WATER SUSTAINABILITY IN THE LITERATURE FROM 2020 TO 2024

Maria del Rosario Molina Gonzalez[1*]
Universidad de Sonora, Mexico

Cruz García Lirios[2]
Universidad Nacional de La Plata, Argentina

***Corresponding Author:** Maria del Rosario Molina Gonzalez

ABSTRACT

The Social Sciences have contributed to the study of Sustainable Development from economic analysis, political, social, psychological and media on the consumption of natural resources in reference to their availability, extraction, and distribution, supply and recycling. In this sense, the objective of this work is to outline eight areas for the analysis of water issues. The relationship between availability and consumption of water belonging to the public supply network is described to establish a system of water tariffs set to situational water areas. In the case of water consumption rates, they seem to be due to public policies "clientelistic" that make it unfair charging system, subsidies, penalties, trading and transparency. The prevalence of clientelist system encourages water and increases the problems of conflicts between citizens and government through neighborhood networks against administrative authorities. In the future, the trend of availability and water consumption seems to outline a situation of extreme scarcity in which conflicts over water supply will be an indicator to explain economic crisis, political, social and individual. The discussions of water issues that prevent humanity develop sustainably contribute in building a public agenda water.

Keywords: *Availability, Distribution, Supply, Consumption, Rate and Water Sustainability.*

INTRODUCTION

Global to local water situational trends are presented in order to project the corresponding water sustainability. In this sense, public policies are essential to establish the costes of water supply. However, citizen, community and neighbourhood participation is also essential in the establishment of unit water prices.

Thus, at the global level, water sustainability is determined by public policies that encourage water savings through international tariff standards. The price of water would be a consequence of international agreements in which the signatory countries commit to reduce their agricultural, industrial and commercial processes. The unit cost would be defined by the level of availability per capita. A larger amount of water for each person would imply a standard cost for the claimant. Consumption above a threshold would exponentially increase the unit price. Globally, costs would be reduced and profits would increase substantially. However, presidents or ministers cannot make global decisions without compromising local development.

In this sense, at the continental level, the relationship between the industrial north and the agricultural south, trade between economic blocs, has a direct impact on the financial and migratory flows that must be considered in the equation of a public policy for water sustainability. At the level of the continents, the establishment of a system of charging for water service is more feasible if we consider the trade agreements between the members of the economic blocs. As a geopolitical group, a public tariff policy would be geared towards subsidizing rich citizens for the subsistence of poor residents. It is a tariff system in which those with greater purchasing power pay a standard tariff that includes financing for those who live in exclusion, marginalization or vulnerability. However, localisms continue to have a specific weight when establishing standard rates and therefore it is necessary to review the national level to clarify the factors that impede sustainability at the continental level.

One cause of economic blocs has been nationalism. From the nationalist conflicts that led Europe to create a common market, to the regionalisms that today promote the collapse of monarchies in Africa and the Middle East, local ideologies have determined the future of societies. In Mexico, conflicts over the right to water have been mitigated by centralist and federalist public policies that justify the extraction and distribution from one basin to another. The State, through the estimates of the Ministry of Finance and Public Credit (SHCP), the Bank of Mexico (WB) and the National Water Commission (CONAGUA), has established public policies aimed at economic growth rather than sustainable development. The State ignored the water rights and assets of rural communities and urban neighborhoods. In this sense, each unit of water has a different and inequitable price. Water is cheap for those who have greater purchasing power and consume more. On the other hand, groups that save water, despite being unemployed or underemployed, pay five times its real cost. However, national water policy is diversified at the state level.

In a federalist country, state governments are a counterweight to the omnipresence of the executive. A president's initiative can be amended by the upper and lower house, the state congress, and the governor. If we add to this the altitude at which rural communities and urban neighborhoods live, we have that states would legislate a differential rate system for each entity. For this reason, the state's water sustainability would have its main obstacle in the finances of the states. Often, state governments spend more than they receive from the federation. This encourages national and local operating bodies to seek agreements to build a subsidy system that benefits users with low prices. The result is a public action organized for collection but disorganized for supply. Without fail, bills are distributed to users but water service is intermittent. For this reason, state water sustainability benefits cities to the detriment of rural areas.

The Metropolitan Area of the Valley of Mexico (ZMVM) is a paradigmatic case of the water trend in the history of humanity. The MVMA has always been a repository of rainfall, seepage and discharge from rivers and lagoons. It could be said that since the founding of the Valley of Mexico there was an obvious overload. Over the centuries and cultures, the basin has been emptied. It is estimated that the current extraction trend would last for about two or three decades to compromise its structure. This geographical complexity is no less than the socio-political complexity. The Valley of Mexico is administered by three entities with their respective congresses. A metropolitan water policy would be defined by representatives of different localities with different needs, expectations and consumption capacities. However, the Mexican Political System (SPM) is characterized by homogenizing the demands of the people and the corresponding offers. On the basis of this structural political feature, a water policy price system is in reality a system of concessions, subsidies and forgiveness. It is a public policy that does not need to be legislated in order to be implemented. At election time, the efficiency of the political system uses the drinking water service as its instrument for promoting, defining and electing candidates and representatives. In this way, metropolitan water sustainability is discretionary, proselytizing and clientelistic. Consequently, at the delegation level, corruption, nepotism and clientelism are its main components.

A consequence of the complexity of the Valley of Mexico is its delegational and municipal demarcations. The diversity of factors that influence metropolitan water sustainability also has an impact on water sustainability at the delegation level. However, delegations are grouped into two groups: inclusive and exclusionary. The former have a low population density and high incomes that would allow them to pay for an exponential increase in rates. The latter are overcrowded, unemployed or underemployed with insufficient income to afford a minimal variation in the unit price of water. In the case of the Iztapalapa delegation, we should add the altitude and the corruption in which the neighborhoods with the greatest shortages and unhealthiness live. It is a delegation in which various factors converge and brings its inhabitants closer to a water crisis. This situation favors the emergence of the location or intentions-actions of non-conformity, protest, confrontation or boycott aimed at obtaining a greater amount of water. Thus, water sustainability in Iztapalapa would require rates adjusted to the uses and customs of its inhabitants who fight corruption but at the same time accept clientelism. In this sense, family-residential lifestyles complement their collective mobilizations.

In the residential environment, water scarcity is the main trend that would lead families to hoard, dosage and pseudo-repair leaks. Indeed, a tariff system in line with austerity strategies would imply consumption thresholds determined by the number of residents, their economic activities and types of recreation. At the level of households, water sustainability means a subsidized payment to those who save water and an exponential price to those who waste or hoard it. Consumption skills and pseudo-leak repair would imply a smaller subsidy that would fit a standard price considering the future trend.

Finally, the water trends presented project future scenarios in which urban density is a global, national and local problem that affects water sustainability. In other words, the expected per capita availability for the coming years is a consequence of public policies that seek to curb the water trend rather than make it sustainable. In this sense, the disappearance of standard, subsidized, situational, interval or tariff threshold systems is predictable. Instead, a new pricing system will need to be implemented to address structural flaws. It is a tariff system determined by global to local water contingencies.

Regarding environmental problems, the social sciences propose the following approaches:

Regional-Community Studies. Water issues, related to solidarity in times of scarcity and festivity in times of plenty, are felt as elements of the community. Community self-management is the main manifestation of global water imbalance with local scarcity effects. That is to say, the lakes, rivers, lagoons, aquifers or glaciers that historically belong to ethnic communities, when overexploited by the cities, propitiate mobilizations in defense of the community heritage for its preservation. In this sense, Sustainable Development is comparable to the self-management of communities due to their historical right to water as their subsistence heritage (Breña, 2004: 40).

Legal Studies. The main problem is the defense of the rights to access and consumption of water. In other words, the aquifers, lakes and rivers that belonged to ethnic groups were expropriated by their governments and redistributed to areas of industrial or agricultural economic development (Morales, Rodríguez and González, 2007: 225). Once again, Sustainable Development is the solution to the problem of the legal recognition of peoples to their self-determination. Sustainable Development is conceived as a document, treaty or agreement in which the laws or principles of the relative autonomy of peoples, groups or human settlements are embodied. Institutions such as the secretariats of the environment or the human rights commissions act as zealous watchdogs of the agreements that the states have signed to control their abuses over the communities and the resources that correspond to them (Hernández, 2004: 330).

