CHALLENGES IN THE MANAGEMENT OF WATER IN THE CONURBATION OF GUADALAJARA

José Arturo Gleason Espíndola*

ABSTRACT

This article is aim to present the main challenges in the management of the water in the Conurbation of Guadalajara (COG) that may display a starting point for the design and implementation of public policies to solve them. This work builds the theoretical fundamentals of the sustainable management of water that provide a basis for resolving major issues related to the management of water such as: physical failures of the hydro-sanitary system, management flaws reflected on the poor planning and deficient administration of water resources. These challenging issues are compared with the theoretical contributions in order to recognize the degree of backwardness and to establish a platform for the approach to new and more sustainable public policies regarding water.

KEYWORDS: Management-Water-Challenges-Sustainability.

INTRODUCTION

As the time goes by, the problem of water on the planet tends to become increasingly complicated, especially in cities. This situation manifests mainly in the shortage of water and, paradoxically, in the presence of floods that affect the population plus the persistent pollution of riverbeds due to wastewater discharges. Today, in most of the cities, the quality of water for human consumption is deficient causing serious health problems in very poor areas.

* He is PhD is and Associate Research Professor to the Art Architecture and Design College Center (CUAAD architecture) of the Universidad de Guadalajara. Is a Level 1 researcher *Researchers National System* (SNI, for its acronym in Spanish) of the Science and Technology National Council (CONACYT, for its acronym in Spanish). He is the leader of the Faculty (UDG-604) *"Management and Technology for Sustainable Architecture and Urbanism"*. Contact e-mail: arturo.gleason@cuaad.udg.mx

The foregoing, are indicators of the constant lacks in the governmental water management system, which has been overtaken by the complexity of these problems. Foremost, confronting urgent affairs has left aside the study of proposals that may empower them to face those critical issues.

The situation tends to get complicated, as the United Nations Report on Water Resources determines that availability of clean water on the planet will be scarce by the year 2030 (UN, 2015).

The CONURBATION OF GUADALAJARA (COG) is the second urban concentration in Mexico that presents the problems described above and needs to establish an outcome proposal.

The main purpose of this article is to present a proposal in the field of *water management* in the Conurbation of Guadalajara, starting from an analysis of the current situation of the water cycle, the physical infrastructure and the management of the administrative mechanism that sustains it.

This proposal begins with the approach of the theoretical concepts of sustainable development manifested through the *Integrated Water Resources Management* (IWMR) and the governance of water.

That being said, a theoretical framework will be presented that will provide the foundations for the understanding of the problem and its solution. Following takes place a diagnosis of the current situation of the water cycle, of the state of the actual hydro-sanitary infrastructure and the management of the administrative structure that carries out its operation. Finally, conclusions are presented that will describe the challenges to resolve and its relationship with the theoretical referents stated at the beginning.

1. THEORY

The theoretical framework is established based on the concept of *sustainable development,* which arises in the *Rio de Janeiro Meeting* in 1992, and is defined in the Agenda XXI as follows: "*Sustainable development is a development that satisfies the needs of the present without compromising the ability of future generations to meet their own needs*" (Brundtland, 1987).

The concept is the result of a strategy agreed by nations to encourage a global economic development model compatible with the environment preservation and social equity. Nowadays, the concept of *sustainable development* becomes the obliged referent to define population's development.

Based on the previous notion, arises another concept called *Integrated Water Resources Management* (IWRM). The definition that provides the *Global Water Partnership* (GWP) is today the most widely accepted: "*The IWRM is a process that promotes a coordinated management*

and development of water, soil and other related resources in order to maximize the economic performance and social well-being in an rightful manner without compromising the sustainability of vital ecosystems" (United Nations, 2014).

In Mexico, the *IWRM* is a public policy approach, incremental and adaptive, which pursues the development and a coordinated management of water, land and related resources. It is oriented to encourage that the proper use of water resources, is directed towards the achievement of those economic and social development national objectives, under the criteria of equity and environmental sustainability (Valencia, w.d.).

Considering *IWRM* from a multidisciplinary perspective, includes as well the management of surface water and groundwater in a qualitative, quantitative and ecological sense, and links its availabilities with the needs and demands of society regarding water. In *IWRM*, the focus shifts from the exploitation or use to the conservation and rational use of the resource, as well as the management of supply to the management of demand (Pérez, 2016).

Components of *IWRM* are:

1. Management of hydro-climatic information: measuring, storage, processing, analysis and disclosure of hydrological data.

