WATER, MEGACITIES AND GLOBAL CHANGE

BUENOS AIRES

Water Management and Climate Change in the Buenos Aires Metropolitan Area, Argentina

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¿Y fue por este río de sueñera y de barro
que las proas vinieron a fundarme la patria?
(…)
Una manzana entera pero en mitá del campo
expuesta a las auroras y lluvias y suestadas.
(…)
A mí se me hace cuento que empezó Buenos Aires:
La juzgo tan eterna como el agua y el aire.

Fragmentos de *"Fundación mítica de Buenos Aires" de Jorge Luis Borges (en Cuaderno San Martín, 1929)*

And was it along this torpid muddy river
that the prows came to found my native city?
(…)
A whole square block, but set down in open country,
attended by dawns and rains and hard southeasters.
(…)
Hard to believe Buenos Aires had any beginning.
I feel it to be as eternal as air and water.

From *The Mythical Founding of Buenos Aires by Jorge Luis Borges, Cuaderno San Martín, 1929 – English translation by Alastair Reid*

Part A

CHAPTER 1
Urban evolution and water

The Buenos Aires Metropolitan Area: megacity and water

The Buenos Aires Metropolitan Area (AMBA) is one of the four megacities in Latin America, together with Mexico, Sao Paulo and Rio de Janeiro (United Nations, 2015). It has a population of 12.8 million (2010 National Census) which represents almost a third of the country´s total population. Half of the industrial activities in Argentina are carried out along the metropolitan area which concentrates most of the political and economic power of the country. The metropolitan area is composed of the Autonomous City of Buenos Aires (2.9 million people) a self-governing entity, the capital of the Republic of Argentina, and 24 surrounding municipalities within the Province of Buenos Aires[1]. The metropolis covers an area of about 2,500 km^2. (Figure 1)

This megacity is located on the edge of an immense river, the Rio de la Plata and surrounded by a plain endowed with a vast groundwater supply, Puelche and Pampeano aquifers. The area is the last segment of Rio de la Plata Basin, the fifth largest basin in the world (3,100,000 $km^{2)}$. The river which has a significant flow of about 23,000 m^3/s. provides a low cost water resource. Furthermore, the metropolis develops over the Matanza – Riachuelo, Lujan and Reconquista rivers basins and other streams flow into the Rio de la Plata (Figure 2)

Moreover, water in the Buenos Aires metropolitan area was always considered an inexhaustible resource since the river and the subsoil provide it "at will" (Schneier,

[1] It includes the Autonomous City of Buenos Aires and 24 municipalities: 1. **Almirante Brown**, 2. **Avellaneda**, 3. Berazategui, 4. **Esteban Echeverría**, 5.**Ezeiza**, 6. Florencio Varela, 7. **General San Martín**, 8. **Hurlingham** 9. **Ituzaingó**, 10. José C. Paz, 11. **La Matanza**, 12. **Lanús**, 13. **Lomas de Zamora**, 14. Malvinas Argentinas, 15. **Merlo**, 16. Moreno, 17. **Morón**, 18. **Quilmes**, 19. **San Fernando**, 20. **San Isidro**, 21. San Miguel, 22. **Tigre**, 23. **Tres de Febrero**, 24. **Vicente López**. The City of Buenos Aires and 17 municipalities featured in bold are included in Agua y Saneamientos Argentinos´s (AySA) drinking water supply and sanitation system. In Figure 1 these municipalities and the city of Buenos Aires are coloured in grey. For the purpose of this monography the so-called Buenos Aires Metropolitan Area (AMBA) has been considered as the limit of Buenos Aires megacity, since it represents an urban continuum and in which water and sanitation services are centralized. It is very important to highlight that there is another region called Metropolitan Region of Buenos Aires (RMBA) which consists of the City of Buenos Aires and 40 districts of the Province of Buenos Aires covering an area of 14,000 km^2 and a population of 15 million people.

2001). Eventually this vision helped certain underestimation of the problem of service rational use, pollution and involved economic costs.

Founded in the sixteenth century, Buenos Aires became at the beginning of the twentieth century, a large urban area (due to the European immigration) and one of the world´s best equipped cities in terms of transportation (harbors, railways, tramways, subways), energy (electricity, gas), communications (telegraph, telephone), and in water supply and sanitation. The development of infrastructure was the basis of its economic and urban development as a cosmopolitan metropolis and as the capital city of the Argentine Republic (Schneier, 2001).

Cholera and yellow fever epidemics were a milestone in the origin of water and sanitation networks. The actual combined sewer network – known as *radio antiguo* - in the central part of the city was designed in 1871 ("Bateman Plan"). The water network built following this plan quickly found its limits due to quick urbanization growth. In 1912, a state-owned company Obras Sanitarias de la Nacion (OSN) was created to manage water and sewage for the entire country and Buenos Aires was at the core its action. Water was considered to have a "social mission" as it was considered a fundamental component of hygiene and health. Thus one major principle in water policy became, until today, the *canilla libre* (Schneier 2001), the "free-tap" policy, a non-metered access to water. Although OSN had achieved adequate service coverage, especially in the 1940s, the water supply and sanitation services were in a deep crisis. As in most Latin American cities, the outskirts were expanding faster than infrastructure (coverage lag). The "Sanitation District Buenos Aires Conglomerate" (1941) and later the "Integral Sanitation Plan of Buenos Aires Agglomerate" (1961) tried to control the urbanization dynamics, but that planned expansion was not enough to frame a periphery structure growing without technical networks while technical networks planning began to keep aside from the main conflicts of a self-urbanized periphery (Babbo, 2015 and Catenazzi, 2015).

