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STATE INVESTMENT IN MUNICIPAL WATER SYSTEMS: THE CASE OF MEXICO CITY

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Abstract: The aim of this paper is to analyze, in first place, the process of commodification of water during the neoliberal era (1990-2010) in the Metropolitan Area of Mexico City. It will be specifically performed an historical evaluation of the monetary investment in hydraulic infrastructure and of the water supplied volumes to the city. Such analysis is evaluated relating the changing trends in the investment and supply with institutional changes, which affects the efficiency in the provision of water for a population of 20 million people by 26 different municipal public companies inside Mexico City. In second place the investigation shows how the supplied volumes of water to Mexico City and the investment in the infrastructure that allows the provision of drinking water is associated with different forms of governance of the municipal systems, ranging within the metropolitan area from exclusively state-run to public-private partnerships. Finally we discuss in the paper how two major ideological differences on the provision of water coexist in the Metropolitan Area of Mexico City. The first, conceptualize water as a human right, while the second is product of a social construction aiming citizens to consume bottled water. We conclude that large state-run companies and small communal operated water systems show higher efficiency in provision and investment in infrastructure than privatized municipal systems.

INTRODUCTION

In 1782 the Perrier brothers built the first modern water supply system, for the city of Paris, which consisted in “two steam pumps, four tanks, and a supply system” (Roth 1987, pp. 251–252). The conflicts and divergent interests between the Perrier brothers with other capitalists prompted the French Revolutionary Government to expropriate, for

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the first time in world history, their water supply company, creating the body that gave rise to the Water Municipal Department of Paris.

In 1985, under the aegis of neoliberal ideology, the former Mayor of Paris, Jaques Chirac, granted in concession the operation and exploitation of the public supply system of the water supply system to the companies Veolia and Suez. On November 24 2008, during the course of one of the biggest crisis of the capitalist system, the Paris City Council decided not to renew the aforementioned concession, remunicipalizing the water service through the creation a public owned company called *Eau de Paris* (Pigeon 2012, p. 25).

The case of Paris, as well as the cities of Hamilton in Canada or Buenos Aires, illustrates the complicated relations and interactions between politics, policy and mode of production, which ultimately define public services and social welfare. Through out the development of capitalism, especially since the Wall Street Crash in 1929, it is possible to observe a historical cycle leading to the nationalization of public services in order to avoid inherent contradictions between different capitalist companies and also to prevent shortages in the provision of water to the labour force.

After the Washington Consensus, multilateral organisms such as the International Monetary Fund (IMF) and the World Bank successfully imposed neoliberal policies as "cuts in welfare expenditures, more flexible labour market laws, and [the] privatization of public services" over indebted countries, as Mexico (Harvey 2007, p. 28). The wave of privatization of public services during the decades of the eighties and nineties of the last century, followed in some cases by a fiscal crisis, disinvestment in fixed capital and the remunicipalization or renationalization of public services, shows the limits to the private exploitation of infrastructure and the contradictions for the capital itself.

The group of recent studies related to the provision of the public service of water and sanitation emphasize the management and governance of the same, and particularly in the Global South, scholars have studied social movements in defense of the right to access to drinking water, or the processes of privatization and remunicipalization occurred in some cities during the past two decades. The 'public' is commonly defined in terms of the management of nonprofit water systems in order to ensure a common and equitable access to water. Such access would be guaranteed by the State or by communities and self-organized groups under a normative vision, aimed by the principle of *utilitatis comunione*.

However, from the urban political economy perspective, the provision of water and sanitation is characterized as a binomial general condition and service for production, in order to achieve a comprehensive view of the public character that this vital service assumes for the social reproduction. The aforementioned binomial has been defined in the following terms:

> "The binomial general conditions and services for production is formed by a combination of natural and infrastructural means of production (GCP), and of workers and inputs, general services of production (GSP), which provide good or services such as water, electricity or roads, that

> are indispensable for the general process of production of goods and for the reproduction of the labor force, but that are externally produced of the individual capitalists" (Garza 2013, p. 19).[2]

Infrastructure for drinking water and sanitation, comprehended as a general condition of production (GCP) is far from being a set of neutral goods that for neoclassical economics can be transferred from the public to the private domain in the merely search of economic efficiency and effectiveness in the provision. The GCP for water and sanitation refers to a form of fixed constant capital which main feature is its socialized use and high magnitude of accumulated value, product of the secular investment required for its construction. Such investment is usually performed by the State.

The high economic value of the infrastructure required for the general service of water and sanitation is permanently transferred to the process of capitalist production and reproduction of the labor force, and is reflected also in the elevated organic composition of this fixed constant capital. Its public nature is also explained by the need of a non-capitalist agent in order to ensure an equitable access for all the capitalist production units, and to secure the provision of the vital liquid and for the fulfillment of the human right access to water. In this process, the water requires therefore to be supplied as an undervalued commodity and the provider cannot be guided by the two main purposes of capitalism: to obtain a profit and capital accumulation.

In order to try to explain the dialectical relation that guides the investment trend and value accumulation in water and sanitation infrastructure with the management and governance of this public service in Mexico City Metropolitan Area (MCMA), in the first part of this document I will summarize the complicated legal and administrative structure required to operate this public service. From the forgoing I will show how there are different trends of investment in infrastructure, depending on the scale of the water utility and the different objectives of the municipal public operators.