Economic and Social Studies. Water problems are studied in relation to human development indices. Ideal human development is related to the optimization of water resources. In contrast, impoverished human development is linked to scarcity, corruption, leakage, and waste. From the economic sciences, the dilemma of the capitalization of natural resources versus their conservation is posed. Faced with such a dilemma, Sustainable Development is proposed instead of economic growth and the preservation of the environment (Corral, 2010: 123). Water economic approaches establish water-saving mechanisms based on tariff systems. The price of drinking water services is established by minimizing or maximizing the relationships between services, their costs and their benefits in exchange situations (Dávila and Constantino, 2007a: 185). In this sense, an increase in unit water prices has an impact on the reduction of consumption and distributive equity. Precisely, in the ZUPs subsidies are established, while in the ZUC incentives are established for the optimization and treatment and reuse of water. Economic organizations such as the International Monetary Fund or the World Bank measure sustainable development based on indices specialized in establishing the causal relationship between per capita income and health, work, education, food, quality of life or subjective well-being (Goicoechea, 2007: 265).

Political-Social Studies. The impact of the scarcity of water resources on the central and peripheral areas of public investment decisions is the problem that frames the study of conflicts between citizens and their authorities. There are two water problems: equity and service financing (Dávila and Constantino, 2007b: 160). Faced with the demands of the citizenry, the rulers offer greater coverage by overexploiting aquifers and filtering wastewater (Goicoechea, 2004: 125). It is a public policy guided by sustainable planning; comprehensive, efficient, equitable and inclusive (Morales and Rodríguez, 2007a: 290). Demands for water resources are manifested in sit-ins, rallies, marches, propaganda and confrontations with the police. Citizen mobilizations are analysed as "clienteles", a mechanism of political electoral control by parties over excluded groups (Cunill, 1991). Faced with such problems, solutions are studied that revolve around an electoral reform in which the rulers offer greater transparency in the management of resources in exchange for greater citizen participation in elections and accountability (Chávez, 2004: 135; López, 2004: 107). In this sense, the legislative branch and its initiatives that allow the direct participation of the majorities and especially the minorities, the main victims of economic growth at the expense of overexploitation and scarcity of resources, in investment and financing decisions for personal and group development are studied. Sustainable Development is the product of debates between citizens and the state, it is an agreement in which both political figures agree on the rational, planned and moderate exploitation of water resources.

Sociological Studies. Water problems focus on environmental uncertainty. The environment is considered as a set of immeasurable, unpredictable and uncontrollable variables that exhibits humanity and its societies as part of the process of evolution and transformation of nature. In other words, nature has gone through different evolutionary stages and the climate change that we are experiencing and suffering today is just one more stage in the development of the Earth. At that stage, humans will become extinct unless their systems can slow the effects of climate change or adapt their descendants to the environmental contingency. The sociological sciences posit risk societies in which technological advances such as nuclear power plants, air transport or water infrastructure can collapse at any time and thus compromise the growth of current and future generations (Ramos and Lorda, 2004: 70). Sustainable Development is a context of certainty in times of risk, a context of security in times of uncertainty, a context of trust in times of negligence and corruption.

Psychological Studies. Water problems consist of the impact of water availability on perceptions, emotions, attitudes, motives, intentions, skills, competencies and behaviors (Corral, 2010: 156). Scarcity, shortages, hoarding or unhealthiness have a direct effect on water saving. This effect is also mediated by cognitive variables (Corral & Pinheiro, 2004). Psychologists carry out the reliability and validity of instruments that measure these variables in order to relate them to other situational, demographic, educational, or geospatial variables. Sustainable Development consists of the adoption of anti- or pro-environmental cognitive and behavioral styles.

Public policies determine global, continental, national, state, metropolitan, delegational, residential, and prospective water sustainability. Public policies try to organize the determinants of water availability based on tariff parameters for the financing of water sustainability. An increase in the unit price of water service has a direct, positive and significant impact on its optimization and savings.

In this way, public policies have created seven tariff systems to guarantee water sustainability.

Fee per standard. The rate per unit of water is independent of the amount of water consumed.

Volume fee. The unit price of water depends on how much is used. It increases or decreases based on government discretion.

Rate per situation. The rate per unit of water increases your cost during the day and decreases your cost at night. During the summer season its cost increases and during the rainy season its unit price decreases. It is equitable and saves the cost of pumping and purification.

Interval rate. The unit price of water increases according to the volume consumed. From the consumption intervals, prices are applied that increase as consumption exceeds the permitted thresholds.

Threshold fees. The unit price of water is constant as long as it does not exceed the comfort threshold. Once the allocated consumption has been exceeded, an increment is applied, linear, logarithmic, exponential or logistical.

Self-financing fee. The unit cost of the service is established based on family income and a comfort threshold. Once the allowed limit is exceeded, the cost increases for each extra cubic volume.

Subsidy fee. The unit cost of drinking water service involves a standard or tiered fee and a subsidy based on a comfort threshold.

Global Scope

Global water situations are significantly related to population size, distribution, and density (see Table 1). In 1960 the Club of Rome, based on the observations of economist David Ricardo made in the previous century, was the first environmental scientific group to demonstrate a direct association between population growth and decrease in hydropower resources. However, this distributive law was used by governments to hold individuals accountable around their exponential and indiscriminate reproduction. States considered that individuals should reproduce as a function of economic growth and technological advances (Leff, 2002: 2004). The Cold War seemed to have a greater impact on the overpopulation of developed and peripheral countries, thus initiating the imbalance between the availability of resources and the needs of the predecessor, current and succeeding generations (Guillén, 2007). In fact, the Club of Rome had only established the inverse relationship between the quantity of natural resources, their consumption and their renewal, but did not consider in its diagnoses the symbolic determinants such as; norms, values and beliefs that prevent humanity from developing sustainably.
However, in its 2010 report, the European Water Statistics Agency (AQUASTAT) warns of a historical trend in which the availability of resources descriases as a function of population growth, urban needs, capacities and consumption expectations.

Table 1. Global scope of the water situation

Year	Situation	Tendency
1800 1900 1925 1950 1960 1975 2000	History	The population was 1000 million Water consumption for agriculture was 300 km3, domestic use was 50 km3 and industry was 25 km3. Agriculture consumed 400 km3 and domestic use and industry did not show significant changes. Agriculture consumed 800 km3 of water, domestic use and industry did not significantly increase its consumption, and hydrological availability was classified as very high in most areas of the planet. 33% of the population lived in cities Agriculture used 1400 km3 of water, domestic use and industry did not increase their consumption, water reserves increased to 100 km3 The population was 6 billion, about 44% of the total population lives in cities. Agriculture reached the figure of 1800 km3 of water consumed and water reserves were 150 km3, about 1000 million had no access to supply.
1900 2000	Population	There were 1.6 billion There were 6 billion
2004	Shortage	Critical between 1000 and 1700 cubic meters per capita per year, low between 1700 and per capita per year, average between 5000 and per capita per year and high per capita per year5000 metros cúbicos10000 metros cúbicos10000 metros cúbicos
2004	Investment	$70 billion was invested in water infrastructure.
2004	Distribution	97.5% is salty, 2.24% is fresh, 60% is concentrated at the poles, 30% is located in aquifers and only 1% is available in rivers and lakes for human consumption. 113000 km3 of water, precipitate annually, 7100 km3 evaporates, 42000 km3 returns to the oceans and seeps into aquifers. 23.8 million km3 of water is frozen, 74200 km3 evaporates, 119000 km3 precipitates on the continents, 458000 km3 precipitates into the sea, 502800 km3 evaporates from the oceans, 10.4 million km3 are deposited in aquifers, 900900 km3 are available in lakes, 1,350 million are deposited in the oceans.
2004	Availability	Annually, in the oceans (which contain 1.35 billion km3), the hydrological cycle involves the evaporation of 502 800 km3 of water, of which 458 000 km3 returns in precipitation, 42 600 km3 returns in surface spills and 2 200 km3 in groundwater spills. On continents (containing 23,800,000 km3 of water in ice and snow, 10,400,000 km3 in aquifers, and 901,000 km3 in lakes and rivers), 119,000 km3 of water precipitate and 74,200 km3 evaporate per year. 70% between 9000 and 14000 km3 annually maintain ecosystems and only 4200 km3 (30%) is available for irrigation, industry (23%) and domestic use (8%).
2007	Utilization	75% of the water was used for food production and 25% for urban, public and industrial use.
2001 2004 2005 2007	Exclusion	One billion people did not have access to water and 2500 do not have sanitation Between 3 million died from hydrotransmitted diseases, 15% of the population is dehydrated 21% of the population was excluded from access 1.1 billion people, about 18% of the world's population, do not have access to water. 2.4 billion do not have sanitation and around 2.2 billion children die from waterborne diseases.
2004	Sustainability	An investment of 180 billion annually is required to achieve water sustainability and contribute to the eradication of 2 billion poor people.