Following a decentralization reform in the early 1980s, the service area of OSN was reduced to the area that would subsequently become the concession's service area (1993 – 2006), Aguas Argentinas S.A. (AASA) The same area is today under the state-owned company AySA.

The Buenos Aires metropolitan area has no regional or metropolitan authority and its management is the result of a complex system of interaction among different agencies from national, provincial and local levels. Due to Argentina's federal organization sub-national jurisdictions have their own competencies and legal frameworks, particularly in relation to water management and environmental protection. For example, when natural resources are shared by different entities (province/municipal), such as the Matanza-Riachuelo basin authority and water and sanitation services provision company, the Federal

Government prevails for its participation of other jurisdictions. This complexity and institutional fragmentation determines the scope and limitations of Buenos Aires metropolitan management.

Figure 1 Municipalities in the AMBA and supplied by AySA

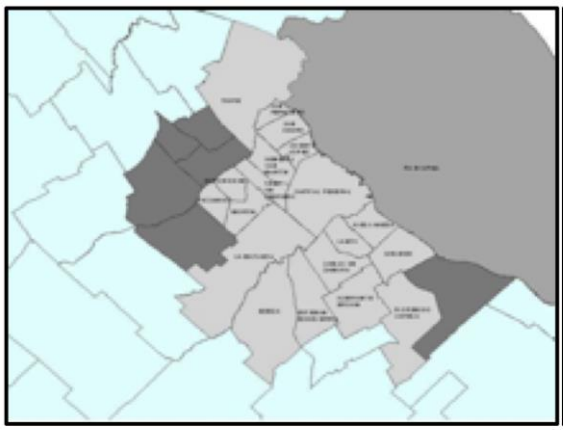
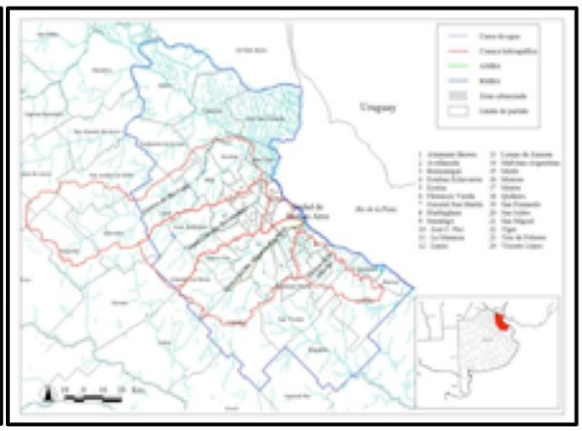


Figure 1: in grey 17 municipalities served by AySA

Figure 2 Water basins in the AMBA



Source: Herrero and Fernández, 2008

The geographical context and floods

The AMBA is located on the last part of the depressed *Pampa*, a low plateau, with an average slope of 0.4 ‰ towards the Rio de la Plata. Maximum daily rainfall in the city of Buenos Aires, in the period 1961-2000, varied between 41.8 and 184.5 mm/h. It is worth mentioning, however, the intensity of 308 mm in 24 hours for maximum historic event from 31 May to 1 June 1985. And more recently, the rainfall of 24 January 2001, with 145 mm in 4 hours in the city of Buenos Aires, and on 1 April 2013 which affected a great area of the AMBA, reaching 175 mm in two hours[2].

Floods in the AMBA are produced for different reasons: riverside, for level increase in rivers draining the basins; for wind effect; internal floods in the cities; rainfall, for the local effect of intense rainfall; and for the rise of phreatic levels (Bertoni, 2012).

The most significant floods occur in some areas of the City of Buenos Aires (where the problem is related to the piped streams overflow as a result of convective rains) and in the basins of the two main rivers depending on the Rio de la Plata.

[2]Annual rainfall average in the City of Buenos Aires has been 1,278mm for the last 20 years (1995-2014) – the same average as in the last 10 years- registering the maximum average in 2014 (1,983 mm) and other high registers (between 1,500 and 1,650 mm) in 2012 and from 2000 to 2003; and the minimum average in 2008 with 722 mm and other low registers (between 865 and 930 mm) in 1995, 1996 and 2011 (National Meteorological Service, Argentina).

One of the AMBA major issues is the event called "Sudestada" which occurs when the wind blows hard from the southeast (in opposite direction to the river). It causes a water level increase, pushing the river water over the city causing flooding on the coastal area. The area has furrows made by uneven streams with minimal slope and low capacity for natural drainage. Landfills on the coast increased the distance to the mouth of streams and slow down the runoff (Bereciartúa, 2008). As a whole, the most affected areas are the lower segments of the Reconquista and Matanza-Riachuelo basins home of marginal settlements and vulnerable population. Slums and informal settlements of poor families occupying the lowlands around rivers and streams (including the piped ones) make Buenos Aires a water risk area, particularly in the coastal area. (Herrero and Fernández, 2008).

As a whole, the main causes of urban floods are the lack of urban planning and infrastructure works as well as the lack of understanding of risks by urban settlers.