The public and decommodified character of the public service of water and sanitation is not exempt, however, of pressures to privatization, product of a growing trend for the commodification of water. Mexico is the main consumer of bottled water in the world, and the percentage of water per capita per year consumed in the MCMA far exceeds the national average. That is why I am performing a first estimate of the consumption of bottled water in Mexico, water which according to government officials, does not exceed the quality of the water supplied through water networks, plus it comes from wells exploited from the same aquifer (Profeco 2007).

The consolidation of Mexico City as the main economic and populated center of Mexico has required the construction of extraordinary works of water and sewage infrastructure through its history. In order to provide an adequate supply of water and sanitation, the various levels of government have heavily invested to build a huge and complex hydraulic infrastructure network.

[2] Free translation.

The aim of this paper is to analyze the evolution of all the elements of the water and sanitation provision system of Mexico City Metropolitan Area (MCMA). The infrastructural system as a whole is conceptualized as one of the general conditions and services of production (GCP-SGP) of the metropolis, as they have been defined and analyzed in the field of urban political economy (Folin 1979; Garza 2013; Skayannis 1990).

THE EVOLUTION OF THE HYDRAULIC INFRASTRUCTURAL SYSTEM

The management model for the use of Mexico City water resources is the result of a five centuries process of constant struggle to provide safe water to its people and to avoid, paradoxically, the constant floods that periodically punished the city and its inhabitants.

It is considered essential to briefly analyze the secular process of construction of water and sanitation infrastructure in the metropolis and its organization in the urban space, because only then will be possible to understand the economic importance of this colossal general condition of production and the high value economic embodied in it. Additionally, the publicness of this infrastructure is evaluated by estimating the extent to which this value is incorporated into the production process of the city and the way it allows the reproduction of its workforce.

The management model in the basin of Mexico for the explotaition of water resources adopted since the sixteenth century is reflected in the huge monetary value accumulated in a monumental water infrastructure and sanitation constituting a vital GCP of Mexico City. To properly understand and estimate the investment required for its construction, it is essential to make a brief description of the process of hydraulization observed over the last four centuries. The hydraulization phenomenon is understood as the "organization of water in the urban space through hydraulic medium and large scale means (canals, dams)" (Sheridan Prieto 2010, p. 67).[3]

Metropolitan process of hydraulization

The MCMA is located in the southwest of the basin of Mexico, which has an area of 10,000 squared kilometers and it forms part of a Mexico's central mountain range called Transversal Neovolcanic Axis. The basin is formed by eleven hydrological zones, where there were five large lakes: Texcoco, Zumpango, Xaltocan, Chalco and Xochimilco. As a whole, during the rainy season, the five lakes came to form a single body of water, because it did not have a natural exit for water from the basin, which by definition is endorheic (Joint Academies Committee on the Mexico City Water Supply et al. 1995).

[3] "Hydraulization" is used following the conceptualization developed by Marie (2004), which emphasizes the impact and result of territorial changes as a result of the construction of large water works.

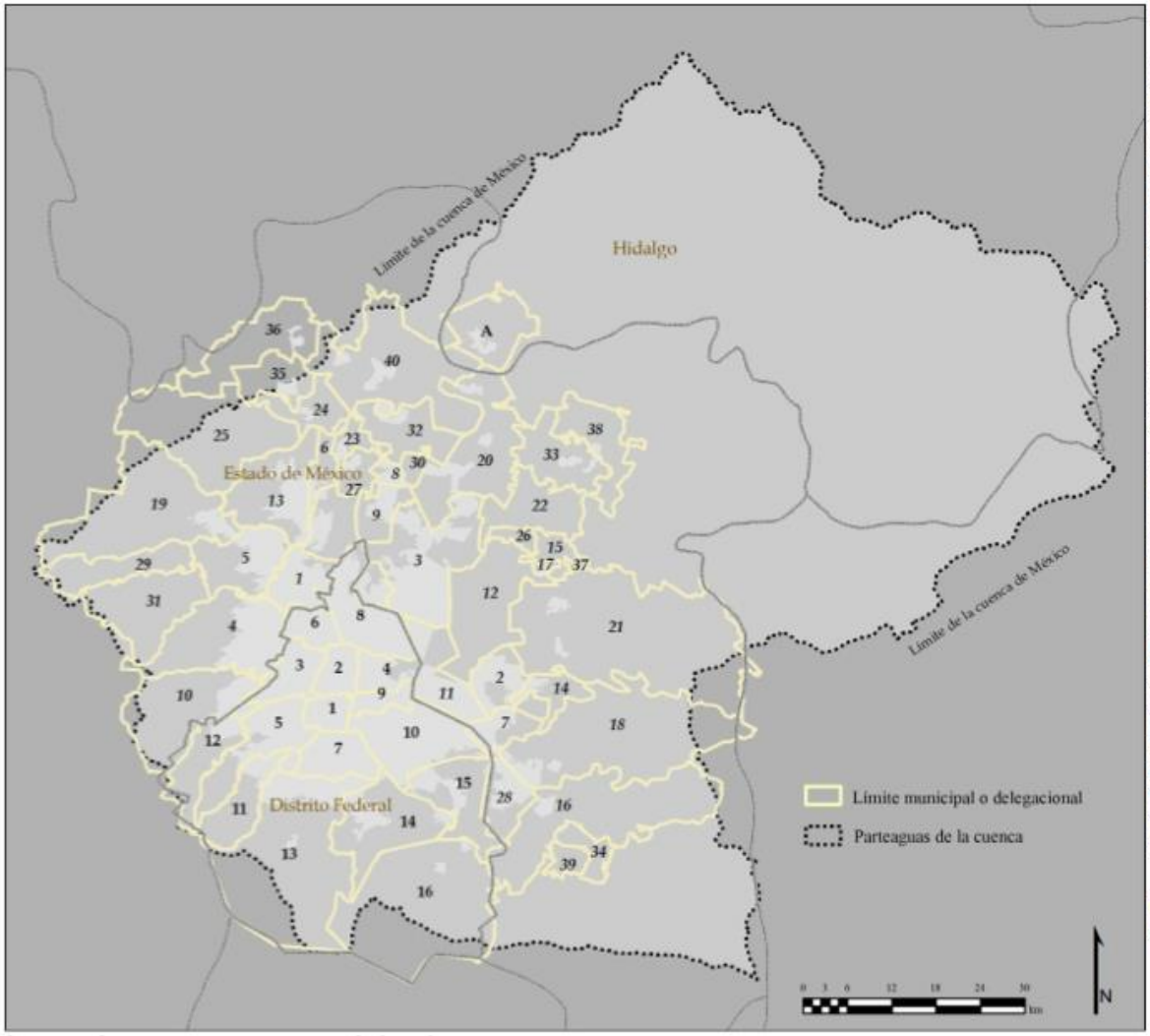
The construction of Mexico City began after the Spanish conquest of the Aztec Empire in 1521. The transformation and destruction of the pre-Hispanic hydraulic system resulted in the gradual blinded canals and dikes, and the reshaping of the previous urban design. The lack of maintenance of the pre-Hispanic GCP for water supply and flood control, caused that in 1524 was recorded by first time, in Mexico history the shortage of vital fluid (Sistéma de Aguas de la Ciudad de México 2012).