Fuente: AQUASTAT (2010), FAO (2010), OMS (2010), ONU (2010), UNICEF (2010) the USCB (2010)

Indeed, with migration from the countryside to the cities, lifestyles changed. The increase in rural populations, urban density and economic growth determined new norms, values and beliefs about nature that considered it a set of inexhaustible and immeasurable resources. Currently, the trend seems to be towards a direction in which manufacturing industrialization is no longer responsible for the imbalance between the availability of resources and the population rate. Now that the population has reduced its trend, its needs, capacities and consumption expectations seem to be the causes of the highest water consumption in history. Thus, agriculture and industry are the biggest water demanders and underground aquifers are the biggest suppliers.
The global water situation seems to be determined by economic growth which, once basic needs were met, increased consumption capacities and expectations. Despite the fact that the population trend has been reduced, inequalities between developed countries and emerging nations seem to determine the drastic decrease in water per capita
In this sense, global water sustainability would be indicated by *global policies that are based on the establishment of the unit cost of water based on population growth, distribution, scarcity, availability, use, exclusion and investment.* If this is the global trend, then you would have to look at the data for the continents to corroborate this trend.

Continental Scope
The continental water situation is indicated by contradictory differences between capital, availability, extraction, supply, and migration (see Table 2). There is an inverse relationship between the water capital of each continent and per capita availability. While the former remains constant, the latter has shown an accelerated decline in recent years. This scenario contrasts with the levels of extraction in which the basins are highly overexploited, but the supply presents a slowing supply. Even the migratory factor from continents with low water availability to continents with medium availability substantially decreases the amount per capita. In this sense, the continental water situation would be determined by migratory flows, which in turn are determined by financial flows. In other words, an increase in foreign direct investment (FDI) leads to an increase in migration from the southern part of the continents to the northern latitude. As a result, water availability is uncertain in rural communities and urban neighborhoods (Wong, 2004).

Table 2. Continental scope of the water situation

Year	Situation	Tendency
1950 1975	History	Only North Africa and the Middle East were showing low availability. The United States, Mexico, and the rest of Asia and Africa were annexed as regions with low availability, and North Africa and the Middle East catastrophically decreased their hydrological availability.
2004	Capital	Brazil with 7,430 million cubic meters per year, Russia 4,350, Canada 3,300, China 2,880, Zaire 1,300 and Colombia 110 are the countries with the largest water capital. Cyprus, Israel, Libya, the United Arab Emirates and Mali are all suffering from shortages.
2004	Extraction	Sub-Saharan Africa and the Middle East, with 90 percent of their aquifers extracted, are the areas with the highest hydrological pressure. In contrast, Canada and Eastern Europe, with less than 25 percent of their aquifers extracted, are the areas with the lowest hydrological pressure.
2004	Availability	Europe has 8576 cubic meters per capita, North America with 16369, Latin America with 38562 and Africa with 5488; Egypt with annual water per person and the United Arab Emirates with annual per capita are the continents with the lowest water availability. In contrast, Suriname with per person per year and Iceland with annual per capita are the countries with the highest water availability. 21 $m^3$61 $m^3$479 000 $m^3$605 000 m^3
2004	Supply	It is 100 percent covered in North America and Europe, with Africa being the continent where only half have both services. Latin America, Asia and Oceania have similar coverage percentages of 75 per cent for supply and 60 per cent for drainage. In Latin America, 84% have access in cities and 41% in the countryside. Around 128 million do not have access to the resource.
1960	Migration	Developed countries concentrate 22 percent of the population in cities, currently 40 percent live in cities. In the case of emerging countries, 61 percent were concentrated in cities and today it has increased by 10 percent populating the periphery of megacities. Finally, the United States is the main recipient of migrants: 12% of its 286 million inhabitants are migrants, 16.8 million of Mexican origin with U.S. nationality and 9.9 million illegal Mexicans. Indeed, migration from Mexico to the United States has increased considerably since the 1990s. From 1990 to 2003, 5.7 million Mexicans out of an annual average of 438,000 people have entered the United States illegally.

Source: AQUASTAT (2010) and USCB (2010)

Faced with a continental water situation determined by financial and migratory flows, continental water sustainability would be indicated by *regional public policies of the economic blocs that are based on the establishment of unit water rates determined from the contradictions between capital, extraction, availability, supply and migration.* In other words, the water situational trend seems to indicate an imbalance between water availability and human needs. However, there would be enough water if it were distributed equitably across continents. Of course, this trend has a direct impact on the national water situation.

Nationwide

The national water situation is determined by a variety of socio-environmental factors; territorial extension, hurricanes, disasters, public investment, volume of basins, aquifers, dams, level of extraction, population increase, urbanization, availability, quality, use, supply, leaks, runoff, agriculture, industrialization, thermoelectric plants, deficit, pollution, treatment and exclusion (see Table 3).

Based on the diagnoses of the National Water Commission (CONAGUA), the National Institute of Geography and Informatics (INEGI) and the National Population Commission (CONAPO), a consequence of migration from the south to the center and north of the country stands out, which is exclusion. Due to the centrality of the federation, agriculture is concentrated in the centre of the country, but it is industry and commerce that demand a greater volume of water to provide work for a high percentage of the economically active population. However, per capita availability in the center of the country is very low compared to the south, where the amount of water per person is very high, but whose productive function is lower in activity and wages than workers in the north who suffer from severe water scarcity (Aldama, 2004). It is also important to point out that a factor of water exclusion in the north of the country is the high percentage of communities located at an altitude above 2000 meters where the cost of energy for pumping would exceed the unit price of water (Toledo, 2002).

Table 3. National level of the water situation

Year	Situation	Tendency
1950 **1995** **2000** **2010**	History	There were 12,885 cubic meters per capita Decreased to 3,921 cubic meters per capita A population of approximately 100 million, a growth rate of 1.8% Between 13 and 28 million people did not have access to water
1995 **2007**	Territory	1,967,183 cubic kilometers; 31% is arid, 36% semi-arid and 33% sub-humid and humid. In the north, 755 of the population lived above 1000 meters 60% of its territory is under conservation around 88500 hectares
2004	Hurricanes	Of the 48 hurricanes that have hit the country since 1980, the H5 hurricanes on the Safin Simpson scale stand out, such as Gilberto in 1988, H4 hurricanes, Wilma in 2006 and Emily in 2005.
2004	Disasters	Annually, material and natural losses from hydrometeorological events amount to 500 million dollars
1991 **1997**	Investment	The federation contributed 2,563 million pesos It was 2,410 million
1995	Basins	There are 314
1990 **1995**	Aquifers	There are 600 of which 100 are overexploited with 50% of the total consumption There are 459 mantles that are recharged with 48 kilometers annually from which cubic deposits are extracted. 24 kilómetros
1995	Dams	The country's 250 largest dams are at 25% of their capacity 2,200 were registered with a capacity of 180,000 million cubic meters to serve 6 million hectares. 0.9% is allocated and 4.5% and 8.0% is recommended.
1995	Extraction	45 million cubic kilometers were extracted from the aquifers. In the southwest, they extract 70% of their water from aquifers. In the field, 8.5 cubic kilometers per year were extracted
2000	Population	There was a population of 97.4 million, about 71% of whom live in cities.
2004	Urbanization	75% of the population was concentrated in the cities.
1995 **2004** **2007**	Availability	42.1% have water available on the ground, 27.7% draw it from wells and 19% take it from an installation in the house. In contrast, in urban areas, 69.6% have it available in some facility, 21.8% in a single improvised intake within the field and 2.7% extract it from a well. It had 2000 cubic meters. There was an average availability of 4547 cubic meters