2. Participative management: Decentralization and delegation of responsibilities to water users.

3. Water demand management.

4. Hydrological risk management: Dealing with extreme hydrological incidents.

5. Designation of volumes of water to different segments of final users and the accurate administration of water rights.

6. Planning over watersheds and with the formulation of projects for the convenient usage of water resources with multiple objectives.

7. Elaboration of policies and schemes to support the water resources management.

8. Preservation of watersheds.

9. Valuation of the water.

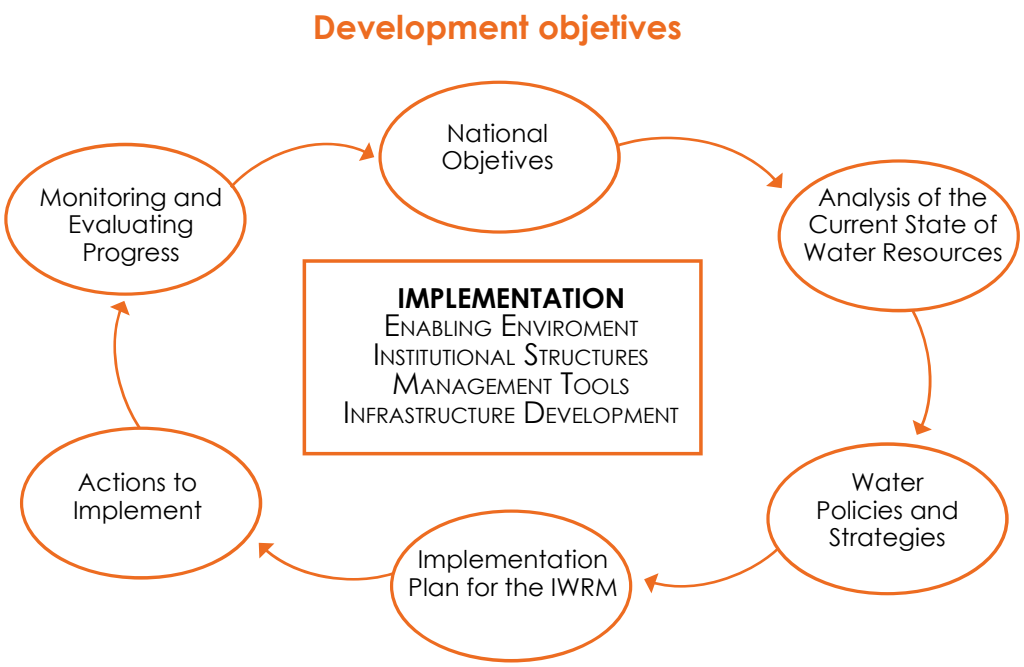
10. Accounting for Water Resources: inventory and characterization of the behavior of surface and underground water resources.

Concerning the formulation, planning and management of policies, it may be considered as a series of sequential steps regarding watersheds management.

The first step is to define general objectives to policies (*where we want to go*). Following steps are to specify problems related to water management in need of resolution (*identify problems*). Then, to make a list of potential strategies (*how to get to where we want*); evaluate each one of them, select a strategy or combination of strategies, implement the strategy, evaluate the results and finally, learn from these results and review our main plan to make it work better in the future.

The steps form a cycle. Of course, in a practical sense, this cycle can be interrupted by external forces, but the "cycle of management based on learning through practice" (see Figure 1) *help to incorporate what we learn in the planning process and the actual water management and to take into account the new information as we have it. This means that we can adapt the way to manage water to changing circumstances, such as political changes, natural disasters and demographic changes* (Global Water Partnership, 2009, p.19).

FIGURE 1. THE CYCLE OF PLANNING AND IMPLEMENTATION MANAGEMENT, BASED ON LEARNING THROUGH PRACTICE



Source: Global Water Parthership

The *governance of water* is another fundamental concept of the theoretical framework. Water management must respond to demands of the society and the environment through a specific system that involves all actors. The *Global Water Partnership* States:

> Governance can be defined as the capacity of the government to provide services and to form, establish and enforce rules. The water governance refers to the range of political, social, administrative and economical systems established for the management of water and provision of services. Depending on the way in which countries manage their water resources, determine the health conditions of its inhabitants, the success of their economies, the sustainability of their natural resources and their relations with neighboring countries. A proper management of the water brings tangible benefits to a country. Therefore, good governance is the fundamental principle to develop and manage water resources and the provision of water services to different levels of society.