In addition to the expensive investments to provide drinking water to Mexico City, another major problem that threatened its existence was the lack of maintenance of the sanitation system. The first works to drain the water from rivers and lakes outside of the basin, the approach adopted by the Viceroyalty, were the so-called *Huehuetoca adi*t and the *Nochistongo pit*. At the beginning of the twentieth century, it had been built a group of major infrastructure systems in order to resolve the two major and paradoxical historical problems of the city: a series of frequent floods and the shortage of drinking water. Of these early works (ca. 1900), stand out for their size and importance, the Grand Canal for sewerage, which together with the Tequixquiac tunnel still in operation today, and the works for water supply from Xochimilco.

Mexico is a Federal State with 3 different levels of government. The MCMA is formed by 16 boroughs that constitute the Federal District, and by 40 municipalities of the State of Mexico and one municipality of the State of Hidalgo (Garza 2000, pp. 240–241) (Map 1). From 1900 to 2010, there was an expansion of the urban area from 2 714 hectares to 154 710, with a relatively stable population density, which fell from 127 inhabitants per hectare in 1900, to 116 in 2000 (Garza 2000, p. 242; Negrete Salas 2000, pp. 247–248).

As population density decreased during the past century, it was possible to observe a vertiginous growth of the population: 344,721 inhabitants in 1900, 8,623,157 in 1970 and 19,530,764 in 2010. Such growth has increased the problem of having a homogeneous distribution of urban services, such as drinking water. The lack of planning entities in certain municipalities and the inexistence of a regulated growth policy for peripheral areas is reflected in the inadequate provision of sanitation works for the municipalities that have recently joined the Metropolis.

Map 1. Metropolitan Area of Mexico City: location on the basin, municipalities and urban area.



Federal District

1. Benito Juárez
2. Cuauhtémoc
3. Miguel Hidalgo
4. Venustiano Carranza
5. Álvaro Obregón
6. Azcapotzalco
7. Coyoacán
8. Gustavo A. Madero
9. Iztacalco
10. Iztapalapa
11. Magdalena Contreras
12. Cuajimalpa de Morelos
13. Tlalpan
14. Xochimilco
15. Tláhuac
16. Milpa Alta

State of Mexico

1. Tlalnepantla
2. Chimalhuacán
3. Ecatepec
4. Naucalpan
5. Atizapán de Zaragoza
6. Cuautitlán
7. Paz, La
8. Tultitlán
9. Coacalco
10. Huixquilucan
11. Nezahualcóyotl
12. Atenco
13. Cuautitlán Izcalli
14. Chicoloapan
15. Chiautla
16. Chalco
17. Chiconcuac
18. Ixtapaluca
19. Nicolás Romero
20. Tecámac
21. Texcoco
22. Acolman
23. Melchor Ocampo
24. Teoloyucan
25. Tepotzotlán
26. Tezoyuca
27. Tultepec
28. Valle de Chalco – Solidaridad
29. Isidro Fabela
30. Jaltenco
31. Jilotzingo
32. Nextlalpan
33. Teotihuacán
34. Cocotitlán
35. Coyotepec
36. Huehuetoca
37. Papalotla
38. San Martín de las Pirámides
39. Temamatla
40. Zumpango

Hidalgo

A. Tizayuca

Source: Own elaboration using GIS software

Mexico City's water supply system

Public water supply infrastructure has historically evolved with the aim of allowing an adequate supply of water, either for consumption of its population or as an auxiliary material for industrial and service processes.