A really disturbing phenomenon was the gradual rise of groundwater levels in vast sectors of Buenos Aires outskirts. Since early ´80s and with greater intensity from 1990s, there have been problems with underground buildings (basements, underground garages, chambers, etc.), due to flooding caused by rising groundwater table level (Maza et al., 2004). According to studies carried out in 2002 about 15% of AySA´s current area was affected by a water table between 0 and 2 meters deep and about 40% of the same water table was between 2 and 5 meters deep (INA-ETOSS, 2003).

During the largest urban-industrial development in Buenos Aires conurbation, the use of Puelche aquifer became overexploited. During the ´70s, the sharp drop in water levels (piezometric levels) caused, in many cases, interloping of salt water and the presence of nitrate volume above safe water standards (related to the lack of basic sanitation utilities or leakage in sewage ducts).

This lowering made the groundwater aquifer disappear in critical positions, by a process known as "downward leakage". In those conditions extraction wells started to be unused and piezometric levels were consequently recovered. This recovery led to the rise of groundwater levels as well, the downward leakage being highly reduced, taking the situation back almost to its original condition. This rise met a new sub-surface building infrastructure, where floodings began to occur more and more frequently. In addition, the water deficit caused by the non-employment of wells service use (of water utilities and for industry shut-down) was replaced by an endowment from the largest improved water treatment plants of the drinking water system, through the so-called "underground rivers" [3]. These

[3] Due to the high availability of surface water provided by Rio de la Plata, the drinking water service has developed, as explained below, based on this resource instead of the underground water. The lower exploitation cost has been the main reason for this decision. More recently the

additional contributions of exogenous water, as well as the deficit in wastewater draining networks, significantly contributed to groundwater rise. Losses in water pipes, sewer and storm pipes also had their impact (Maza et al., 2004).

Land use environmental impact

The Buenos Aires metropolitan region expansion started in the city of Buenos Aires following first the railways which went into rural areas and then, in the 1900s had two dynamics: by "conurbation" (first and second ring of urbanization around the city radial) and then again radial with transport axes (north, west and south). On this urbanization process, during the 1990s, private investment significantly extended closed urbanizations high income families -"sub-urbanization of elite groups" (Torres, 2001)-. Indeed, during the last two decades, the process of improvement and extension of new road infrastructure (highways) caused a proliferation of new closed urbanizations failed to fulfil water preservation criteria. Thus, occupations of traditionally agricultural areas and wetland sites have been generated, undergoing significant changes in the landscape.

Opposite to these "sub-urbanization of elite groups" processes, the "*villas*" (shanty towns) and informal settlements started to grow as a result of urban informal processes. "*Villas*" or slums are individual land occupations used for the construction of minimum houses, generally with precarious materials and self-made (Cravino, 2006). The "*asentamientos*" (settlements) were originated by land illegal occupation processes.[4]

In AMBA´s region the use of natural resources generate environmental changes that affect people's welfare and health. In megacities of such characteristics, if the state does not intervene correctly in the management and use of natural resources, real estate unregulated pressure rapidly exceeds the capacity of natural systems to regenerate. Under these circumstances environmental problems arise; this is exactly what happened in the Matanza-Riachuelo basin which is an emblematic case of environmental pollution in the geographical center of AMBA directly affecting 8.2 million people in an area of 2239 km^2.

Water Resources, Supply and Sanitation today

Water and sanitation services in Buenos Aires are served almost completely by Agua y Saneamientos Argentinos S.A. (AySA) and Aguas Bonaerenses S.A. (ABSA), since only a small portion is served by the municipal company from Berazategui.

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amount underground water used has decreased because of the high pollution level due to septic tanks filtrations in regions where there is no sanitation service.

[4] The difference with slums is their collective character, as well as the expectation of future regularization and permanence in the place. The slums and settlements share a peripheral location, usually in areas of lower environmental quality.

AySA´s supply includes the City of Buenos Aires and 17 municipalities of the "*conurbano*" (outskirts conurbation). The other municipalities of the AMBA which are further away from the City of Buenos Aires -Jose C. Paz, Malvinas Argentinas, San Miguel, Merlo, Moreno, and Florencio Varela - are served by ABSA. AySA´s service shows higher percentages than the provincial company. Both companies have higher water supply coverage than sanitation utilities.

In 2010 (last information available), 3,250,124 households had water utilities in the AMBA (Figure 3), out of which 89.2% was served by AySA, 8.1% by ABSA and 2.7% by the municipal company in Berazategui. (INDEC, Censo 2010). In the remaining area under ABSA 2,317,471 households are connected to the water networks (Figure 4), 92.2% in AySA´s area, 5.1% in ABSA´s and 2.7% in the municipal area of Berazategui, respectively.

In the area of AySA´s provision, 86.2% of the households have drinking water services and 63.5% sanitation utilities. Municipalities served by ABSA have considerably lower percentages, changing between 10.7% in Malvinas Argentinas and 77% in Florencio Varela as to water utilities, and between 2% and 34.1% Malvinas Argentinas, San Miguel, in relation to wastewater collection services. The municipality of Berazategui has the best access opportunities to both services, since 94.1% of the households have water utilities and 66.9% sanitation service. With the aim of proving a better description and understanding of the relevant aspects, the analysis will focus on AySA´s service, which represents near 80% of the total population in AMBA.