On the other hand, the *International Union for Conservation of Nature* (IUCN) asserts that "*the governance of the water is a political, legal and institutional-administrative system that directly or indirectly affects the use, development and management of the water and an adequate provision of the service to different levels of society*" (Global Water Partnership, 2012).

Another very important aspect to achieve a sustainable management of water is an expected close involvement between the systems: public institutions and society in general. The *Organization for* Economic Cooperation and Development (OECD, 2015) through the document "Principles of governance of water", sustain that:

> The governance of water can intensely contribute to the design and implementation of such policies through a shared responsibility between the various orders of government, civil society, businesses and a wide range of actors that play an important role. All, in close collaboration with policymakers to collect the economic, social and environmental benefits as an effect of the good governance of water (p. 3).

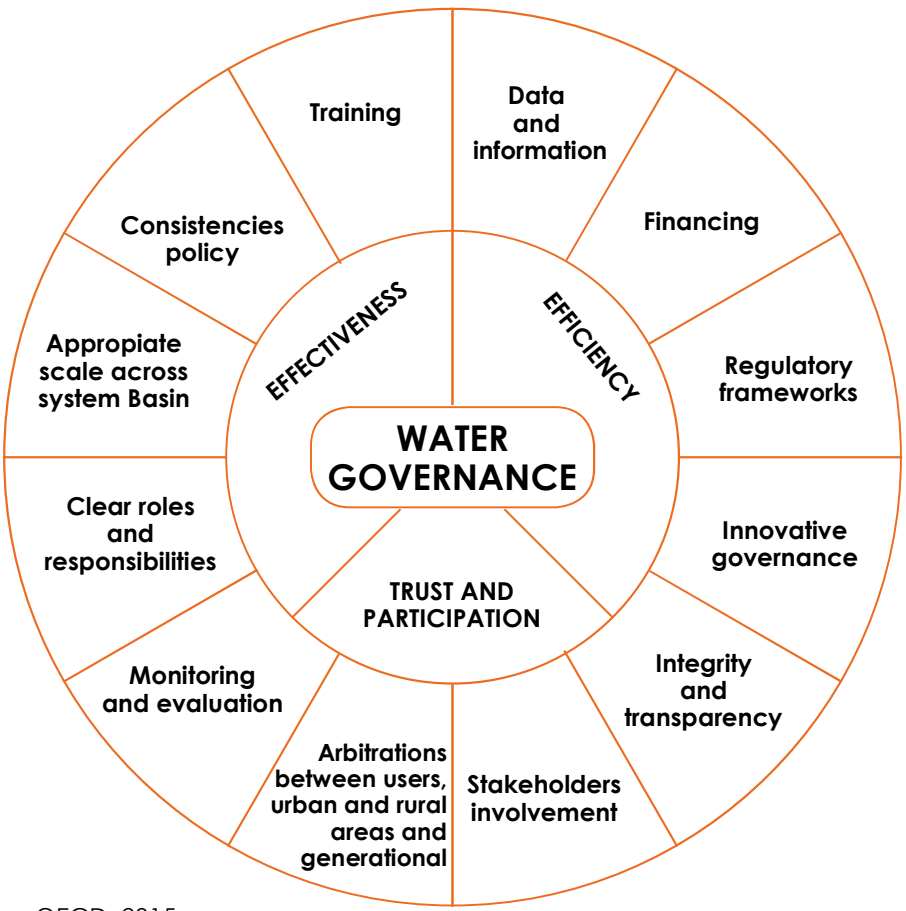
In this same document, OECD proposes "*The Principles of the Governance of Water*" which have the intention to contribute to the creation of tangible results-oriented public policies, based on three dimensions of the governance of water that mutually reinforce and complement each other (OECD, 2015, 3-4):

> • *The effectiveness refers to the contribution of the governance in defining the goals and clear sustainable objectives for water*

policies in all government's levels, in the implementation of such policy objectives, and on reaching the expected goals.

- *The efficiency relates to the governance's contribution in maximizing the benefits of the sustainable management of the water and the well-being at the lowest cost to society.*
- *Trust and participation are related to the governance's contribution towards building confidence between the people and to ensure the inclusion of the involved actors through democratic legitimacy and equity for the society in general.*

In Figure 2 shows the principles of governance of water with its diverse elements that allow us to realize more accurately their implications concerning the water management:



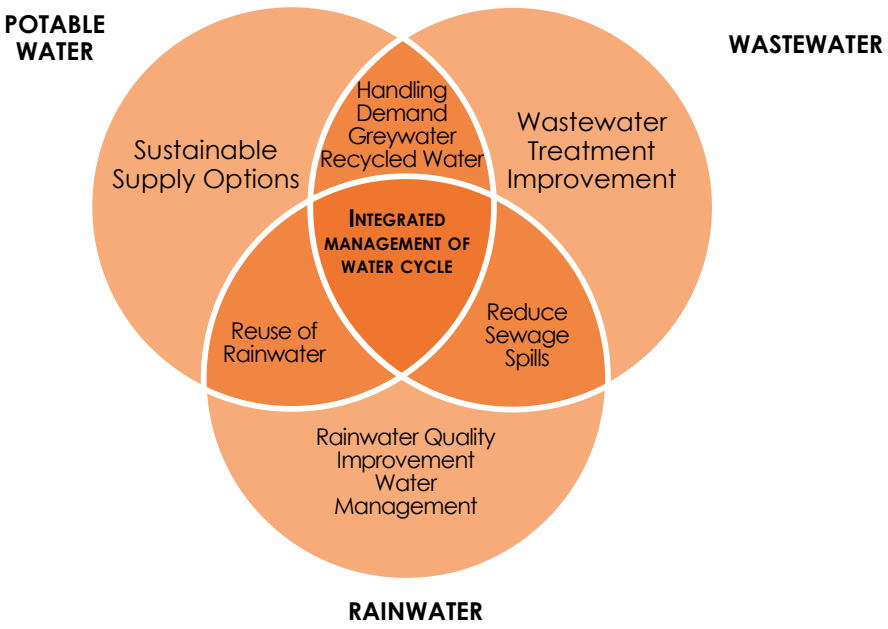
Source: OECD, 2015.

The *Integrated Urban Water Management* (IUWM) is another key concept for improving the way of handling the water in cities. The SWITCH *(Sustainable Water Management Improves Tomorrow's Cities' Health)* program, in its training kit, says, *IUWM recognizes that problems found in a certain area of the urban water cycle can be the result of a bad management in another area.*

When considering the water of a city as an integral system, its evaluation makes it possible to keep to a more efficient and sustainable resources use" (Van, 2011, p. 6). In this trend, *SWITCH* raises the following hypothesis: '*the design and management of the urban water system based on the analysis of the entire system will lead to more sustainable solutions that the design or the management separated themselves from the main elements of the system'* (Van, 2011, p. 4).

A logical inference then would be to say that *IUWM* is an applied form of the *IWRM* to cities or, in other words, the integrated management of water or hydrological cycle in the cities. This last concept may be better understood in the Figure 3:

FIGURE 3. INTEGRAL WATER MANAGEMENT



Source: Hoban and Wong (2006).

As shown in Figure 3, this approach is far from being a *straight-lined* system where the water enters *(supply)* and then exits *(wastewater)*, but it integrates them both as spheres that interact one with each other and, at the same time, the same effect with another sphere called *rainwater*.

The spheres in the Figure 3 are labelled as *drinking water, rainwater and wastewater*; all are integrated by links to accomplish a functioning interdependent water management.

For example, in the *drinking water* sphere, supply options are considered to be sustainable through the reduction of the water demand through the user´s low consumption habits and the implementation of saving systems in households services. It is also noticeable when the *drinking water* sphere interacts with the *rainwater* one; there may be a true gain of rainwater by harvesting it in buildings and treated surface runoffs. This could increase the water supply and reduce the water demand.

On the other hand, when the *sewage* sphere interacts with the *drinking water* one, improved systems of treated reused *blackwater* and *graywater* increase the water supply for restricted uses and reduce demand for clean water. In addition, to implement systems for reuse, reduce the volume of treatable *wastewater* as well as the cost of operation of treatment plants.