2007	Quality	10% met the standard of good quality, 65% average, 25% poor.
1995 **2004** **2007**	Utilization	77% of the available water is used by agriculture, 10% by industry and 13% by public supply. 61.2 cubic kilometers were extracted, 41.1% from surface sources and 20.1% from underground sources for agriculture. In the case of industry, cubic waste was used for 1387 companies2.5 kilómetros 76.3% went to agriculture (about 62.4 billion cubic meters), 17% to domestic use, 5.1% to industry, 1.4% to aquaculture, and 0.2% to hydropower 145 cubic kilometers were distributed for electricity generation or consumptive use
1960 **1970** **1980** **1990** **1995** **1997** **2000** **2004**	Supply	Potable water coverage inside the home was 23.5%, while the out-of-home service was 8.8% 61.2% had potable water and 41.2% had drainage. Drinking water service outside the home was 5.2% 70.2% had the service and 49.2% had drainage 77.7% for drinking water and 61.3% for drainage, but 15.5% was not disinfected. Outside the home only accounted for 10.3% 80.9% had the service, 200 out of every 100 inhabitants did not have drinking water service around 14,400,000 individuals 86 out of 100 had potable water and 72 out of 100 had drainage, about 14 million were excluded from service and 28 million had no drainage but 5.1 million were not disinfected 15,100,000 inhabitants lacked service and 30,300,000 did not have sewerage service. That is, 56.6% of the homes had the service inside and 26% had the service outside the home. In the countryside, 47.5% were without service and 70.1% were without drainage A coverage of 87% of supply and 73% of sewerage was achieved. In cities, 13 million do not have access to water and 27 million are excluded from the drainage system. In the camps, 65% do not have the service and 33% do not have sewerage
1995 **1997** **2004**	Leak	50% were recorded leaking from the networks, 55% was lost due to evaporation and infiltration in agriculture It accounted for 43.63% of the total Losses were 35%, about 4.7 kilometers were wasted, equivalent to the consumption of 64 million people (about 38.68 billion cubic meters are evaporated or filtered). Moreover, 22% of leaks are not repaired, 50% were wasted in cities due to poor infrastructure. Between 30 and 50% is lost through evaporation or seepage in agriculture.
1995	Runoff	The Lerma-Chapala basin presented a runoff of 3,817 million cubic meters.
1993 **2004** **2007**	Agriculture	The value was between 70 and 80 billion pesos, about 6% of GDP Efficiency was 37% of the 60.5 kilometers destined for agriculture, which was wasted by evaporation or filtration. Around 600,000 hectares were salinitized, almost 20% of the total. 38.1 kilómetros79% of the total was used With a potential of between 20 and 25 million hectares, only 18 to 22 million hectares are harvested. The irrigated area is 6.3 million
2004	Industrialization	50% of the water was used for cooling, 35% in processes, 5% in boilers and 10% in services.
1995	Thermoelectric	80% of the electrical energy was generated with 20% of the available water, about 113.5 cubic kilometers per year
1995	Deficit	A deficit of 1.1 billion cubic meters was recorded
1995 **2004** **2007**	Contamination	The surface water quality percentages of 393 stations in 225 rivers, 81 stations in 62 lakes and dams, 26 stations in 13 sanctuaries and coastal sites, 15 wastewater discharge stations, as well as groundwater consisting of 228 stations in 24 aquifers, were evaluated with the Water Quality Index with values between 0 and 100. the latter being excellent, then acceptable, mildly polluted, polluted, heavily polluted, and the latter as excessively polluted. 60.7% of surface water and 46.3% of groundwater are polluted and heavily polluted, while surface water in the Valley of Mexico is excessively polluted with 32.49%. The industrial sector produced 2.05 kilometers of wastewater (855 percent of its waste) equivalent to the waste of 68 million inhabitants. In the same year, the agricultural sector generated cubic amounts of wastewater7.4 kilómetros Between 10 and 20% of the textile dye waste was disposed of into the sewer system
1992 **1995** **1997**	Treatment	There were 546 water waste treatment plants Only 0.53% of all water used for irrigation was treated because there was an infrastructure with a treatment capacity of 1.4 cubic kilometers. In that same year, the

		industry only treated cubic only 8% of the total0,17 kilómetros There were 821 wastewater treatment plants
1995 **2007**	Exclusion	The south where 24% of the population lives, in the center and north where 76% of the population is concentrated and 70% of the GDP is produced Around 12 million inhabitants do not have drinking water service, 23 million are without sanitation
2006	Sustainability	It was necessary to invest 215 billion pesos plus 167 billion pesos for maintenance.

Fuente: BANXICO (2000), CONAGUA (2010), CONAPO (2005) and INEGI (2000)

Thus, the water situation of the center of the country would determine the national water sustainability since it is the federal power that administers the national finances. In this sense, investment seems to emerge as a determining factor of the causes and consequences exposed. In other words, an increase in the equitable demand for water would imply an increase in the cost of supply. National water sustainability would be indicated by *public policies based on the establishment of the unit price of water based on its environmental conditions and economic trends aimed at equitable distribution among the residents of the south, center and north of the country*. However, at the state level, other factors seem to adjust the concept of water sustainability to water rights and culture.

Statewide

At the state level, the water situation is determined by the volume of droughts, population, density, infrastructure, extraction, supply, leakage, availability, utilization, consumption, recharge, collection, deficit, and inequity (see table 4).

In this sense, it is cities and their industrial, commercial and consumerist dynamics that monopolize the supply of rural communities and peripheral neighborhoods (Santos, 2004). In fact, cities with more than 500,000 inhabitants have a very high demand for consumption and consequent supply of services compared to the residents of rural communities where the aquifers that supply cities, their industries and trade centers are located (Breña, 2007). This inequity is aggravated if we consider that the most excluded communities live at an altitude above 2000 meters.

Table 4. State-level water situation

Year	Situation	Tendency
2004	Hydrosystem	San Luis, 71% is located in the highlands, only 44% of the rains rainfall, 83% of its economy is manufacturing. In contrast, 56% rush into the Huasteca with 29% of the population. 88% live at an altitude of more than 600 meters where 44% fall. While 12% live less than 56% of the rainfall. In your metropolitan area; 37% of the population and 85% of the industry are concentrated, water is extracted at depths with 110 million cubic meters and a recharge of 62 million with an overexploitation of 48 million. 500 metros200 metros
1948 1970 1993	Droughts	From 1948 to 1954 droughts spread in the states of Zacatecas, Nuevo León, Durango, Chihuahua, Coahuila, Tamaulipas, and Sonora. From 1964 droughts spread to the states of Baja California Norte, Sinaloa, Baja California Sur, Veracruz, San Luis, Colima, Jalisco and Guanajuato. 1960 a From 1970 to 1978 droughts were adjusted in the states of Nuevo León, Durango, Zacatecas and Tamaulipas. From 1993 to 1996 droughts lasted in the northeast, lowlands, center and west, only Guerrero, Chiapas, Yucatan, Campeche and Quintana Roo had rainfall during that period.
1984 2004	Population	There were 300,000 inhabitants in the city of Hermosillo, Sonora, in northern Mexico. There were 600,000 inhabitants in Hermosillo
2000	Density	Veracruz had 6,800,000 inhabitants and Baja California Sur has the least with 500,000 inhabitants. Regarding the population under 15 years of age, Jalisco and Veracruz are in second place with one million.
2004	Infrastructure	The infrastructure of the city of Hermosillo, Sonora was 30% in an irregular state.
2000	Extraction	San Luis: 477,100,000 cubic meters of water were extracted
2004	Supply	San Luis, with 2,200,763 inhabitants, only 73% had drinking water service; 27 out of 100 did not have the liquid in their homes Hermosillo, Sonora had 20,000 inhabitants without service. Efficiency in water conveyance and distribution was 59.3 and 64.3 percent
2004	Leaks	About 700 million cubic meters were lost through evaporation and filtration. 30% was wasted in leaks around 1600 cubic meters per month in the city of Hermosillo, Sonora.
2000	Availability	The area of greatest industrialization and commerce has been classified with an extremely

		low availability index with less than 1000 cubic meters per inhabitant per year. Regarding the central and northern areas of the country where economic growth is significant, the availability of the resource is classified as very low per capita per year. Only the southeast of Mexico, which has had little significant economic growth, has been classified as having a high availability per person per year. Regarding per capita consumption; 78.85% consume bimonthly, 11% around bimonthly and 0.38% more bimonthly1000 a2000 metros cúbicos10000 metros cúbicos50 metros cúbicos10 metros cúbicos180 metros cúbicos
1997	Utilization	93.3% were required for agriculture, 6.3% for domestic use, and 0.5% for industry.
2004	Consumption	Per capita consumption in the city of Hermosillo was 407 liters per day.
2000	Reloading	San Luis 319,600,000 cubic meters were recorded as recharge.
1996 2004	Collection	Only 43.5% was raised Only 64% was raised
2000	Deficit	San Luis recorded a deficit of 157,600,000 cubic meters.
2000	Inequality	About 28% of the available water is consumed by 77% of the population, which contributes 84% of the Gross Domestic Product (GDP). In contrast, 72% of the available water is consumed by 23% of the population contributing 16% of GDP. The national average coverage is 89.2 percent. Regarding the sewerage service, the national average is 85.6, with the northeast, center and southeast areas having the highest service coverage. The country is divided into two regions: North and South. In the first there is an availability of 1874 cubic meters per person per year. In the second, there is an availability of water per person per year. The north is home to 32 percent of the world's water, 77 percent of the population, and 85 percent of its gross domestic product (GDP). The south is home to 68 percent of the world's water, 23 percent of the population, and 15 percent of GDP.13 759 metros cúbicos

Fuente: CONAGUA (2010), CONAPO (2005) AND INEGI (2000)

Regarding the extraction, distribution and supply from rural areas to cities, there are two factors that have a direct impact on the water sustainability of the states: evaporation and runoff. Often, water extraction, distribution and supply lose about 60 percent of its volume in leaks that are caused by deficiencies in distribution and supply networks. These factors not only diminish the growth opportunities of cities but also affect their per capita energy since the extraction, distribution and supply require large amounts of energy for pumping, transfer and disposal. Consequently, state water sustainability is directly related to the national energy situation.