At present, the water "system" consists of all "internal and external water sources to the valley [sic] as well as the different infrastructure components that allow the conduction, regulation and distribution of the water flow required by the different users inside the city" (Merino 2000, p. 344).

Table 1: Mexico City Metropolitan Area, water supply system and coverage, 2011

	Unit	*Federal District*	*State of Mexico municipalities*
Population	Inhabitants	8 873 107	10 657 657
Urban area	Km^2	1 504	3 230
Houses	unit	2 215 451	2 256 181
Housing connected to water system	unit	2 152 009	2 149 183
Housing connected to sanitation	unit	2 064 147	2 022 309
Access to water system	inhabitants	8 177 634	8 695 929
Primary water supply network	km	1 273	1 255
Secondary water supply network	km	11 971	17146
Aqueducts and pipelines system	km	731	1 087
Lerma wells	well	351	0
PAI wells	well	84	70
Basin wells	well	423	400
Chiconautla wells	well	27	0
Treated flow	lt. per second	32 260	16 620

Source: Own elaboration with data from CONAGUA, (2003, 2009a), Encinas (2006), Merino (2000, p. 350). And a personal request of access to public information to the SACM, "INFOMEX" access number 0324000057011 on August 15, 2011.

In addition, MCMA water supply system requires of a series of regional infrastructure composed by 76 dams, levees or troughs, 38 major water treatment plants and 533 kilometers of aqueducts, all of them operated by the Federal Government. The regional water supply system for the MCMA relies in a series of works completed in the past sixty years, situation which becomes complex because of the high depreciation of this constant capital and also because of the rising costs required for its operation and maintenance.

Between 1970 and 1980 the Federal Government started the construction of which is probably the most important water work for Mexico City. This was an ambitious project known as "Cutzamala" system, which was built between 1982 and 1993 with a design flow estimated in 19 cubic meters per second (Sistema de Aguas de la Ciudad de México, 2012).

The two main goals of this system were to reduce groundwater extraction from Mexico's basin. However, with the growth of the metropolitan area and the

subsequent growing demand of water by the population, the goals were never achieved.

Since the eighties, along with the problem of aquifers over-exploitation and the depletion of water sources, Mexico City government had a clear diagnosis of associated causes with the rapid devaluation of the water supply system, such as the "soil subsidence, affecting the operation of hydraulic system components". It was believed that Mexico City was in "an extreme situation [because] there is a risk that supply sources depleted", which meant "the need to bring the water from distant basins to the Valley of Mexico [sic], which could imply higher costs" (Departamento del Distrito Federal 1989, pp. 15–19).

Sanitation system

The management of the MCMA water resources requires a delicate balance, which is tested every year when the city is exposed to heavy rains, especially between June and September. During this period 70% of the average annual precipitation observed historically falls (CONAGUA 2010). Besides, the location of MCMA on a former lake and the lack of natural outputs for produced sewage from the basin, have forced the construction of massive infrastructure in order to prevent periodic floods that whipped the city.

The "Metropolitan system of sanitation and flood control" consists of all "sewers that collect waste and storm water" (Merino 2000, p. 346). Sanitation infrastructure is actually a complex system ranging from primary and secondary pipeline networks, water collectors or even pluviometers (Table 2).

Table 2: Sanitation and flooding system of the MCMA, 2011.

	Unit	
Primary pipeline network	Km	2 107
Secondary network	Km	10 237
Pumping stations	Station	91
Sewerage system storage dams	Dam	17
Open channels	Km	124
Enclosed channels [c]	Km	52
Urban area with access to sewerage system	Km2	632
Deep sewerage system length	Km	166
Pluviometers	Station	69

Source: Own elaboration with data from Merino (2000). Updated according to public information access request number 0324000057011, august 15th 2011.

According to Mexico Population Census 2010, sanitation system was connected to 90.1% of inhabited houses of the metropolitan area, with small variations between its three federal entities. While in the Federal District the

coverage reaches 90.9%, in the municipalities of the State of Mexico coverage rounds 89.6% (INEGI 2010). [4]

Caused by Mexico City subsidence, in the late sixties, the Federal Government decided to implement a new method for the removal of wastewater for Mexico basin: a deep drainage system. This system is the third artificial exit for wastewater out of Mexico basin. It consists of a central deep tunnel and 14 interception tunnels with diameters from three to five meters and with a length of 192 km, of which 166 are in operation. This work, together with all those works made since 1900, are the most important parts of a vast sewerage system that covers virtually the entire metropolitan area and that extends outside its boundaries.

Despite this significant effort the historic problem of flooding in MCMA has not been entirely solved. In 2000, 2010 and 2011, for example, the overflow of the "River of the Company" has resulted in significant losses to impoverished areas in the municipalities of Chalco and Ixtapaluca.

Governance of Mexico City Metropolitan Area

The construction of a huge socialized constant capital for the provision of water and sanitation for Mexico City Metropolitan Area (MCMA) has required a historical and substantial investment. These expenditures have been made mainly by the Federal District Government, followed by the State of Mexico Government through its various operating agencies, and to a lesser extent by the Federal Government and the metropolitan municipalities.