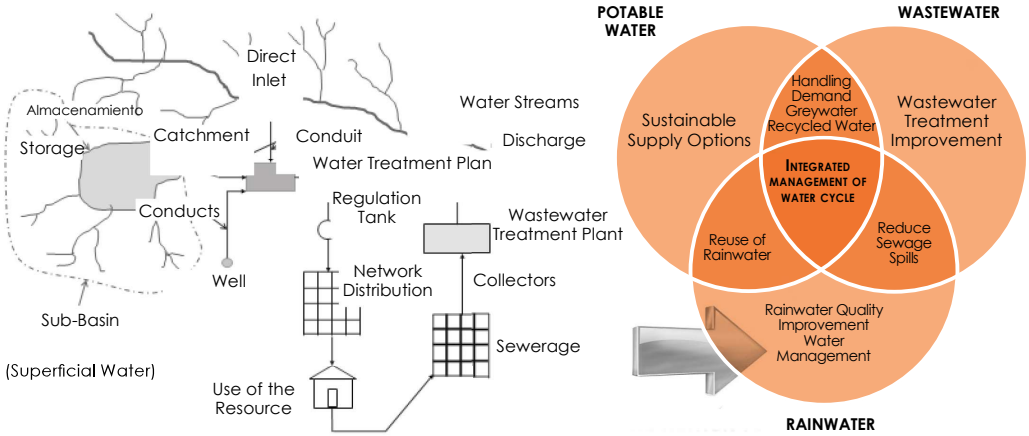
Finally, when *wastewater* interacts with *rainwater*, the volume of water from rain can infiltrate to the subsoil or be collected in buildings and public spaces, allowing the expected separation of waters and the decrease of *combined* water overflows (wastewater and rainwater) that overfill collectors and treatment plants. It is quite clear that the main purpose of the IUWM is to achieve a balance between the three spheres, which is known as the '*integrated management of the water cycle*'.

To attain such balance, it is necessary that governance is the vehicle to reach a shift of paradigm that consists in the transition from an 'extraction expulsion' type of model towards a 'low extraction-less expulsion' kind of model.

Therefore, it is firstly imperative to move from a sectorial and centralized management of water (*governmental participation only*) in the direction of an integrated and decentralized management (*with participation from all sectors of the population*).

Afterwards, leave for later the construction of new sources of supply that involve high economic costs, irreparable environmental damages and the opposition of those affected by the construction of the mentioned major projects. To understand graphically the prior explanation is Figure 4:

FIGURE 4. PARADIGM SHIFT IN THE MANAGEMENT OF THE WATER



Sectorial-Centralized Management **Integral-Decentralized Management**

Source: Prepared by the author (2010).

Up to here are introduced the main concepts underlying the approach to the management of water needed in the Conurbation of Guadalajara (COG). According to the 2015 United Nations World Water Report: 'Water for a Sustainable World', "*water is the center of the sustainable development*" (UNESCO, 2015). Therefore, it cannot be ignored in the development of cities.

The concept that arises from development and its application to water´s identified as '*Integrated Water Resources Management*' (IWRM). This concept has the purpose of a coordinated water management in order to maximize the economic performance and social well-being in a rightful manner without compromising the sustainability of vital ecosystems.

Another important concept presented was the *Governance of Water*, defined as the capacity of public institutions to carry out this management jointly with the citizens under the principles of effectiveness, efficiency and participation.

This 'governance of water' will allow the implementation of an *Integrated Urban Water Management* (IUWM), which is reflected in an integrated control of the water cycle where the water supply, wastewater and rainwater are integrated to progress from a *straight-lined* model (water entrance and water exit) and transition to a *decentralized-integrated* model (recycling).

2. THE CHALLENGES OF WATER MANAGEMENT IN GUADALAJARA

In the last few years, it has been observed that conventional water management in urban areas has not had neither the capacity to confront the present challenges nor being able to anticipate the future ones. Some significant problems are the increasing scarce of water, severe pollution and over-exploitation of sources of supply, frequent floods, the harm to public health, the deterioration of ecosystems and, as collateral damage, the social conflicts by escalating competition for the vital fluid. The leading reason for these serious troubles is that the management of water supply, sanitation and rainwater has not been executed thoroughly; instead, each one of these elements has been operated, planned and carried out separately and consequently the interconnections between the problems and possible solutions are missing.

There is an imbalance in the management of the water cycle that does not allow the efficient operation of the infrastructure and its administrative mechanism. Therefore, it is necessary to approach to reality with an accurate diagnosis that allows having an overall view of the problem to establish public policies to solve them. The diagnosis of water management in Guadalajara covers three main axes: deterioration of the water cycle, physical malfunctions and faults on the management of the urban hydro-sanitary system.

The part of the water cycle identifies the effects of an inadequate intervention in the territory as changes in the land use are affecting the appropriate functioning of the water cycle variables: precipitation, infiltration, runoff and evapotranspiration. With regard to the physical damages of the urban hydro-sanitary system, describes their main lags in its technical operation. Finally, on the topic of management shortcomings, it is analyzed the planning aspects and the administration of the governmental structure that runs both the system as a whole and the water cycle process.

