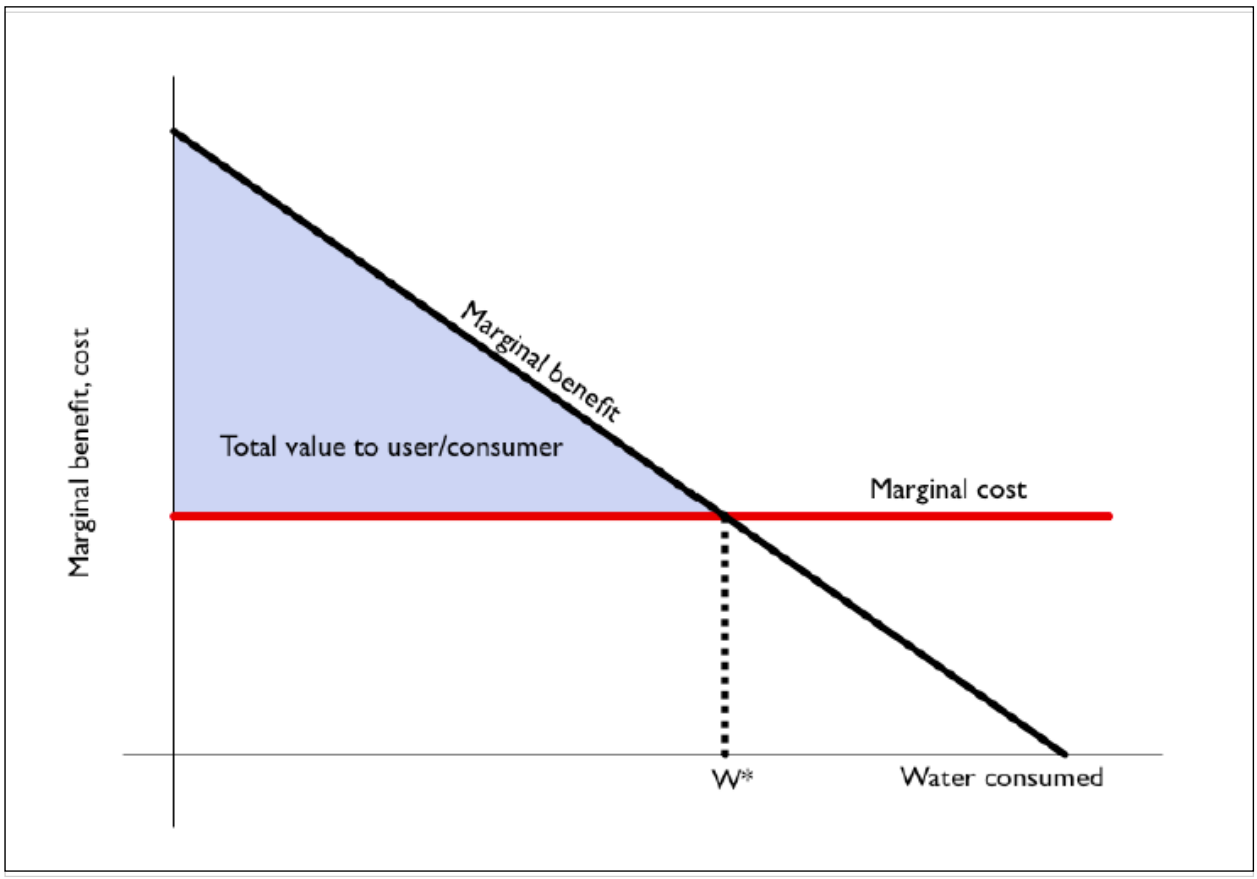
Appendix

Appendix 1: Global physical and economic water scarcity