Investment in water and sanitation systems is product of an intricate set of relations between the three different levels of government. Water from oceans, rivers, basins, wells and lakes is, according to the Federal Constitution, property of the Nation, and its access, use and exploitation is regulated by the Ley de Aguas Nacionales of 1992. The Federal Constitution guarantees the human right access to water, but also allows its concession to private individuals or companies in order to exploit water from aquifers or dams.

Also, according to the Federal Constitution, municipalities have the obligation to provide water to its citizens. This obligation is not always fulfilled, and in most of the cases is product of the financial weakness of several poor and small municipalities. In Mexico it is possible to find almost every kind of arrangement to provide water and to operate municipal water systems, ranging from Public Entities (SiP), Non-profit entities (SiNP), all of them with different modalities of

[4] Data was calculated according to Instituto nacional de Estadistica y Geografía (INEGI) (2010). In this paper only individual housing units connected to the public network are considered, unlike the INEGI, which defines as houses with access to sanitation all of those that have a drain connected to the public network, septic tanks, gullies or cracks or even directly to rivers, sea or lakes.

partnerships, and also completely private operators or in some cases Private-Public Partnerships.

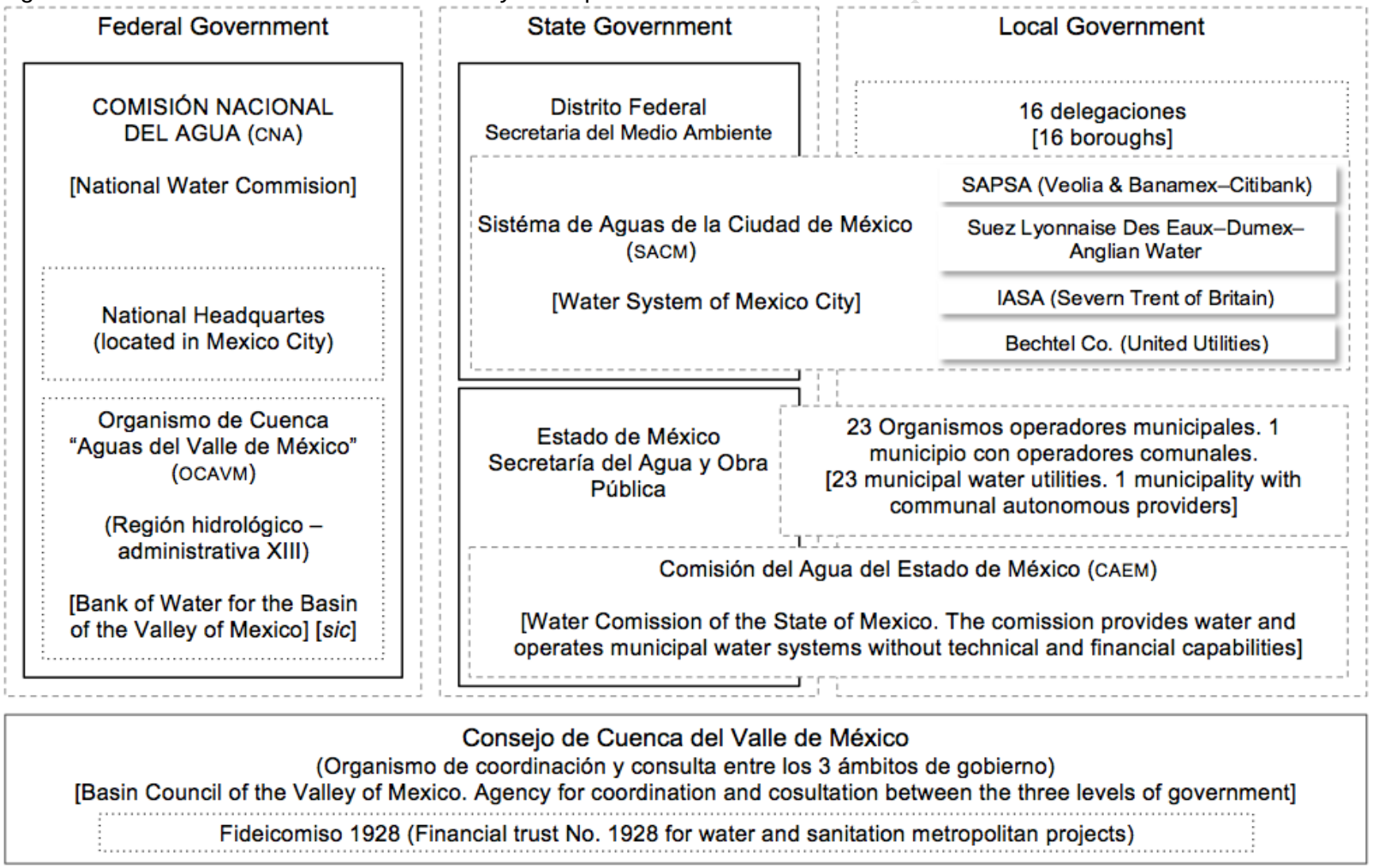
In the Mexico City Metropolitan Area we find a fragmented model for the operation and governance of the different municipal water systems and a peculiar different model for Public agency (SiP) for the Federal District called *Sistéma de Aguas de la Ciudad de México* (SACM). According to the aforementioned Federal Law of Water of 1992, the Federal Government regulates the access to water aquifers or dams through a public decentralized commission called *Comisión Nacional del Agua* (CONAGUA), which regionally operates through 13 hydrological administrative regions, which follow the natural division of the main basins in the Country.