Thus, state water sustainability would be indicated by *public policies that establish mechanisms for subsidizing, sanctioning and unit cost of water based on the rainy and dry seasons, the altitude of cities and communities, the energy situation, and leak capture and repair technology*.

If the state water trend is focused on cities, then it would be necessary to clarify the water situation of the Metropolitan Area of the Valley of Mexico in order to envision a prospective situation for the other metropolises.

Ámbito Metropolitano

The Metropolitan Area of the Valley of Mexico is a complex city in which water situations and sustainability alternatives can be observed for the other cities that grow in the same proportion.

The second largest metropolis in the world exhibits a water situation in which factors such as; territory, population, urbanization, density, rainfall, aquifers, evapotransmission, investment, systems, extraction, pressure, overexploitation, importation, supply, availability, utilization, industrialization, consumption, leaks, waste, subsidence, erosion, drainage, sanitation, reuse, collection and exclusion (see Table 5).

However, institutions and academic specialists agree that the overexploitation of the basin is the main factor that would impede the sustainable development of the MVMA. That is, as population has increased, density has intensified, migration has increased exponentially, and urbanization has expanded, per capita water availability has been reduced to levels below the national and global average (Díaz, 2007). However, efficient distribution and supply are sufficient to alleviate the problem (Morales & Rodríguez, 2007). It is estimated that in the coming years the governments of the Federal District and the State of Mexico will have to change their supply policy to one of demand, thereby adjusting the rates, penalties and subsidies of drinking water, sanitation and reuse services (Hernández, 2004).

Table 5. Metropolitan area of the water situation

Year	Situation	Tendency
1910 1960 1990 2005 2010	Territory	It had an area of 27 square kilometers It was 382 square kilometers It was 1209 square kilometers It had 7854 square kilometers It was 1475 square kilometers
1950 1990 2000 2005 2006	Population	There were 3,442,557 inhabitants There were 18,076,572 residents with a rate of 1.03 There were 18,620,763 inhabitants There were 19,239,910 inhabitants There were 22 million inhabitants
1910 1960 1990 2000 2010	Urbanization	It was 27 square kilometers. It was 382 square kilometers It was 1209 square kilometers It was 1350 square kilometers It was 1475 square kilometers
2000 2005 2007	Density	There was a population density of 3,740 people per square kilometer; 7 million are under 15 years of age, half of them women, and 12 million live in the State of Mexico, which, together with the Federal District, is the first and second states with the most occupied homes. There was a density of 2450 people per square kilometer It is the state with the largest number of inhabitants, with 21 million. Regarding the population under 15 years of age, there are 2 million in the State of Mexico and the Federal District (DF) in second place with one million. The population with the highest number of people of working age between 15 and 64 years old is in the State of Mexico with four million, the Federal District with three million 27.7 million of the Mexican child population is extremely poor and is concentrated in 4 million in the State of Mexico, which contrasts with the 8 million people between 15 and 64 years old.
2000	Rainfall	6646 cubic hectometers were precipitated, about 211 cubic meters per second.
2007	Aquifers	They operate 972 wells, of which 86 are for irrigation
2000	Evapotransmision	5257 cubic hectometers evaporated, 166 cubic meters per second and there were 580 cubic hectometers, per second18 metros cúbicos
1995	Investments	The subsector's investments in urban areas amounted to 394,200 pesos in the ZMVM and were channeled solely and exclusively to wastewater treatment.
2004	System	The Cutzamala System includes 6 macro pumping plants, a 20.78-kilometer aqueduct and a water treatment plant with five modules that filter per second. It delivered 27 cubic hectometers to the city of Toluca and 16 delegations to Mexico City and 5 municipalities in the State of Mexico. 4000 litros452 a
1870 1952 2001 2004 2005 2007	Extraction	They were extracted from the cubic metres per second Nine cubic meters per second were extracted 71 cubic meters per second were extracted 2924 cubic hectometers were extracted from the Valley of Mexico basin; 62% of the basins, 29.3% of the Tula and Lerma basins, 6% of recycling and 2.5% of surface sources. The industry required 234 cubic hectometers of first use; 147 in self-sufficiency and 87 in the public network. 83% of the wells in Edomex and 17% in Mexico City. For its part, the manufacturing industry extracted 127.54 cubic hectometres from the ZMVM; 59 from Edomex and 28 from Mexico City, the services sector extracted 19.45 cubic hectometers. A total of 151.8 square kilometers were extracted, around 2922 cubic hectometers. In the CVM, the volume was 2923 cubic hectometers of first use and reuse. A total of 2,923 cubic hectometres were extracted, of which 2,123 were for domestic and urban public use, 595 for agriculture, 177 for industry and 28 for other uses
2005 2007	Pressure	It is 173% for the basin of the Valley of Mexico (a demand of 1710 hectometers and a supply of 1943 cubic hectometers per year with a recharge of 751 and an overexploitation of 951), 69% for Tula and 36% for Lerma A volume of 2564 cubic hectometers was obtained from the basin
2000 2004	Overexploitation	300% was extracted about 1338 or 44 cubic meters per second An additional 751 cubic hectometres were extracted at around 10 cubic metres per second

2004 2006	Import	622 cubic hectometres were imported from the Cutzamala and Lerma systems 50.5 cubic meters per second were imported from the wells and 20.3 from the Lerma basin and the Cutzamala dam, 1.2 from dams and rivers in the Valley of Mexico basin
2004 2005	Demand	1.72 cubic meters per second were required; 234 cubic hectometres needed by the industry The demand was 2922 square kilometers, about 2922 square kilometers.85.8 metros cúbicos
2004	Offer	The public service provided 57% of the local aquifer and 43% of other surrounding basins
2007	Efficiency	The industrial ones of the Edomex occupied 32 cubic meters per day and those of the DF 18.5
2007	Deficit	There was a deficit of 8 cubic meters per second, about cubic meters per inhabitant per year, about every second per inhabitant in the CVM and for the ZMVM of over a second 17.497.01 metros10.24 metros
2004	Import	622 cubic hectometres were imported
2004 2007	Supply	1994 cubic hectometres were supplied; The manufacturing industry was granted 87 cubic hectometers and for domestic use a volume of 1907 cubic hectometers. 1994 hectometres were supplied to the public grid and 570 hectometres to private services, about 395 for farmers and 147 for manufacturing
1955 2004 2005 2007	Availability	There were 11500 cubic meters per capita There were 4094 cubic meters per capita There were 272 liters per person per day There were 85.8 cubic meters per inhabitant per year
2000 2004 2007	Utilization	48 percent of water is used for agriculture, 46 percent for public supply and 6 percent for industry. In the agricultural sector of the ZMVM, 86 per cent of the water it uses comes from surface water and 14 per cent from groundwater. In contrast, the utility uses water that comes 82 percent from groundwater and 18 percent from surface water. The industry uses water, 78 percent of which comes from the subsoil and 22 percent from the surface. A total of 2122 cubic hectometres (73% of the total) were extracted, 596 for agriculture (20% of the total) and 177 for industry (6% of the total), about 177 cubic hectometres were allocated to industries and 596 cubic hectometres to agriculture It was used for home use, 17% for industrial use and 16% for shops and services
1993 2003 2004 2007	Industrialization	The industry had 265,000 units and the manufacturing industry 13,252, increasing at a rate of 2.3% in Mexico City and 5.9% in Edomex It had 481,000 maquiladoras It extracted 70% from underground sources, 17.5% from surface sources and 12.4% from recycling. The manufacturing industry accounts for 20% of the national GDP It accounted for 32% of GDP and grew at a rate of 4.5%; There were 20,026
2004 2005 2006 2007	Consumption	272 liters per day were consumed per individual, about 343 for Mexico City and the State of Mexico. About per capita per year 229.36 litros97 metros cúbicos 97 cubic meters per capita per year were consumed 72 cubic meters per second were consumed 63 cubic meters per second, equivalent to 2,000 cubic hectometers, were consumed
1995 2004 2007	Leaks	40 percent of the water that is distributed through the supply is wasted in leaks. In every building, leaks are caused by the wear of gaskets in the faucets, and as a result, water is wasted by up to 60 percent. 37% lost in leaks About 35% of 25 meters per second were lost
2004 2007	Waste	1,041.59 cubic hectometers were exported to the Tula basin; 17.5% came from industry The wastewater reached a volume of 359 cubic hectometres
2004	Sinking	It sank between 6 and 28 centimeters
1988	Erosion	28,207 tonnes of soil were lost daily
2000	Drainage	There were 1.45 million without drainage, but there were 87 pump-pumping plants to evacuate per second and 91 plants to evacuate per second. Sewerage coverage was 92% and there were 161 plants for this purpose. 670 metros cúbicos16 metros cúbicos
1995	Sanitation	There were 161 treatment plants; 48 industrial, 47 commercial, 41 municipal and 25