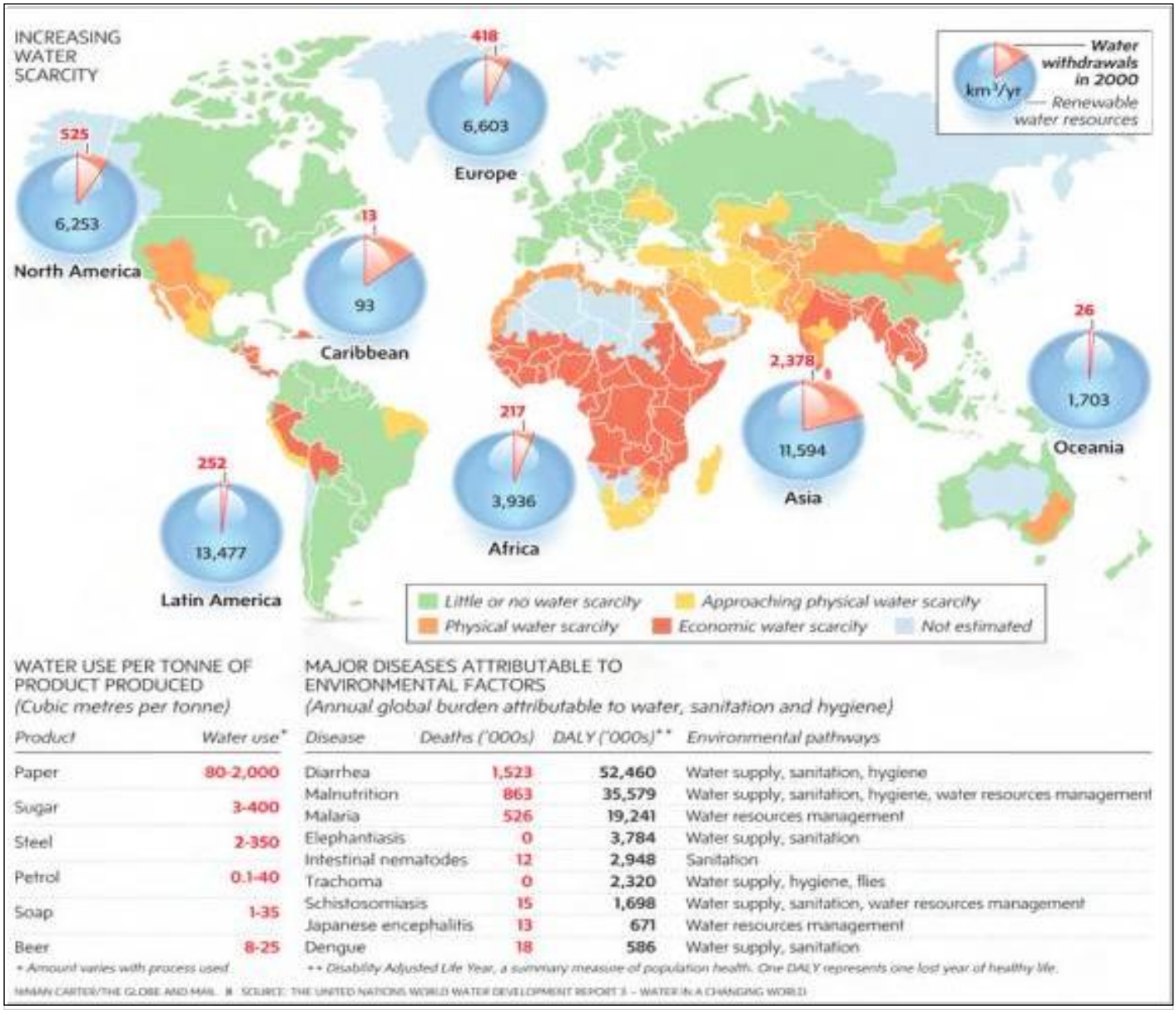
Source: World Water Assessment Programme. (2012).