The municipalities are in charged of the provision of water and sanitation in their respective territory, and according to the law are required to achieve financial sustainability and autonomy from their respective Municipal Governments. This is a major issue, especially because municipal companies should be autonomous decentralized entities that are allowed to transfer the water and sanitation infrastructure under the scheme of concession to private companies. The most famous example is the northern Mexican city of Aguascalientes. This municipal water company is considered an example of economic efficiency by Mexican authorities, but it also leads the number of complains by water users and has the higher tariffs of water in the country (Instituto Mexicano de Tecnología del Agua 2013).

The paradox of the water supply system for Mexico City is that despite the fact that the metropolitan area has a continuous urbanized area, following the political subdivisions, is operated through 1 federal agency (CONAGUA), 1 state commission, the *Comisión de Aguas del Estado de México* (CAEM), a financially and legally non-autonomous entity for the Federal District (SACM), 23 decentralized municipal entities, and also 1 municipality, Tezoyuca, which successfully operates the public service of water through self-governed public committees in each neighbourhood or town. The Federal District is divided in 16 boroughs (*delegaciones políticas*), which are in charged of the operation and maintenance of the secondary water and sanitation network in coordination with the SACM (Figure 2).

In order to try to coordinate this wide range of public entities there is an agency or Basin Council for the Metropolitan Area called *Consejo de Cuenca del Valle de México.* Metropolitan projects that require investment from two or more municipalities or the Federal District are funded by a trust called Fideicomiso 1928, which distributes and transfer money with the specific purpose of building new infrastructure or to improve the existent.

Figure 1: Governance of Water in Mexico City Metropolitan Area



Source: Own elaboration according to Jímenez Cisneros *et al*. (2011, pp. 127–142).

From public to public-private to public: Sistéma de Aguas de la Ciudad de México

For private individual capitalists it is very difficult to invest in water and sanitation infrastructure, under current economic conditions. Usually, private participation is limited to the commercialization or marketization of water, with a lack of investment in new infrastructure. It is important to remark that the public service of water and sanitation is indispensable for the social reproductive process, so the intervention of the state for financing its construction is usually indispensable. The public nature of the general condition and service of water and sanitation, is product not only of their scheme of governance but mainly from the historic accumulated value in this form of social fixed capital. This dialectical relation needs to be fully understood in order to address the dangerous issue established by national development policies in Mexico that indicate that "the best way to ensure the sustainability of the resource is given through proper economic assessment" and with a "fee structure [that should reflect] the actual carry cost of water from its source to the place where it will be used" (CONAGUA 2006c, p. 52).

Following such neoliberal principles, in 1994 the government of the Federal District granted in concession the commercialization of water to 4 transnational companies: Servicios de Agua Potable (property of Veolia and the Citybank), Industrias del Agua (owned by Severn Trent of Britain), TECSA (a joint venture of Suez Lyonnaise Des Eaux-Dumex and Anglian Water), and Agua de México SA (Bechtel Co.-United Utilities). This pseudo-privatization was unattended by the population of Mexico City mainly because it was an undercovered concession of the commercialization of water in Mexico City. The 4 companies operated under the institutional image of the SACM, and also because the infrastructure, assets, financial control, operations and maintenance of water and sanitation infrastructure remained under control of the local government.

The private participation was limited to water metering, billing, and to restrict or cancel the provision of water to 'users'. The fee collection for the access to water and also the different tariff were heavily incremented during the period 1994-1997 product of private participation. In contrast the subsidies and investment of government rounded the (2008 USD) $2.12 billion for the period. In 1997 the Federal District, capital of the country, achieved its autonomy, becoming a self-governed city with its own elected mayor and legislature. This democratic change was reflected not only in the arrival of the left to the local government for first time in Mexico's contemporary history, but it changed also the concept of public and access to urban services, specially to water, sanitation, health and public space.

The leftist mayor of Mexico City elected for the period 2000-2006, Andrés Manuel López Obrador, restricted private participation in water commercialization and modified the legal regime and structure of the SACM. The SACM became a fully public entity with control over the assets, investment, tariffs, operation and maintenance. Maybe the most important change was the change of regime of the SACM, from a decentralized financially autonomous public company to a financially

and legally non-autonomous entity, which finances were part of the whole Mexico City government. Although literature about public services and common goods encourage autonomy and locally operated systems, the scale of the state-owned SACM, requires in order to provide water for more than 9 million people, the financial support and the direct transfer of public money to successfully operate. In the period 2000-2006 the total expenditure and investment of the leftist government of Mexico reached the (2008 USD) $5.5 billion, equivalent to USD $637.1 per capita.

The 4 private companies were, during the period, as any other private or public company, contracted to supply auxiliary services for the commercialization of non-valorized and subsidized water to the inhabitants of the Federal District. Despite the success of the actual regime of the public entity SACM, and the higher efficiency and coverage in comparison of the State of Mexico, major inequalities persists in Mexico City. In some localities, between 3 and 6% of the population of the Federal District, particularly in the poorest localities, the access to water is not guaranteed, and the inhabitants have to appeal to alternative ways to obtain water, usually with higher costs per liter and without achieve the minimum normative provision of water, sometimes $10 USD per 200 liters (González 2013).