Figure 3. Households with water utilities (2010)

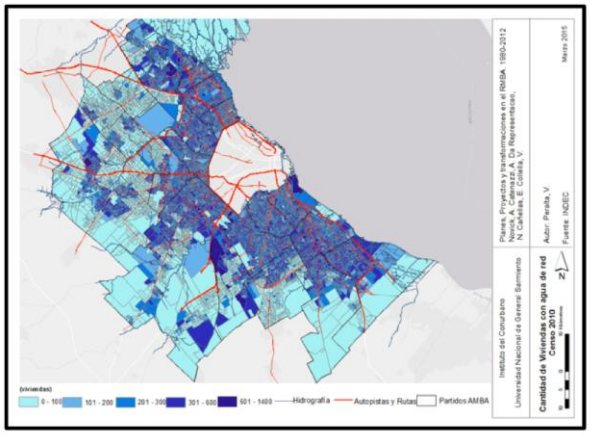
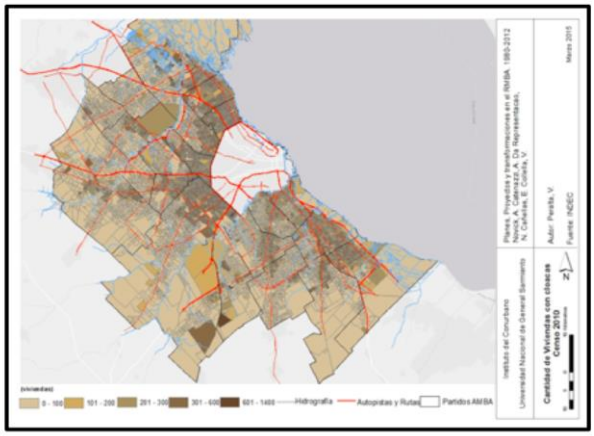


Figure 4. Households with sewage network (2010)



In AySA´s supply area coverage is uneven: in the city, 97% households had access to the public water network inside the house and 98% had toilet drain to the public network; while in the municipalities of the conurbation coverage of piped water utilities is of 72.1%. In the case of sanitation service the public network covers a 40.5% while the rest of the population has to use septic tanks and pit latrines.

AySA bills safe drinking water service to 3.3 million users (invoicing accounts) and the sewerage service to 2.8 million. 2014 invoicing reached USD 239 million.

Water resources for AySA are supplied by the Rio de la Plata (95% of the total amount) and treated the General San Martin Plant (in the City of Buenos Aires) with a production capacity of 2.9 million m^3 per day and in the General Belgrano Plant with a capacity of 1.9 million m^3 per day (in the municipality of Quilmes). The water catchment system is developed through a process beginning with water intake structures, located at a distance of 1000 m away from the Rio de la Plata coast. The treated drinking water is sent through gravity flow along large underground rivers to a group of lift pump stations to be later taken into distribution networks. The supply is completed in some areas of the outskirts with the contribution of groundwater taken from local wells or wells batteries (5%). Drinking water distribution and transportation system is 19,000 km long. Recently, in order to improve and expand water utilities, a new treatment plant was built in the municipality of Tigre with a daily capacity of 900,000 m^3. In 2014 AySA´s water production reached the equivalent of 5 million m^3 per day.

AySA´s drinking water quality parameters are stipulated in the regulatory framework (Law 26,221 / 2007) and supported in the concession contract (Resolution MPFIPyS No. 170/10). Furthermore, the company is required to submit an annual sample plan of water quality control. The regulatory body oversees the control carried out and it also hires an independent laboratory for

additional verifications. AySA also performs monitoring and analysis of the water from Rio de la Plata and its tributaries which could get to safe water treatment plant collection pipes.

The main structure of the sewerage system consists of primary, secondary networks, large pipes called "maximum sewers"(a total of 11,000 km long network) and pumping stations that collect and carry wastewater towards depollution plants discharging effluents into the Rio de la Plata, Matanza-Riachuelo and Reconquista.

Until 2014, most of the collected wastewater (86%) was dumped into the Rio de la Plata without any treatment whatsoever through a 2.5 km-long outfall in Berazategui (southeastern outskirts), the remaining received primary and secondary treatment in six plants. During 2014, a pre-treatment plant was finished in Berazategui with a processing capacity of 33 m^3 per second (2.9 million m^3 per day), which is being dumped into the Rio de la Plata through the 2.5 km-long existing outfall, until the new 7.5 km-long one is built.

As for AySA´s management´s economic and general efficiency aspects it is worth mentioning, first, that tariff system is almost the same applied by OSN and Aguas Argentinas. The system classifies users' category (residential and non-residential) and calculates the value invoiced to each user according to the premises covered surface and the land measures, the building age and quality and the area where the property is located. Even though there is a system with consumption metering and another one without metering, the latter prevails and even the measured system is applied with a high fixed charge (50% of the fixed fee paid by non-metered ones). The metering system is applied to 12% of the users, but since it includes those ones with the highest consumption volume, the incidence of this group in the company´s turnover reaches 40%. The non-metering system is within the class of "flat rates" or *canilla libre* and involves strong subsidies crossings between users (mainly from non-residential to residential, measured to non-measured and high to low zones). These crossed-subsidies applying criteria have goals not verified in practice, because they are altered by the outdated cadastral data and the significant lack of reasons for the allocation of real costs to users' consumption. Furthermore, following its state-owned status, AySA´s directly receives significant subsidies from the Federal Government..

t is considered that this pricing system together with the abundance of water resources which has contributed to the "popular belief" that water service has a very low cost, resulted in the fact that the consumption average of the population is one of the highest in the world: daily demand per capita consumption in 2014 is estimated in 344 liters.[5] It should also takes into account the high levels of

[5] AySA 2014 – Quality Service Repport [Informe de Niveles de Servicio] and AySA 2014 – Anual Repport. Comes from the ratio of 2,928,410 m3/day to 8,520,030 people served.

losses in the network, which in 2014 reached a level of 42% of the production delivered to the network, leading to an allocation equivalent production of daily 593 liters per inhabitant.