2000 2004 2007		autonomous. Only 13 percent of wastewater was treated Only 12% of the total extraction, around 359 cubic hectometres Only 8 meters per second were treated, about 10%
2007	Reuse	200 cubic hectometres were reused for agriculture, 128 for urban use and 31 for industry.
1989 2000 2004	Collection	The Ministry of Finance and Public Credit collected 4,159.9 million pesos, and in 1993 it was an outstanding year, collecting 1,637.5 million pesos. The average payment in Mexico City is 110.25 pesos bimonthly. This means a collection of fees from users of 80 percent in relation to their real cost for the service. The average payment in Mexico City was 110.25 pesos bimonthly. About 23.83% pay 23 pesos on their bimonthly bill. Only 1% pay more than a thousand pesos every two months. 22.2% are not registered with the public supply service because they do not bill their consumption and debts. Only between 25 and 80% of the total cost is collected based on the registry of users. The cubic meter of water cost 1.80 pesos and the recharge of the aquifer would mean an amount of 164.6 million pesos. About 0.15 cents or 10 pesos more per person was required to fund conservation and recharge projects
2004	Exclusion	There were 920,000 people without coverage

Fuente: CONAGUA (2010), CONAPO (2005) and INEGI (2000)

The new public policy for metropolitan water sustainability will be in a conjunctural dilemma: water sustainability or economic growth. In the State of Mexico (EDOMEX), in the face of private investments for industry and commerce, water availability will have to increase significantly to guarantee the supply of manufacturing production, which currently represents 20 percent of the national Gross Domestic Product (GDP). In this sense, an increase in the unit price is looming along with the elimination of subsidies and the increase in aquifer concessions. In contrast, in the Federal District (DF), the regulation of concessions, the limits on investments and the pricing policy seem to be oriented towards a water sustainability determined by tourism of 20 million annually and the electoral political support of suburban neighborhoods via subsidies or forgiveness.

In the opinion of experts, water sustainability is also conditioned by the rainfall period and the volume of recharge. It is estimated that the Oriente Emitter, a mega drainage project that will transfer wastewater from the Valley of Mexico basin to the Tula basin, will distribute 6 percent of the stormwater. According to the scientists, if the volume of rainfall is captured, stored, distributed and supplied, the current per capita availability will be guaranteed.

However, the industry appears to contravene scientific advice by extracting about 80 percent of its supply from the basin and leaking about 90 percent of its waste into the public drain without treatment.

In this way, metropolitan water sustainability would be indicated by *public policies that subsidize agriculture, industry and citizens, the real costs and establish a discretionary tariff system based on electoral political interests.* This collection system should have an impact on the sustainability of the delegation. However, a different trend is observed.

Delegational scope

The water situation of the delegation, being a local level, is determined by the capacity of government management and community self-management (Breña, 2004; Medina, 2004)). In this way, the delegation's water situation includes; population, density, availability, use, coverage, consumption, and exclusion (see Table 6).

However, in the case of the delegations of the Federal District, mainly in Iztapalapa, both management and self-management are uncertain. It is possible to observe that according to the delegation it is the water situation and sustainability. Those districts with a higher population density face serious problems of roughing, corruption and unsanitary conditions (Becerra, Sainz and Muñoz, 2006). In contrast, delegations with higher per capita income have a higher amount of available water per person.

Table 6. Delegational scope of the water situation

Year	**Situation**	**Tendency**
2000 2007	Population	There are 1,773,342 in Iztapalapa, 1,622,697 in Ecatepec, 1,225,972 in Netzahualcóyotl and 1,235,542 in Gustavo A Madero There are 1,820,888 in Iztapalapa, 1,913,161 in Gustavo A. Madero, 1,688,258 in Ecatepec, 1,140,528 in Netzahualcóyotl and 821,442 in Naulcalpan
2000	Density	Half a million were young people under 15 years of age, plus 1,200,000 inhabitants between 15 and 64 years old, for a total of 1,750,000 people
1995 2004	Availability	There was an availability of 11500 cubic meters per capita per year. It decreased to 4094 cubic meters per capita per year.
2004	Utilization	Water is used for industry (17%), commerce (16%) and domestic use (67%)
2004	Coverage	905,000 people do not have access to drinking water because there is a shortage of six cubic metres per second.
2004	Consumption	78.5 percent have a consumption of less than 50 cubic meters, 11 percent consume less than 50 cubic meters and consume more than 50 cubic meters.10 metros cúbicos10.38180 metros cúbicos
2004 2006	Exclusion	The Gustavo A. Madero and Álvaro Obregón delegations consumed 13.75 and 9.94 percent, respectively. In contrast, the districts with the lowest consumption were Cuajimalpa, Tláhuac and Milpa Alta with 5.97 percent. 28 liters were consumed daily in Ecatepec, 176 in Tlalpan and 885 in Miguel Hidalgo

Fuente: CONAGUA (2010), CONAPO (2005) and INEGI (2000)

The local water situation shows a tendency to decrease the unit price of drinking water in the districts with the highest economic income and, on the contrary, in the delegations with unemployment, the cost of drinking water increases exponentially. About 20 percent of the family's income is invested in the purchase of jerry cans in the districts with lower economic incomes.
Delegational water sustainability would be indicated by *public policies that establish a rate per unit of water based on economic income and electoral clientelism.*
In the case of the Iztapalapa delegation, altitude, migration, density, corruption, and clientelism directly influence per capita availability. The water situation is constant if we consider that the shortage due to infrastructural deficiency, political profitability or population density converges in a scenario of scarcity and unhealthiness that favors sites contrary to management or self-management.
In this sense, conflicts over corruption and shortages have led the inhabitants of Iztapalapa to move from declarations of disagreement to confrontations against their authorities and neighbors (Sainz and Becerra, 2003).

Water sustainability in Iztapalapa would be indicated by *the location of communities and neighborhoods in the face of clientelistic subsidies.* That is to say, in the face of proselytizing subsidies, communities and neighborhoods protest by declaring their discontent in the press, threatening their authorities and organizing boycotts, street closures, marches and rallies for the regularization of the service. This location is complemented by savings strategies in the face of the shortage crisis at the residential level.

Residential
Despite the fact that global and local situations seem to be influenced by public policies adjusted to a market of supply and demand, the residential water situation is conditioned by supply, consumption and leakage (see table 7).

At the residential level, water availability presents a different problem if the house is considered as a space of comfort and security determined by the dimensions and the storage system. A large residence would have a greater storage capacity and thus guarantees the needs of personal hygiene or cleaning of utensils, garden irrigation, car washing and hydration. On the other hand, apartment dwellers see their possibilities of comfort reduced by sharing the resource with their neighbors.

In this sense, leaks due to the deterioration of the facilities or lack of maintenance compromise the expected comfort. It is estimated that in addition to the 60 per cent that evaporates or drains into the supply network, 40 per cent of household leaks and the water used should be added, a high percentage destined for toilet use (Goicoechea, 2004).

Table 7. Residential area of the water situation

Year	Situation	Tendency
2004	Provision	79.3% represents a daily supply (44.7% throughout the day and 17% during a period of the day), 11.2% every third day, 5.7% once a week and 3.8% twice a week
2007	Consumption	Domestic (67%) which is divided into the use of toilets (40%), showers (30%), clothes (15%), dishes (6%), kitchen (5%) and others (4%).
2007	Leaks	Leaks are caused by the wear of faucet gaskets, which means that up to 60 percent of water is wasted.