Water system as a mean of collective consumption

Since 1930 until 1985, a process of rapid industrialization accompanied the growth of the population of Mexico City. Both have been considered the main factors behind the steady increase in the demand for water in the MCMA (Aboites 2009, p. 38; Garza 1985, p. 266; Perló & González 2005, p. 51).

The main problem of water supply to the MCMA is that under the current management model, the water supply system needs to import significant volumes of water from distant basins, generally located at altitudes more than 1 000 meters below the level of the city. In addition to the substantial investment for the construction of these works, the model of provision of vital fluid generates high costs for its operation and maintenance.

Table 3: MCMA water volume from 1930 to 2010. (M3/s)

Volume and source	1930	1940	1950	1960	1970	1980	1990	2000	2010
Total volume	3.10	4.30	10.80	21.00	36.00	50.26	60.30	67.30	70.52
Federal District	3.10	4.30	10.80	21.00	28.10	38.26	35.30	35.10	35.41
Metropolitan municipalities					7.90	12.00	25.00	32.20	35.11

Source: Own elaboration according to (CONAGUA 2005, p. 8, 2009; Encinas 2006; Garza 1985, pp. 268, 387–389; Joint Academies Committee on the Mexico City Water Supply et al. 1995, pp. 22–27; Perló & González 2005, pp. 59–61)

From 1970 until 2010 the water flow supplied to Mexico City has doubled, from 36 to 70 m^3/s (Table 3). The problem is that the growth rate for the supply of drinking water to the metropolitan area is lower than the rate of the growth of its

population. It is important to note that the real supply of drinking water per capita (liters/per capita/day) constantly diminished over the last forty years. The decrease of the real supply could not been stopped despite the building of the Cutzamala system, which contributes with the 20% of the water supplied volume to the metropolis.

These problems are also associated with an inequitable distribution of the vital liquid inside the city. While certain boroughs and municipalities reach between 491 and 567 l/c/d, neighbouring municipalities on the east side of the city, operated by autonomous municipal companies, are below the minimum suggested by United Nations (Metrópoli 2006, p. 137; Perló & González 2005, p. 72).

However, the provision of drinking water is nowadays a general public service which allows an adequate social reproduction of the MCMA labour force, besides that the water infrastructure has collaborated "decisively in creating the great city that is Mexico City today" (Bassols Batalla 1993, p. 29).

MCMA: investment in water and sanitation

The Federal District between 1929 until 2012 made all of the investments and expenditures in water and sanitation in a centralized way, transferring minimal amounts of money to the boroughs administrations and just for maintenance. There is an easy access to historical data, online and in public registries, for the entire 20 century. Also, the legislature of the Federal District revies the public accounts of the Water System in order to program tariffs and next year expenditure. In comparison, in the State of Mexico, expenditures in water and sanitation, despite that also have been made by public water companies, have been made by the three different levels of government (municipal, state and federal government), so the access to data

The evolution of the expenditures in MCMA water and sanitation infrastructure shows, first, a considerable growth for the last 40 years (Table 4). The gross investment realized until 1970 in the Federal District represents only 7.1% of the accumulated value between 1971 and 2009, which means that total expenditures, multiplied 15 times during the last 40 years, while the population grew only 1.3 times.

Given the reduction in the rate of total expenditures for water supply and sanitation, it is possible to observe that the average annual cost per capita tends to increase in the last 40 years, having doubled between the seventies and the first decade 21st century. The data in table 4 shows also the existence of decreasing returns of scale in water supply and sanitation in Mexico City.

Table 4: Federal District, economic value and average investment in water an sanitation.
(2008 USD x 1000)

Year	Annual average incomes	Annual average total expenditure	Investment		Annual average deficit	Accumulated Value for the last year
			Water	Sanitation		
1980 - 1989	80,383.02	542,823.15	109,563.39	115,456.06	-462,440.13	5,450,781.62
1990 - 1999	287,527.63	843,795.68	101,548.37	169,247.43	-556,268.05	7,934,330.10
2000 - 2005	381,089.33	769,516.54	82,367.49	95,249.50	-388,427.22	9,623,933.92
2006 - 2012	393,448.54	918,675.44	165,750.25	126,653.99	-525,226.90	11,145,094.86

Source: Ministry of Finance, Public Accounts of the Federal District Department, yearbooks from 1970 and 1974 to 1997 (SHCP, Mexico, various dates), and the Federal District Government, Public Account of the Government of the Federal District, yearbooks from 1998 to 2009 (Ministry of Finance, Mexico City, various dates).

Unlike the Federal District, it was not possible to construct a historical series to obtain the value and expenditures in water and sanitation for the metropolitan municipalities of the State of Mexico.

Economic value of Mexico City's water and sewerage system

For the last forty years Mexico City has had growing requirements of drinking water, a fact which required to build monumental works to allow the transfer of water from distant basins to the metropolitan area, and the expel of rainwater and sewage through a complex system of sewerage. The development of this huge infrastructure is reflected in the value of this fixed capital.

The total expenditure in the metropolitan water supply and sanitation system between 1980 and 2009 amounted the considerable sum of MXN $295,217.7 millions). The per capita value of water and wastewater infrastructure increased from MXN $1,322 pesos in 1930, to MXN $6,114 in 2010.