Another factor that contributes to excessive water consumption and which also impacts on the financial sustainability of the service is given by the excessively low cost-related tariffs. At this current stage of state management a high subsidies policy was chosen for both supply and demand. Despite the inflationary process which started with the macroeconomic crisis in 2001/02, tariffs were kept at the same values of January 2002 until late 2011, when the national government implemented a process of partial removal of subsidies starting with users with better payment capability. However, this process has been slowly developed. As a result nowadays the monthly average bill is USD 9.15 and the average value billed per cubic meter is USD 0.13 (13 cents) (including water and sewerage services). Since the average operating cost is USD 0.32 (32 cents) per cubic meter consumed, it is concluded that AySA´s invoicing income is just enough to cover 41% of the operating costs.

As regards investment levels, over the last thirty years there have also been variations with increasing trend. In the latest years of OSN average of USD 99 million were invested per year, in the AASA´s period that average rose to USD 210 million and during AySA´s period (2006/13) the annual average went up to USD 477 million.

CHAPTER 2. Water and governance

Legal and institutional framework

A main problem for Buenos Aires water management is the complexity of the institutional and legal framework. The main basins on which the AMBA stands go through a great variety of political and administrative divisions.

Both the legal and regulatory framework as well as the institutional one for water and sanitation services have national jurisdiction in the case of AySA and provincial for ABSA. The national competence of AySA´s services accounts for the property of assets inherited from OSN.

In this context, in order to develop actions in relation to climate change, one of the greatest challenges for Buenos Aires is first to coordinate the three government areas: Nation, provinces and municipal. Given the different priorities each government level has and the sectorial way in which these complex problems are dealt.

For example, in the late nineties the Province of Buenos Aires introduced a set of guiding premises to implement water resources protection and improvement

policies, under the principle of "comprehensive treatment of hydraulic systems and the water cycle "(Act 11,723 / 95). Some years later the Provincial Water Authority (1999) was created, an autonomous body to establish a system of protection, conservation and management of water resources in the province. Finally, in 2007 the Water Code (Decree 3511) was established. Meanwhile, in 2010 the City of Buenos Aires approved its own Water Environmental Management Act (Act 3295). Both the province and the city have their respective water resources management and control authorities. Other authorities are basin management organizations with inter-jurisdictional nature (Nation/City of Buenos Aires/Province of Buenos Aires/Municipalities): the Matanza-Riachuelo Basin Authority (ACUMAR), the Committee of Reconquista River Basin (COMIREC) and the Committee of Lujan River Basin (COMILU).

AySA services legal and institutional framework

A historical review of the institutional organization for water management during the 1900s shows four different governance models of water and sanitation services implemented in Buenos Aires,

From 1912-1980, the "Federal Welfare State" stage has a national state-owned company for the entire country, Obras Sanitarias de la Nación (OSN); follows the OSN decentralization process in the 1980s, with the transfer of services to the provinces and OSN keeping the Buenos Aires metropolis water management. In 1993 until 2006 a concession was granted to an international consortium Aguas Argentinas SA (AASA) [6]; together with the creation of a regulatory organization; finally from 2006 to the current situation, a stated-owned company Aguas y Saneamientos SA (AySA) (De Gouvello et al, 2012, 2014; Lentini, 2011 and Ordoqui Urcelay, 2007). Together with these public and private actors it is worth to note among water management stakeholders the permanent presence along the above mentioned stages with an important role in the legal and institutional reforms processes: the water and sanitation powerful union[7].

Focusing the description in the last two stages, it is worth mentioning that AASA´s concession started its activities in 1993. Significant difficulties appear from 1995 in connection with the services expansion financing (Schneier, 2005). An important contract renegotiation in 1997 allows defining new modalities,

[6] This stage has four main features. 1) OSN´s assets ownership is not transferred to AASA, they are granted in concession for a period of 30 years. 2) The private company is an international consortium led by Lyonnaise des Eaux, which includes other Argentine, Spanish, French and English shareholders. 3) The economic model is based on the concept of full cost recovery - excluding preexistent assets, which means that the operation, maintenance and investments in services expansion, including profitability, should be paid through the water service bill within the concession term. And 4) The concession is controlled by a specific regulatory framework and an independent regulatory body, ETOSS develop.