Source: CONAGUA (2010)

However, the situation of shortages has had an impact on the practices of hoarding, dosing and pseudo-reparation. That is, in the neighborhoods excluded from drinking water service, people learned to optimize water in storage, personal hygiene, washing utensils and reusing it for the toilet. Mainly, in irregular settlements, the number of utensils determines the daily transfer and supply. In these groups, people wait about three to five hours for the pipe that will sell them the water. These families also look for water in the mains to milk it. In some cases, they travel to neighboring neighborhoods or delegations to collectively buy jugs whose prices range from five to 30 pesos depending on the season of the year. A leak in the supply substantially reduces your daily supply and consumption. For this reason, they carry out improvised and temporary pseudo-repairs to retain the liquid. These groups also tend to filter the water that is sent to them every three to four weeks by the system with a dark color and rotten smell.

Perhaps the biggest problem is concentrated in the hoarding carried out by families with more members, longer waiting times and the number of utensils. Indeed, if water exclusion at the global and local level refers to the inequitable availability of water, residential exclusion refers to the distribution biased by the bribery of those affected towards the piperos.

In this sense, residential water sustainability would be indicated by *hoarding, dosing and domestic pseudo-repairs.* From the water trends presented, it is possible to establish the trend that is expected in ten, 20 or 30 years.

Prospective scope

In the coming years, the trend of global and local water situations offers a scenario that will compromise sustainable development. Obviously, water sustainability will imply the financing of a system of extraction, collection, distribution, supply, consumption, sanitation and reuse based on the contingent price of each water unit demanded by agriculture, industry, commerce and domestic (Castillo, 2004).

Experts point out that despite the actions taken to avoid a water crisis scenario and promote a culture of saving water, there will be exponential consequences in the proliferation of hydrotransmitted diseases, famines, migrations and conflicts that will lead to unprecedented economic, political and social changes.

Source: AQUASTAT (2010), CONAGUA (2010), FAO (2010) and USCB (2010)

Unlike the current trend in which the global water situation does not seem to have a significant influence on the national and local levels, the water trend of the future will directly, negatively and substantially determine the economic growth of nations and the local development of their cities.

In Mexico, population growth and overcrowding are leading to a concentration in cities and a deterioration in the watersheds that supply them. As the number of cities with more than 500,000 inhabitants increases, interchange between the basins will be limited. There will be competition for water resources that will lead to conflicts of all kinds and with it the increase of the water gap between those who can buy and those who will only be able to usurp it from the networks.

In a scenario like the one that is projected, technology will play an important role in water optimization. Austere behaviors will no longer be enough, now even among those who have been excluded, the acquisition of collectors, storage and filter filters will be essential to face the scarcity and unhealthiness that is coming.

In the case of the Valley of Mexico, per capita availability will be insufficient for domestic use. The industry will have to invest in sanitation and water recycling to survive. The State will have to rationalize water demand by radically changing its supply policy. The government administration will increase tariffs, eliminate subsidies, and rigorously sanction waste in all sectors.

Consequently, prospective sustainability will be indicated by *public policies that establish a unit price of water based on water contingencies. In other words, the water service rate will be determined by variations in per capita availability. An increase in the amount of water per person will mean an increase in the cost of the service.*

Table 8. Prospective scope of the water situation

Year	Situation	Tendency
2015 **2020** **2025** **2030** **2050**	Global	A 1.5 degree Celsius temperature increase will cause the extinction of at least 9 percent of plant and animal species, an average increase of 2.5 degrees Celsius will cause the disappearance of the Amazon, in North America severe droughts are expected in growing areas, in Latin America glaciers are predicted to melt and water shortages in the surrounding regions, in Africa, prolonged droughts and the extinction of crop fields are predicted, in Europe flooding is expected in areas below sea level, and in Asia, communities near rivers will face severe flooding. Availability of 3500 cubic meters per capita per year is expected Agriculture is expected to consume 2200 km3 of water, households and industry to save water and reserves to increase to 100 km3, it is estimated that only North America and Europe will have sufficient hydrological availability for their economic growth. It is estimated that 80% of the world's population will be in high scarcity. A global crisis of irregular and unhealthy water supply is expected in which 2 billion individuals will not have access to drinking water. 5.5 billion will suffer shortages A range of temperature increase of 1.4 to 5.6 degrees Celsius is expected, causing a rise in sea level, 5% more rainfall and the extinction of a quarter of species. A temperature rise of 5.6 degrees Celsius causes sea level rise, 5% more precipitation and the extinction of a quarter of species44 centímetros1,4 a44 centímetros
2020 **2025** **2030** **2040**	National	In 2020, 16.6 million inhabitants are expected to be without drinking water service and 36.6 million will not have sanitation services. There will be a population of 123.4 million, an availability of 2,740 cubic meters per capita per year. It will be necessary to invest 500 billion pesos in infrastructure and around 600 billion pesos for maintenance. In the agricultural sector, 760 billion pesos will be required in infrastructure investment with its corresponding 770 billion pesos in maintenance. Around 17 million inhabitants will not have drinking water service and 49.6 million will not have sanitation service. The population growth of 32 cities with more than 500,000 inhabitants, highlighting the Metropolitan Area of the Valley of Mexico (ZMVM) with 22.5 million inhabitants, the Guadalajara Metropolitan Area (ZMG) with 4.8 million inhabitants and the Monterrey Metropolitan Area (ZMM) with 4.9 million inhabitants. By 2050, the population is expected to increase by 48%, with an estimated population of 131.7 million by 2025. GDP is expected to grow by 1.5% on average A population of 133 million is expected
2015 **2020** **2025** **2030**	Metropolitan	6000 hectares of conservation will be occupied and 144400 million liters will be lost at an approximate cost of 120 million pesos. There will be an availability of 3500 cubic meters per capita The ZMVM will have the lowest availability of all national regions. A volume of less than 1000 cubic meters per inhabitant per year is expected. 771 cubic hectometres will be imported. 445 cubic hectometres will be recycled. An additional 1360 cubic hectometres will be extracted. A total population of 127 million is expected, of which 100 million will live in cities. The population of the ZMVM will increase to 22.6 million and two hydrological regions will be outlined in the country: Scarcity zone in which the metropolises of Tijuana, Mexicali, Ciudad Juárez, Monterrey, Guadalajara, San Luis, Puebla, Toluca, Cuernavaca, will be in an unsustainable situation of high risk. Availability zone in which the cities of Acapulco, Jalapa, Tuxtla Gutierrez, Villa

		Hermosa, Merida and Cancun will be in a sustainable low-risk situation. 3817 cubic hectometres will be extracted in the ZMVM. 830 cubic hectometres will be imported. 469 cubic hectometres will be recycled. An additional 1471 cubic hectometres will be extracted. The degree of pressure will be 226%

Conclusion

This essay has described eight areas, situations and trends of water availability, supply and consumption around which it is possible to infer public policies that are meagre in their relevance to address the water problems of scarcity, intermittent supply and unhealthiness related to the drinking water system. In this sense, the establishment of a public agenda alluding to the equitable distribution of supply and collection of drinking water service would include the variables exposed to determine a system of quotas, sanctions or subsidies to citizens.

However, the trend of water situations in each of the areas described seems to indicate that water supply obeys a clientelistic socio-political system in which the scarcity or intermittent supply of water is an indicator of the inefficiency of public policies related to water problems.

The description of the situational areas and the trends of supply and consumption are evidence of the complexity of water problems. It is an asymmetrical relationship between the State and citizens in which the distribution of resources is a factor that inhibits sustainable development. In other words, the percentage of leaks identified in the public network is similar to the percentage of leaks estimated at the residential level: 40 percent of water is lost due to leaks from the main network and 40 percent of water is filtered into the toilet.

Both problems could be explained from human cognition, but the social sciences have focused on the analysis of power relations between users and authorities. Explaining the waste of water in a context of scarcity from the pragmatic relations between residents and public service managers, attributing the problems to the corruption of the Mexican political system, the minimum investment in the public supply network or in the nature of supply and demand, can be complemented with the analysis of the rules. values, perceptions, beliefs, attitudes, knowledge, competencies, intentions and personal behaviours.