Appendix 2: Benefits, costs, price and value



Source: Washington State University. (2013)

Appendix 3: Population growth, climate change, reckless irrigation, and chronic waste are placing the world's water supplies in danger



WATER USE PER TONNE OF PRODUCT PRODUCED
(Cubic metres per tonne)

Product	*Water use**
Paper	80-2,000
Sugar	3-400
Steel	2-350
Petrol	0.1-40
Soap	1-35
Beer	8-25

* *Amount varies with process used*

MAJOR DISEASES ATTRIBUTABLE TO ENVIRONMENTAL FACTORS
(Annual global burden attributable to water, sanitation and hygiene)

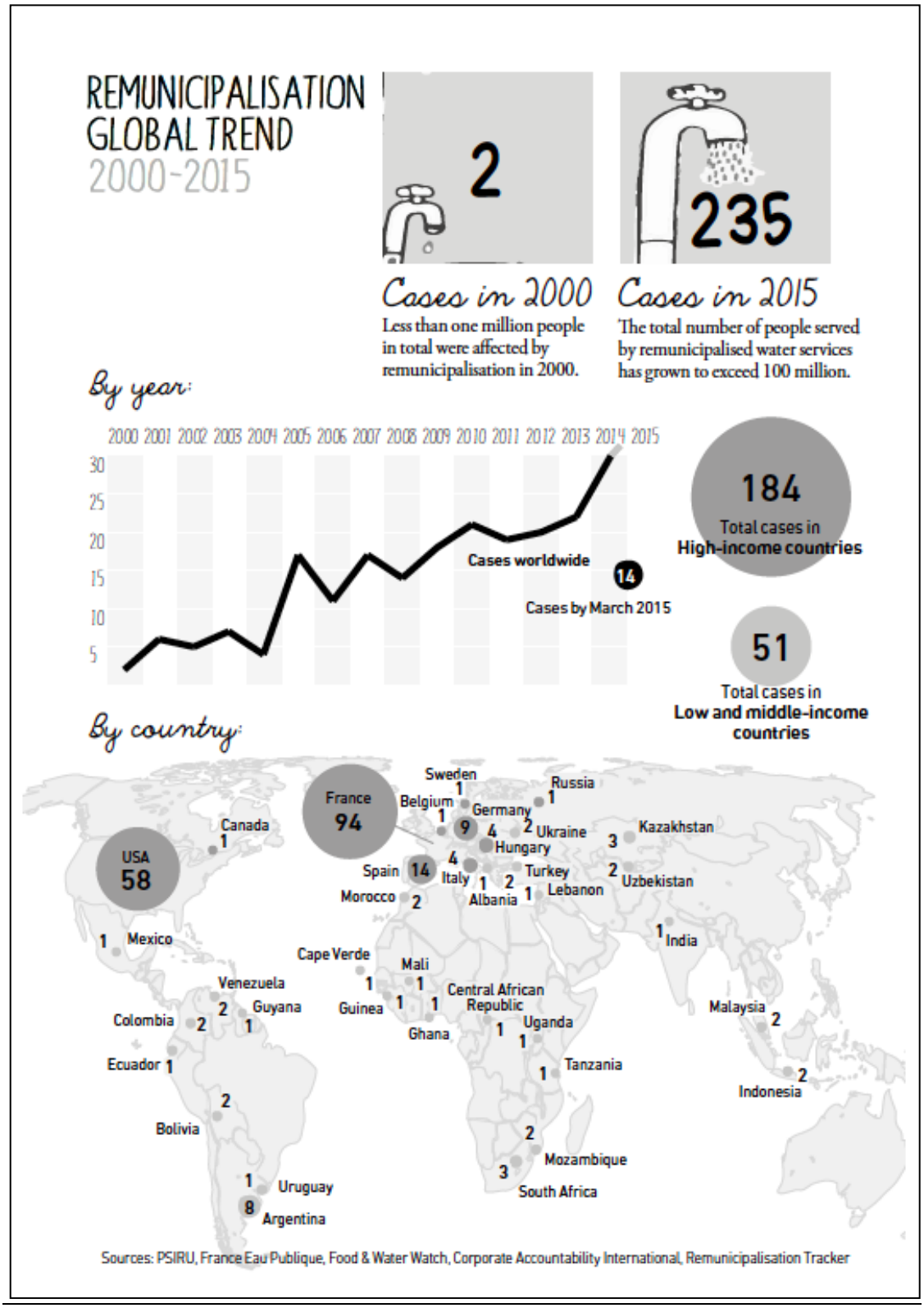
Disease	*Deaths ('000s)*	*DALY ('000s)***	*Environmental pathways*
Diarrhea	1,523	52,460	Water supply, sanitation, hygiene
Malnutrition	863	35,579	Water supply, sanitation, hygiene, water resources management
Malaria	526	19,241	Water resources management
Elephantiasis	0	3,784	Water supply, sanitation
Intestinal nematodes	12	2,948	Sanitation
Trachoma	0	2,320	Water supply, hygiene, flies
Schistosomiasis	15	1,698	Water supply, sanitation, water resources management
Japanese encephalitis	13	671	Water resources management
Dengue	18	586	Water supply, sanitation