[7] Sindicato Gran Buenos Aires de Trabajadores de Obras Sanitarias (SGBATOS).

increasing the investment plan especially in sanitation, together with a tariff increase. AASA makes the company increase efficiency levels in the early years and improves infrastructure and services operational management conditions. At the same time it fails to fulfill the committed investment plan. The concession becomes weaker with the 2001/02 economic crisis which has impacts on the financing structure and the contract economic equation. The new renegotiation is unsuccessful for reasons attributable to both parties, including the concessionaire´s delegitimization (De Gouvello, 2014, Lentini, 2011). This leads to the contract termination by the Argentine Government in March 2006 mainly because of breaches in the investment plan and the presence of non-standard nitrates in the water in some parts of the Concession area. As a result of this termination AASA´s private shareholders filed a lawsuit in the international arbitration court, ICSID.

In this context, to replace the private sector, the National Government established AySA as a corporation (the State participates with 90 percent of the share capital and workers keep 10 percent).

It issued a new regulatory framework for the provision (Law 26,221 / 2007) and signed a concession agreement with AySA. The regulatory framework, among other issues, reformulated the institutional organization of the concession services that started to be ruled by three agencies under the Ministry of Federal Planning, Public Investment and Services (MINPLAN): 1) the enforcement authority by the Secretariat of Water Resources, responsible for services regulation; 2) Planning Agency (APLA), responsible for planning and controlling the execution of works for service expansion and improvement; 3) Water and Sanitation Regulatory Authority (ERAS). In the last two agencies participation bodies were involved: 1) the Board of Directors of both entities consists of three members, although it is presided by a National Government representative, one of its members is appointed upon the City of Buenos Aires Government´s nomination and the other one is appointed upon the Province of Buenos Aires Government´s nomination; 2) the Advisory Commission of the APLA and 3) the ERAS Users Syndicate. Unlike the previous outline, in which the works and investments were agreed between the concessionaire and national officers, the new regulatory framework rules established that the service expansion plans are to be defined by said Planning Agency with the participation of Nation, municipalities and AySA. Thus the municipalities, through the APLA´s Advisory Committee have a growing presence in AySA´s expansion works planning and service improvement.

Some demands of expansion in health risk areas have been included in the planning process through Water + Work and Sewer + Work programs. Both programs had been formulated years ago. These programs provided social plans

beneficiaries with the possibility to become part of the neighborhood cooperatives for sanitation works.

Towards a governance model for water? Local and citizen's growing participation

Buenos Aires has definitely entered in a new phase for water and sanitation management, as local actors (mostly municipalities) and civil society organizations (NGOs, *cooperativas,* grass-roots movements, users and consumers association, residents movements, associations) gradually get more involved. However, these movements are not enough to promote a long-term institutional change due to the lack of participation mechanisms for an integrated water management at different basin levels (Schneier, 2005, De Gouvello et al, 2014). Literature on the basin management agrees to point these issues as an institutional and political challenge in Latin American countries. Literature on the basin management agrees to point out that it is an institutional and political challenge in Latin American countries. All environmental crises erupt in the framework of a social and institutional organization. By definition, basin management means managing a contrasting interests conflict. Those ones with greater political power often care less about environmental conservation, or they use it as a means to achieve other goals. (Merlinsky, 2013b).

Part B

Climate Change Impact on the metropolitan urbanization

The metropolitan urbanization of Buenos Aires is highly exposed to climate risks arising from rainfall increase, temperature rising and greater surfaces damaged by floods. Different studies point out the possible increase of floods due to the Rio de la Plata level rise (Barros et al. 2005).

Among the expected changes it can be mentioned that the average annual temperature increase range is likely to be about 0.5°C for the short term (2016-2035), while, at worst, the rising temperature could exceed 3°C. Furthermore, increasing rainfalls are expected, especially for the worst scenario of the period 2012-2100. The possible rates of annual rainfall increase goes between 1.4% and 7.6%. In general, increasing precipitation is observed in the whole region, but most significant changes are found in AMBA´s area. Winds future scenarios show increasing intensities and direction changes to the East. Besides a 0.6 m increase in the average sea level is likely to take place this century, with a possible variation of 0.30 m to 1.00 m. With the maximum expected scenario of 1 m increase of sea level towards 2100, the salinity front will not move from its current position,

without affecting the nature of Rio de la Plata freshwater. According to regional reports, increasing extreme hot temperature trend and heat waves are likely to continue, being higher in urban areas, due to the urban heat island effect.

The Third National Communication on Climate Change (2015) states that among the impacts expected for Argentina, heavy rainfalls and floods on the coasts of the Rio de la Plata are to continue. They are caused by storm surges which will affect larger areas due to the sea level increase. Frequency of "*Sudestadas*" will slightly increase during this century. This will therefore cause a slight increase in flooding frequency as well. In general, extreme weather events are expected to be more intense, more frequent and longer.

Although winds cause major changes in the level of the Rio de la Plata estuary (tides levels) and are the main cause of seasonal variations, expected changes in the sea level during the twenty-first century will be the main factor of changes in the estuary waters average level. However, sea level increases from 0.50 to 1m are not supposed to cause permanently flooded areas, but vulnerability to climate change in coastal areas of the AMBA is likely to appear as a result of greater territorial scope –southeast blows- ongoing floods as a result of the Rio de la Plata average level increase (Barros et al, 2005).

Chapter 3. Climate change impacts: main challenges

The AMBA faces different problems and challenges connected with water resources with different temporalities (permanent and current, short and long-term, temporary and structural); difficulties of different nature (political, environmental, urban, social, economic, legal, etc.) and different level of significance and urgency; different value and sensing in the public opinion and in those public official responsible for public policies planning. Considering this scenario, the climate change impact is not just one of the problems, but it can make the existing ones even worse increasing vulnerability and inequality.