References

1. Water Statistics Agency (2010) *Water Statistics.* New York: FAO-AQUASTAT
2. Aldama, A. (2004). *Water in Mexico: A Crisis That Should Not Be Ignored*. In M. A. Villa & Saborio, E. (coord.). Water Management in Mexico: Challenges for Sustainable Development (pp. 11-31). Mexico: Porrúa-UAM
3. Airola, J. (2007). The use of remittance income in Mexico. *International Migration Review*, *41*(4), 850-859.
4. Becerra Pérez, M., Sáinz Santamaría, J., & Muñoz Piña, C. (2006). Water Conflicts in Mexico. Diagnosis and Analysis. *Gestión y política pública*, *15*(1), 111-143.
5. BREÑA, Agustín. (2004). Integrated management of water resources. In Jacobo. Villa., Saborio, Marco. and Saborio, Elsa. (coord.). Water Management in Mexico: Challenges for Sustainable Development. (pp. 39-54) Mexico: Porrúa-UAM
6. BREÑA, Agustín. (2007). The problem of water in urban areas. In Jorge. Morales, and Rodríguez, Lilia (coord.). Water economics. Water scarcity and domestic and industrial demand in urban areas. (pp. 69-92). Mexico: Porrúa-UAM
7. Castillo, I. (2004). *Water quality and sanitation*. In M. Villa & E. Saborio (coord.). Water Management in Mexico: Challenges for Sustainable Development. (pp. 255-266) Mexico: PorrúaUAM
8. CHÁVEZ, Rubén. (2004). Sustainable groundwater management. In Jacobo. Villa., Saborio, Marcos and Saborio, Elsa. (coord.). Water Management in Mexico: Challenges for Sustainable Development. (pp. 133-138) Mexico: Porrúa-UAM
9. National Water Commission (2010). *Water Statistics in Mexico*. Mexico: CONAGUA
10. Zúñiga, E., & Molina, M. (2008). Demographic trends in Mexico: The implications for skilled migration.
11. Corral-Verdugo, V. (2010). Psychology of sustainability: An analysis of what makes us pro-ecological and pro-social. *México DF: Trillas*.
12. Corral-Verdugo, V., & De Queiroz Pinheiro, J. (2004). Approaches to Sustainable Behavior research. *Medio ambiente y comportamiento humano Journal*, *5*, 1-26.
13. CUNILL, Nuria. (1991). Citizen participation. Dilemmas and perspectives for the democratization of Latin American states. Caracas: CLAD

14. DÁVILA, Hilda. and CONSTANTINO, Roberto. (2007a). Towards an alternative methodology for the determination of tariffs applied to water consumption in the urban domestic sector of the Valley of Mexico. In Jorge. Morales, and Rodríguez, Lilia. (coord.). Water economics. Water scarcity and domestic and industrial demand in urban areas. (pp. 179-216). Mexico: Porrúa-UAM
15. DÁVILA, Hilda. and CONSTANTINO, Roberto. (2007b). System of use of drinking water rights in the Federal District. In Jorge. Morales, and Rodríguez, Lilia. (coord.). Water economics. Water scarcity and domestic and industrial demand in urban areas. (pp. 149-178). Mexico: Porrúa-UAM
16. DÍAZ, José. (2007). Water in the context of sustainable cities. In Morales, Jorge. And Lilia. Rodríguez (coord.). Water economics. Water scarcity and domestic and industrial demand in urban areas. (pp. 335-349). Mexico: Porrúa-UAM
17. Adamson, P. (2005). *Child Poverty in Rich Countries, 2005. Innocenti Report Card No. 6*. UNICEF. 3 United Nations Plaza, New York, NY 10017.
18. GOICOECHEA, Julio. (2004). Household water and drainage services in Mexico: relative coverage and convergence. In Jacobo. Villa, Saborio, Marco. and Saborio, Elsa. (coord.). Water Management in Mexico: Challenges for Sustainable Development. (pp. 111-132) Mexico: Porrúa-UAM
19. GOICOECHEA, Julio. (2007). Economic performance of the Yucatan Peninsula: potable water and operating agencies. In Jorge. Morales, and Rodríguez, Lilia (coord.). Water economics. Water scarcity and domestic and industrial demand in urban areas. (pp. 259-286). Mexico: Porrúa-UAM
20. ESPINOZA-MORALES, F. R. A. N. C. I. S. C. O., & GUILLÉN, A. S. GOVERNANCE OF COMPLEX ORGANIZATIONAL SYSTEMS.
21. HERNÁNDEZ, Felipe. (2004). The management of the water business. In Jacobo. Villa, Saborio, Marco. and Saborio, Elsa. (coord.). Water Management in Mexico: Challenges for Sustainable Development. (pp. 329-336) Mexico: Porrúa-UAM
22. National Institute of Statistics, Geography and Informatics (2000). *XII National Population and Housing Census*. Mexico: INEGI
23. Leff, E. (2012). Latin American environmental thinking: a heritage of knowledge for sustainability. *Environmental ethics*, *34*(4), 431-450.
24. Leff, E., Beling, A., & Estevez, M. (2014). Environmental rationality: The social re-appropriation of nature. *Alternautas*, *1*(1).
25. LÓPEZ, Mario. (2004). The Water Management Modernization Program: Progress and Perspectives. In Jacobo. Villa., Saborio, Marco. and Saborio, Elsa. (coord.). Water Management in Mexico: Challenges for Sustainable Development. (pp. 103-110) Mexico: Porrúa-UAM
26. Medina, R. (2004). *Citizen participation in water management*. In M. A. Villa & E. Saborio (coord.). Water Management in Mexico: Challenges for Sustainable Development. (pp. 329-338) Mexico: Universidad Autónoma Metropolitana
27. MORALES, Jorge. and RODRÍGUEZ, Lilia. (2007a). Performance of the manufacturing industry in water use in Mexico. In Jorge. Morales, and Rodríguez, Lilia (coord.). Water economics. Water scarcity and domestic and industrial demand in urban areas. (pp. 287-324). Mexico: Porrúa-UAM
28. MORALES, Jorge. and RODRÍGUEZ, Lilia. (2007b). The water problem in large cities, the case of the Metropolitan Area of the Valley of Mexico. In Jorge. Morales, and Rodríguez, Lilia (coord.). Water economics. Water scarcity and domestic and industrial demand in urban areas. (pp. 15-68). Mexico: Porrúa-UAM
29. MORALES, Jorge., RODRÍGUEZ, Lilia. AND GONZÁLEZ, Abelardo. (2007). Water demand by the manufacturing industry of the Metropolitan Area of the Valley of Mexico. In Jorge. Morales, and Rodríguez, Lilia (coord.). Water economics. Water scarcity and domestic and industrial demand in urban areas. (pp. 217-258). Mexico: Porrúa-UAM
30. Organisation for Economic Co-operation and Development (OECD). (2010). *Education at a glance 2010: OECD indicators*. Paris: Oecd.
31. FAO, F. (2018). Agriculture Organization of the United Nations (2010). The State of World Fisheries and Aquaculture 2010. *A Report of the Food and Agriculture Organization of the United Nations*.
32. United Nations Educational, Scientific and Cultural Organization (2010) *Education For All. Monitoring report.* New York: UNESCO
33. World Water Assessment Programme (United Nations), & UN-Water. (2009). Water in a changing world.
34. World Health Organization. (2011). Strengthening response to pandemics and other public-health emergencies: report of the review committee on the functioning of the International Health Regulations

(2005) and on pandemic influenza (H1N1) 2009.
35. RAMOS, C., & Lorda, J. (2004). The Development of the Hydrological Infrastructure in Mexico. In Jacobo. Villa., Saborio, Marco and Saborio, Elsa (coord.). Water Management in Mexico: Challenges for Sustainable Development. (pp. 65-80) Mexico: Porrúa-UAM
36. Sainz, J. & Becerra, M. (2003). Water Conflicts in Mexico: Research Advances. *Gazette of the National Institute of Ecology*. 67, 61-68.
37. Santos, J. (2004). *Organized public action: the case of the drinking water service in the suburbs of San Luis Potosí*. Mexico: UAM–Porrúa
38. Toledo, A. (2002). *Water in Mexico and the World*. Gazette of the National Institute of Ecology. 64. 9-18.
39. Balk, D., Leyk, S., Jones, B., Montgomery, M. R., & Clark, A. (2018). Understanding urbanization: A study of census and satellite-derived urban classes in the United States, 1990-2010. *PLoS One*, *13*(12), e0208487.
40. Wong, P. (2004). *Water and Sustainable Regional Development: A Methodological Approach*. In M. A. Villa & E. Saborio (coord.). Water Management in Mexico: Challenges for Sustainable Development. (pp. 283-300) Mexico: Universidad Autónoma Metropolitana.