2.1. DETERIOTATION OF THE WATER CYCLE IN GUADALAJARA

If the problem is not clearly defined, it will surely not be resolved altogether. It must be recognized that the main source of supply has been damaged: The water cycle. The imbalance of its own variables

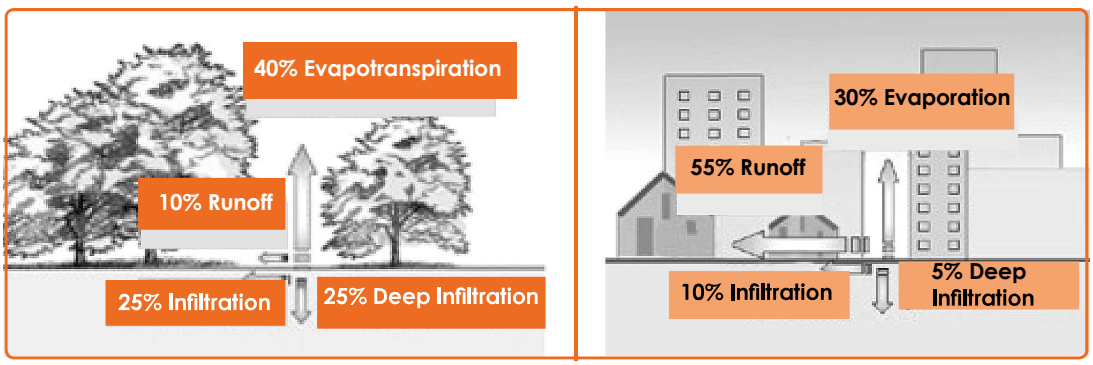
such as evapotranspiration, runoff, infiltration and precipitation, is the main cause of the present state of the water. A rampant disordered urbanization leads to the stain of concrete (buildings and avenues) to cover the infiltrative surface that prevents the water to recharge into aquifers also to the significant decline of the evapotranspiration that affects the behavior of the rain.

Once the surface has been '*waterproofed*', recurrent floods are causing serious damages to people, their goods and to the natural environment. In consequence, the water that had to infiltrate to recharge aquifers is now conducted to the drains and mixed with *blackwater*. This lack of infiltration is causing the aquifers to eventually dry if there is no recharge.

The withdrawal of forests directly affects the evapotranspiration that produces rainfall and local temperature changes, thus forests are turning into deserts of concrete. This reduction in evapotranspiration directly alters rain behavior. In the absence of forest mass, there is neither perspiration of the trees nor evaporation that when raised to the sky it condenses and become rain (Spracklen, D.V., 2012). In addition, the retreat of the trees decreases the water infiltration to the underground through their roots.

In Figure 5, it is observed a change on the conditions of the water cycle variables when they were functioning in natural conditions (Subsection A) and when an urbanization takes place and potentially can cover 70 to 100% of the surface of the ground (Subsection B):

FIGURE 5. BEHAVIOR OF THE WATER CYCLE BEFORE AND AFTER THE URBANIZATION



A) Water Cycle in Natural Conditions **B) Water Cycle in Urbanized Conditions**

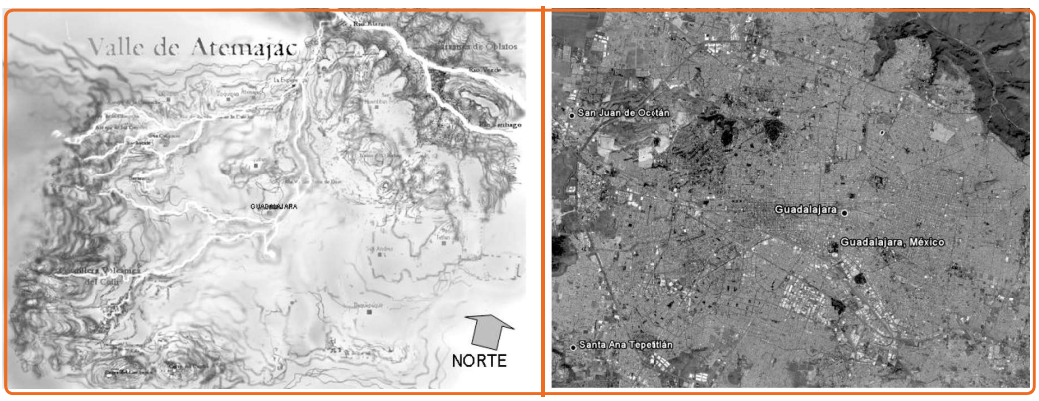
Source: EPA (2010).

As you can see in Figure 5, the major imbalance observed are the variables of runoff and infiltration. When a territory is covered between 70 to 100% of its surface, runoff increases five times. On the other hand, superficial infiltration is perceptibly diminished but profound infiltration is drastically reduced. Serious consequences of the above are floods and the dryness of the aquifer (Del Castillo, 2016).