One of the main questions set forth is: which would be a government´s encouragement to take measures on climate change effects which are likely to occur out of their management period? Within a political agenda in which emergencies usually prevail, and taking into account the short visibility of the relationship between the critical nature of some environmental and urban problems and the climate change in urban policies design.

Reducing vulnerability

Climate change impacts forecasted for the AMBA notice the temperature rising, rainfalls intensity and larger surfaces affected by floods in the coastal area of the Rio de la Plata. Also, the area magnitude worsens the negative consequences of these impacts by the urban heat island effect. On the other hand, this

phenomenon does not affect all the population with the same intensity: the most significant floods take place in the low basins of rivers and streams and have impact on the poorest homes since they are moved towards lower environmental quality lands because of the real estate market which sets a higher price to non-flooding lands, which grows in densification, and the lack of public rules which cannot dissuade, or the public control cannot avoid people´s settlement and household building on flooding or low environmental quality lands.

Despite increasing criticizing of these space and social segregation processes, the unequal access to the city has not been duly set forth in the different governments´ agenda. On the contrary, the prescription of public policies has had a divided focus on environmental and urban problems, expressed by a wide range of public agencies and with poor articulation among each other.

Therefore, there is a political dilemma from decision taking and setting priorities, also considering the economic restrictions to finance in the short term all the measures and projects desired to be carried out. In this way, the development of specific measures directly related to climate change impact (either adaptation or mitigation measures) may reduce efforts in terms of other environmental, social and urban policies. For instance, to slow down execution plans to provide an extension of public services affordability and availability. The encouraging side is that many of the actions that are to be carried out in order to solve priority attention problems in the AMBA (household, floods management, public services universalization, solid wastes collection and disposal, industrial pollution, etc.) are at the same time those actions which help adaptation to climate change.

More frequent and extreme floods

Urban sprawl has reduced absorption surfaces (green areas occupation, streets pavement, etc.) in such a way that there are a few water retention mechanisms. As a consequence the volume of water drained and which must be evacuated is usually equal or larger than the fallen volume. This retention deficiency is influenced by the obsolescence of the rainfall drainage network in the central area of the metropolis, the insufficient investment for expansion and cleaning works, lack of continuous maintenance of storm drains.

During the latest years, extreme hydro meteorological events (precipitation, *sudestadas*, increase of the river level, or a combination of them) have increased in frequency and intensity as well as a result of climate change processes. For instance, it is worth mentioning the precipitation of 1 April 2013 which mainly affected north and west AMBA (between 175mm and 185mm were registered in two hours, in some towns), causing the evacuation of hundreds of inhabitants and the death of 8 people.

Therefore, the adaptation of these extreme events requires reinforcement of different institutional levels and actors, as well as information about risks and threats in order to enable a better response and increasing resilience.

Drinking water and sanitation supply

Another great challenge related to climate change effects is drinking water and sanitation service supply: to extend the provision towards vulnerable areas where there is no supply at present; to guarantee service quality, quantity and continuity; preserve quality and quantity of water collection sources as well as the rest of the facilities which form part of the system; and to face an eventual demand increase produced by temperatures rising.

Rio de la Plata is the main source of raw water catchment; therefore any change in it might directly impact in the safe water treatment plants. Therefore, there could be upstream events, more frequency of algae presence which alters quality and downpipes in the river level which could produce service interruption for a period of time.

Furthermore, although the increase of temperature average produced by climate change effect might affect, in normal conditions, drinking water consumption, the current excessive high consumption per capita in the AMBA is a structural problem itself, which forces to take measures in order to achieve a reduction of inhabitants´ consumption provision in the area.

Institutional framework complexity

Water management in the Buenos Aires Metropolitan Area presents multijurisdictional and interjurisdictional problems and solutions. The underlying dilemma is that certain contamination processes produced in the metropolitan perimeter are segmentally faced from the local point of view, or centralized from the provincial and national one.

The persistence of poor coordination between the different water management organizations gets even worse for the lack of institutionalization of the metropolitan phenomenon as a management ambit, in a way that a public orientation of the metropolitan development is represented.

Therefore, the limited visibility of risk reduction and adaptation to climate change as metropolitan issues is one of the main problems of water management.

Chapter 4 – An agenda for adaptation

In order to execute climate change adaptation and mitigation actions in the megacity of Buenos Aires it is essential to think about an integral scope which

joins and supports interaction of technical and government aspects. Therefore, the following public political lines formulation and follow-up is required: knowledge and information, infrastructure investment, social protection, territorial arranging and institutional adapting (Merlinsky, 2015).

Knowledge and information policies

As regards knowledge and information policies, it is important to consider that risk assessment is a key pre-requisite for any climate change adaptation strategy. Meteorological information systems are essential for infrastructure planning and for the permanent monitoring in terms of disaster risk management. Furthermore, this information is necessary to work on contingency plans and to reinforce interaction between actors.

At present it can be considered that data quantity, quality and systematization is not enough yet, although it is important to highlight that there have been advances in this matter. For example, the City of Buenos Aires has a meteorological alert network which enables to design a precipitation mapping and other climate variables per neighborhood, and an early flood alert system based on sensors within drainage pipes (Buenos Aires Ciudad, 2014).