** *Disability Adjusted Life Year, a summary measure of population health. One DALY represents one lost year of healthy life.*

NAMAN CARTER/THE GLOBE AND MAIL ■ SOURCE: THE UNITED NATIONS WORLD WATER DEVELOPMENT REPORT 3 – WATER IN A CHANGING WORLD

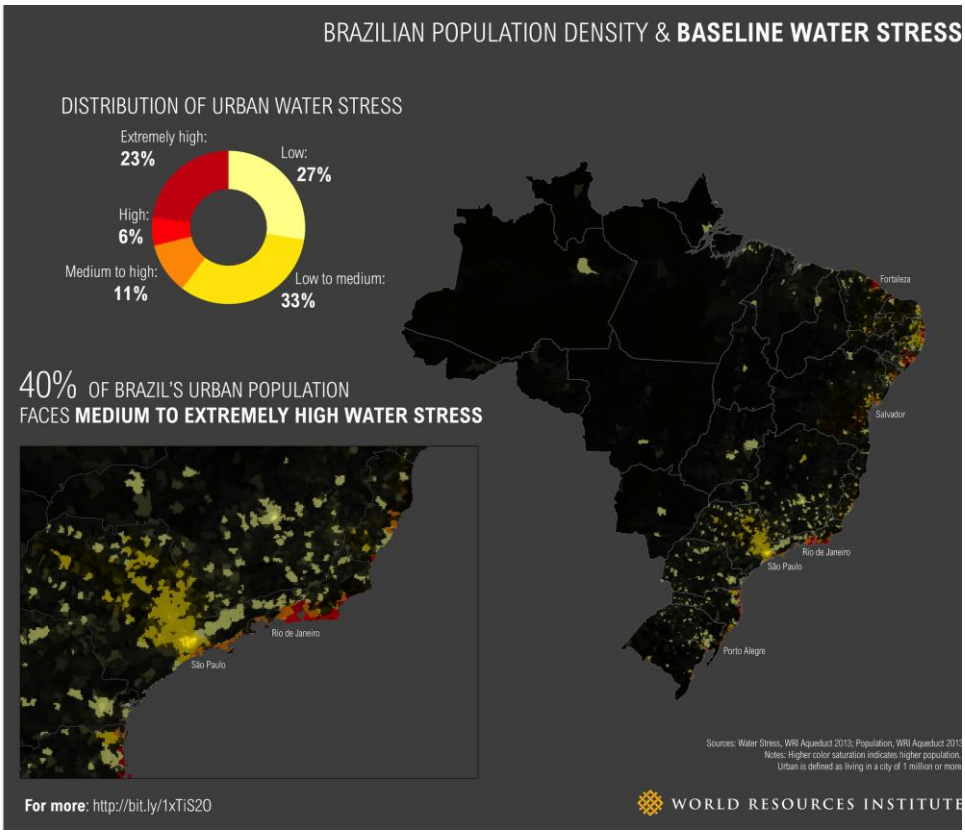
Source: Global Issues in Water, Sanitation, and Health. (2009)