As a result, the most serious consequences of the damage to the cycle are floods by the lack of infiltration, the overexploitation of aquifers due to a high demand of water and pollution of surface and groundwater by discharges of sewage. Others are the substantial temperature increaTse owing to the absence of trees and the modification of the rainfall patterns attributable to a decreasing evapotranspiration. All this leads us to the shortage of this vital liquid.

Trying to resolve this problem without reaching the bottom line of the case, will make things more complicated. Figure 6, displays a change of coloration of the surface of the territory of Guadalajara between the years 1542 (subsection a) and 2010 (subsection b). The first image illustrates a green colored area and the second one, a gray color area that shows the growth of the urban expansion that has almost completely covered the areas of infiltration:

FIGURE 6. MODIFICATIONS OF THE LAND SURFACE OF GUADALAJARA



A) Atemajac Valley Basin in 1542

B) Atemajac Valley Basin in 2010

Source: Alejandro Ulloa

Source: Google Earth

An up-to-date example, is the urbanization of the endorheic basin named '*El Bajío del Arenal*', which is a territory considered to be as one of the major recharging areas of the aquifer of Atemajac. This space has been partially covered by the construction of the Pan American Villa, the *Omnilife* Stadium, residential developments and schools.

It has been demonstrated that the urbanization of this watershed will end up in a remarkable decrease of the infiltration rate and will emerge persistent floods, without putting aside that this type of constructions incite the urbanization of the wooded area identified as 'Bosque de La Primavera' *(La Primavera Forest)*. In this logic, in the near future it will not sound strange that some developer, in a greed rush, promotes the construction of a so-called '*ecological residential development*' entitled "*La Primavera*".

On the other hand, there are cases such as the construction of the markets of *Mexicaltzingo* (2003) and *Corona* (2016). These constructions have blocked the path of the water flows under the surface because of their underground parking lots that are blocking the natural watercourse and its final destination such as springs or other body of water. In our time, water of the markets is misused, pumped out and straight down the drain. Another sad case is the urbanization of '*Cerro del Tesoro*' where nearly all of its surface has been covered with concrete without considering any harm or impact made to the behavior of the water cycle variables (Carapia, 2016). This type of constructions will cause intensified bigger inundations and will reduce the rate of water infiltration to the subsoil.

The 2015 United Nations World Water Report: 'Water for a Sustainable World' (UNESCO, 2015) asserts that "*disturbed ecosystems, the relentless urbanization, the inappropriate practices in agriculture, deforestation and pollution are factors that are weakening the nature's capacity to provide environmental services such as clean water*" (p. 2).

Then, a reasonable deduction would be that water availability problem does not lie entirely in the lack of sources of supply, but in the serious worsening of the performance of the water cycle variables. This situation represents one of the greatest challenges for the society of Guadalajara, which first needs to know the situation and then decide to take immediate actions to stop the harm and compensate all the damage as soon as possible before it is too late.

2.2. PHYSICAL IN THE OPERATION OF THE HYDRO-SANITARY SYSTEM

This part will be brief to give more space to failures in management. In the first place, according to the *Inter-Municipal Potable Water and Sewerage System* (SIAPA, *for its acronym in Spanish),* the sources that supply water to Guadalajara are the *Chapala Lake* (60%), groundwater aquifers of *Toluquilla* and *Atemajac* (30%) and the *Calderon Dam (10%)* approximately (SIAPA, 2012). Depending on the case, these three sources of supply are polluted to a greater or lesser extent, which compromises the quality of water for the city.

Not only the pollution comes from the sources, but also the quality of the water is affected when it goes through the old pipelines, it is contaminated with particles of iron or asbestos that are detached from the pipes.

Considering the distribution network, the system operator has declared a 28.4% losses, in other words of each ten glasses of water produced, almost three do not reach the houses (Muñoz, 2016).

However, it is not clear how this information was obtained; therefore, this percentage can be raised by reason of the level of deterioration of the pipelines for its useful life.

This is why, among other things, the produced water is not suitable for human consumption. As of households consumption, the majority of citizens consume water irrationally, which raises demand in an unreasonable way affecting the availability of water (Del Castillo, 2016). Citizens are not educated to carry out a rational management of water in its housing.

The unawareness of the value of the water among the population is widespread. It is oblivious of the importance of the water cycle, of its current status and how the urban hydro-sanitary system works.