Accumulated value, considered as equivalent to replacement costs of water and sanitation infrastructure of Mexico City is even similar to the economic value of water supply and sanitation systems of global cities like New York and Los Angeles. It is estimated that the value of the infrastructure for MCMA is equivalent to USD $19.5 billions (including the State of Mexico), while the value of the infrastructure of the City of New York would be around 16.1 billions and Los Angeles of approximate 4.5 billions (Los Angeles Department of Water and Power Water System 2010, p. 13; New York City Water & Sewer System. A Component Unit of The City of New York 2009, p. 16).

Per capita value of water supply and wastewater infrastructure, according to the previous calculations is USD $1,002.04 for Mexico City, 827.28 for New York City and 351.04 for Los Angeles. Data reveals the complexity of water infrastructure of the MCMA, and that an important aspect of what constitutes the public of the services of water and sanitation is the accumulated value in a colossal socialized fixed capital required for the reproduction of its society, but also in order to consider the city as a productive force. Mexico City, despite its inequality and high rates of poverty is classified in the eighth place according to its gross domestic product, while New York and Los Angeles are classified as the second and third largest cities in the world (Hawksworth, Hoehn, & Tiwari 2009, p. 31).

CONCLUSIONS: PUBLICNESS AND THE ACCES TO WATER AS A HUMAN RIGHT VS. COMMODIFICATION OF WATER

In 2012 the Federal Congress of Mexico approved a modification to the Constitution in order to consider the access to water and sanitation as a human right. However, this normative aspect does not ensure the existence of public companies or public arrangements to provide water to Mexican population. On January 14, 2014, the CONAGUA presented a draft to modify the *Ley de Aguas Nacionales* [Law of National Waters] of 1992 , where it was stated that "[a]lthough the Constitution establishes the human right to the water, this does not imply its gratuity. In order to guarantee the access of the population, market, economic, and environmental incentives should be established" (Enciso 2014).

In opposition, in the Federal District, the local legislature, the ALDF, modified the local law in order to ensure that if the citizens are not able to pay the tariffs for the service of water, a minimum and adequate amount of water should be supplied through the network. Also the elderly and disabled people are exempted of any payment for the water service. The operation of the water service of the Federal District contrasts with management of all the other smaller municipalities that form part of the MCMA. The way that SCMA is operated is not the ideal scheme of governance, or could be applied to other cities, but constitutes a successful public alternative to neoliberal policies that have tried to establish processes of marketization and commodification of water.

Despite the aforementioned, in Mexico, and especially in Mexico City, since the outbreak of the epidemic of Cholera in 1991, it has been socially constructed with the help of mass media, the idea that the water provided through public supply systems is not safe for human consumptions, despite the fact that several quality controls and a high percentage of yearly expenditure goes to water purification. According to public sales reports of Coca-Cola Co. (FEMSA) and Cultiba (under license of PepsiCo Inc.) two of the main bottled water providers in Mexico, I have estimated the bottled water consumption for Mexico and Mexico City (Table 6)

Table 6: bottled water sales and consumption in Mexico and MCMA, 2012.

	Mexico			MCMA	
	USD (x 1000)	*l/c*	*l/c/d*	*l/c*	*l/c/d*
Total	13,379,782	196	0.54	280	0.77
The Coca-Cola Company	3,144,249	46	0.13	66	0.18
PepsiCo Inc.	2,542,159	37	0.10	53	0.15
Groupe Danone	3,545,642	52	0.14	74	0.20
Others	4,147,732	61	0.17	87	0.24

Source: own calculation according to Cultiba SAB de CV (2011), Coca-Cola FEMSA (2012), PROFECO (2007).

According to table 6, Mexico would be the first consumer of bottled water in the world, above countries like Italy and the USA. Annual sales of bottled water approximate USD $13.4 billion. The challenge for municipal water providers is to challenge the social construction of the lack of quality of the water provided through the public network. That is probably the biggest challenge in order to challenge the processes of commodification of natural resources and of public services. The main task for social researchers is to discuss and provide different alternatives from an academic perspective of successful public companies for urban services .

The objective of this paper was to propose as an alternative and discuss the public nature of the water supply providers of the MCMA. The hydraulization process of the territory where Mexico City is located was presented as a required condition for the growth and development of the Capital of the Republic and its population. The analysis reveals also a high environmental, social and economic vulnerability of the metropolis, which arises from the adoption of a model that requires increasing expenditures for the construction and maintenance of its infrastructure and that leads to the overexploitation of the aquifers located in the Basin of Mexico and to import water from distant sources. Paradoxically, at the same time it is required to expel storm water out of the basin through a complex and expensive system, in order to trying to avoid the high risk of the historic floods of the city.

One of the main difficulties for the elaboration of this paper was to determine the value of the water and sanitation infrastructure for the metropolitan area, showing an accumulation process of a public fixed capital superior in magnitude to most of the private producers located in Mexico City. Regarding the high value of the water supply infrastructure, it has been a steady increase of the per capita value over the last four decades.

To ensure the future sustainability of Mexico City, further research is required to review the current model of exploitation of water resources and to fully understand the public nature of the water supply system, which is perhaps, the most important general condition and service of production in the history of the city.

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