Appendix 4: Remunicipalisation global trend 2000-2015



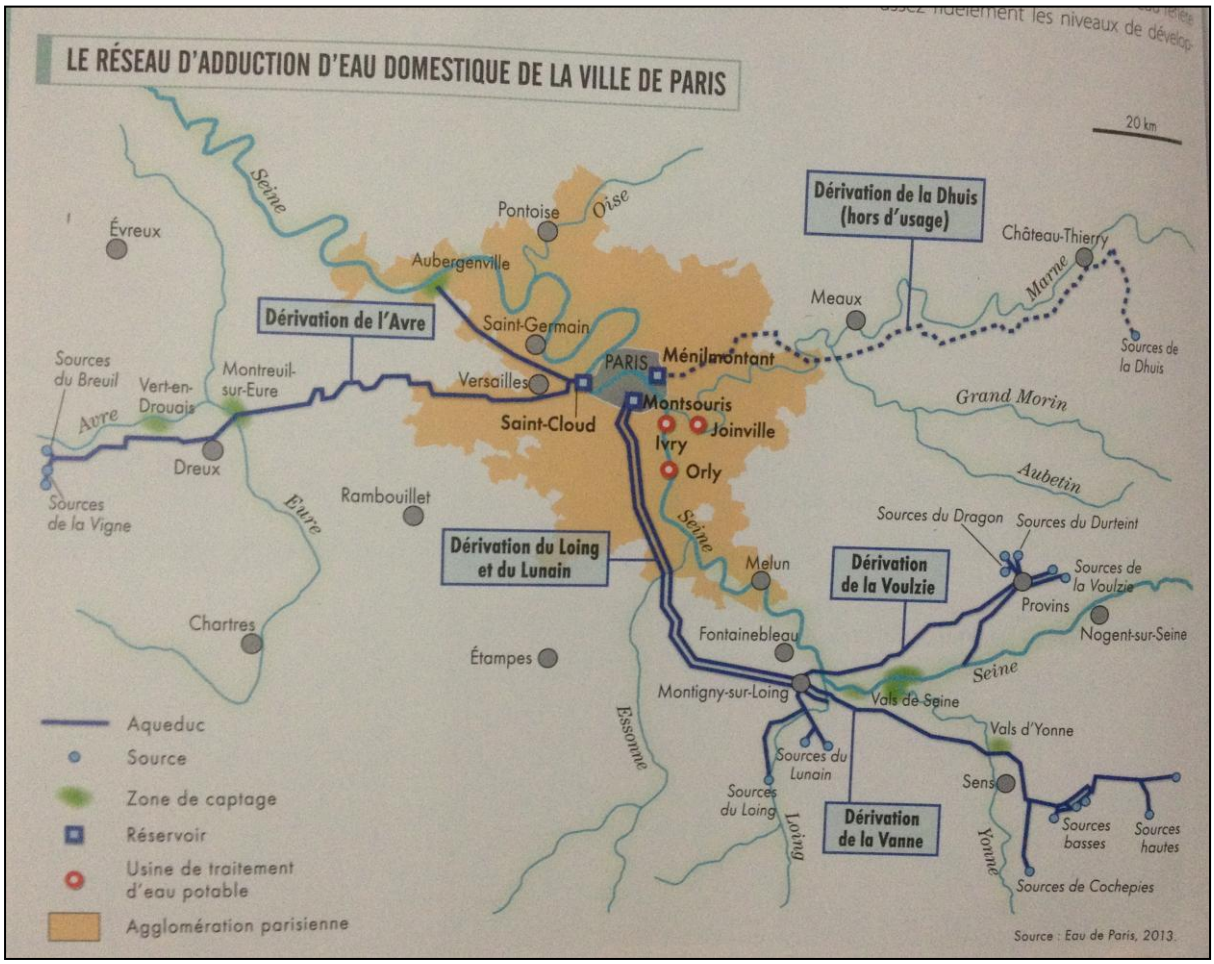
Source: Lobina (2015). Our Public Water Future

Appendix 5: Brazilian population density and baseline water stress.



Source: World Resources Institute (2015)

Appendix 6: Water distribution model in Paris



Source: Blanchon & Boissière (2013)