In this sense, it is also interesting to point out that disputes about sanitation in Matanza- Riachuelo Basin and its judicial process, gave rise to the implementation of a public information system which involves the execution of periodical studies on water quality control and results of sanitation advances in the basin, among others.

Investment on infrastructure and social protection policies

As regards infrastructure investment policies related to disaster risk management it should be considered that later damage level is usually inversely proportional to investment levels on infrastructure issues (Merlinsky, 2014). Also, they are closely related with social protection policies which are the way to guarantee distributive justice in terms of social equity measures for adaptation. Therefore, when planning these measures for adaptation, either structural or non-structural, institutions should join and harmonize works technical criteria, with economic aspects connected with financing and others associated with social assessment and impact distribution.

Improvements in terms of urban drainage system are highly important in a scenario where an increase of extreme events (floods) is forecasted, caused by more frequent and stronger precipitations and *sudestadas*, especially because most flooding areas are currently inhabited by low income population. In this regard, it should be pointed out that this issue is being treated through various

hydric plans related to different judicial-political-administrative divisions, with consequent superposition and territorial gaps, possible scopes and focuses, as well as different levels of financing and execution.

Plan Director de Ordenamiento Hidráulico – Director Plan for Hydraulic Regulation from the City of Buenos Aires established in 2004 and the Basic Director Plan for Drainage of the Matanza Riachuelo Basin updated in 2009. These plans include drainage systems maintenance, streams cleaning, reservoirs creation and the building of new outlet channels, among others. It is worth stating that they also set forth the importance of non-structural measures such as the new legislation, early alert systems implementation, contingency plans elaboration, flooding areas zone division and establishment of flood insurances, among others.

On the other hand, investment on Matanza Riachuelo and Reconquista Basins sanitation, together with water and sanitation networks expansion are virtuous measures which help water courses be sanitary (considering that part of pollutants turn over come from household effluents and losses in the network), and also to provide population with better health and lifestyle conditions.

State-owned company AySA is currently executing the Director Plan which provides a network extension in order to reach the 100% coverage of drinking water supply and 80% in the case of sanitation service. However, considering the works temporal horizon together with the investment amounts, it is necessary to provide intermediate solutions which enable the population under risk to have access to the services, since the expected works have an execution term which is likely to be complied with provided that there are favorable macroeconomic conditions.

At the same time, consumers´ adoption of new consumption habits needs to be urgent in order to restrict wastes and reach a rational use of drinking water. This would also lead to lower operative costs, a more efficient use of plants capability (both of drinking water and wastewater treatment plants) and a better energy efficiency which could contribute to reduce greenhouse effect gases emissions. Therefore, it is necessary to encourage reuse of waters and rainfall water collection for uses that do not require drinking water, as well as to promote the increase of consumption micro measurement for services invoicing and to establish tariff rates of financial sustainability accompanied by subsidy mechanisms guaranteeing a universal access.

Furthermore, the development and strengthening of household policies become more relevant as it is necessary to carry out a relocation of population residing along the margins of Riachuelo and Reconquista rivers in order to prevent flood risk and as a way of guaranteeing a good quality public space along riverside

areas. This mission is even more complex because of the lack of soil production policies for lower income inhabitants.

Territory arrangement policy

The climate change is a process which, in general, strengthens the negative effects of hydro climate threats in the metropolitan territory, so it should be taken into account when designing a territory arrangement policy.

During the latest years, it should be recognized that there have been spaces generated at a national level in order to discuss these subjects in a federal framework. The creation of Planning Federal Council (associating provinces), successive advances of the Territory Strategy Plan at a national level under the responsibility of the Territory Planning Sub secretary of Public Investment, have been relevant measures to institutionalize debate.

However, in general terms, it can be pointed out that the territory arrangement as a public policy tool has not much presence in the different governments´ agenda. There is still a sectorial view of territory problems and interventions are decided in terms of public works, mostly without much preoccupation about its environmental consequences and its effects on the cities´ social and economic development.

In this scenario, the design of territory arrangement policies is relevant, which should include risk assessment and climate change adaptation and intend to advance in terms of socially equitable, politically democratic, economically efficient and environmentally sustainable strategies.

Institutional Policy

Each of the above mentioned policies´ achievement, and in consequence the success of climate change adaptation, is subject to the correct functioning and coordination of multiple involved institutions and organizations; i.e., a good governance.

In this context, we should refer to the creation of Matanza-Riachuelo Basin Authority (ACUMAR) in 2006, an organism which has legal capacity to act along an extent territory in the megacity, and also the state-owned company AySA. These institutional actors have contributed to define a new agenda for the metropolitan environmental policy. At the same time, the interjurisdictional nature of these organisms (although neither of them exactly coincides with the megacity area) starts to mitigate the lack of a metropolitan authority in a limited aspect.

However, in connection with climate change adaptation planning, it is observed that it has been an incomplete and isolated activity, revealing the lack of an integrating institutional policy. In those cases in which measures have been taken in order to overcome the climate change, they have focused their attention in reinforcing infrastructure without being an integral adaptation strategy. For this purpose, the starting point is to have reliable information, enabling the integration of climate change risks assessment with all planning aspects of public policies, and the institutional reinforcement in order to be able to support policies prolongation in time.

Acknowledgement

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