This ignorance keeps the user in a *kind of bubble* situation where they think that everything is fine and the water used will be eternal.

Once a citizen uses the water, it is downloaded to the sewer pipes network where rainwater and sewage mix. During the raining season, sewerage network saturates causing floods in different points of the city. The economic losses amount to $ 180 million pesos annually, without considering the deaths that have occurred by this problem (Pérez, 2015).

On the other hand, despite two treatment plants are operating, *'El Ahogado'* in *Tlajomulco* and *'Agua Prieta'* in Zapopan, their capacity is still insufficient since there are no collectors that will lead the total amount of wastewater flows toward the plants (NTX, 2016).

Subsequently, the pollution of watercourses persists to date, especially on the *Santiago River* that is severely contaminated (Tamayo, 2016).

Physical failures of the hydro-sanitary system are manifestations of a poor management that tends to complicate as time progresses and above all, to compromise the supply of water to the population and the environment.

Hence, it is necessary to establish a public policy that allows the hydro-sanitary system to recover gradually to take down the lags intelligently so an efficient infrastructure can be maintained for the current and future generations.

2.3. FAILURES IN THE MANAGEMENT OF WATER IN GUADALAJARA

The management, understood in contemporary terms, is the procedure of adequacy of resources of any kind to those purposes for which they were collected (Anonymous, 2016a). On the other hand, it is also understood by management as the completion of proceedings aimed at obtaining some benefit, taking the people who work at the institution as active resources for the achievement of the objectives (Anonymous, 2016b).

It will be carried out an analysis of water management in the aspects of planning and administration in order to understand the issue from an operational perspective and set actions in these areas that lead toward the achievement of a sustainable management of water.

2.3.1. FAILURES IN PLANNING

One of the major challenges is to have a *measurement system* that lets to have full knowledge of the behavior of the water cycle through time. In real time, it is not known exactly the quantity and quality of water in the basins of the city.

There is no monitoring system that will facilitate a clear picture of the current status of groundwater, surface water and in the environment. Without this information, it will be almost impossible to establish realistic diagnoses and, at the same time, to formulate relevant proposals.

Unfortunately, nor has a procedure to monitor the urban hydro-sanitary system operation, so it is not known with accuracy the quality and quantity of water in the supply lines, the current state of the collectors, the degree of contamination of the wastewater, among other aspects.

As already has been said, the *lack of precise information*, is a major obstacle that does not allow to perform in-depth diagnostics on the real situation for both the water cycle and the urban hydro-sanitary system.

For example, when researching for this article, studies were requested to know the real state of the drinking water distribution

network of the conurbation of Guadalajara (COG) and were only presented one sheet as a response,[1] an executive summary of a study.[2]

In addition were delivered three pages that expose the objective, the main technical indicators and a plan of actions. However, the study where they show how they reduced the losses of 43% to 32% in 2007 were not delivered. Recently the SIAPA through its Director stated that the rate of losses is currently 28.4% (Muñoz, 2016), but did not mention the method that was used to reduce those losses.

On the other hand, it is unknown the physical conditions of the filtering tunnels that still supply certain areas of the city or how much water from the springs is channeled directly to the drains.

Without clarity on the global availability of the resource, a common error comes when presented expensive projects to provide water without correcting the wastes. Without information cannot be decision, without data cannot be evaluation and without evidence cannot be improvement. In this sense, the 2015 World Water Report '*Water for a sustainable world*' (UNESCO 2015) says:

> *Monitoring the availability of water, its use and its interrelated impacts, unveil the highest and most persistent challenges of all. Reliable and factual information about the state of the water and its management is often poor, absent or otherwise, inaccessible* (p. 15)"..." *this lack of information and knowledge, creates barriers to the formulation of a cohesive public policy and a correct decision-making correct according to the objectives of development* (p. 16).

Another challenge is the *lack of completion of the governmental hydraulic plans*. Analyzing the hydraulic plans of the three levels of government, and accordingly to the targets set at the beginning of the governmental periods, can be concluded that they had not been fully met. An example of the preceding statement is the project of *La Zurda-Calderon* built in 1991 meant to supply water to Guadalajara.

1. SIAPA, (2007). Directed to L.C.P Carolina Ochoa Camarena. Transparency and Public Information Office. Signed by Ing. Guillermo Camacho Leyva, Head of the Leakage Section. Part No. 097/07.
2. SIAPA, (2004, April). "Diagnostic study and integrated planning of the potable water and sewerage systems and sanitation of the inter-municipal system for the potable water and sewerage services in the municipalities of Guadalajara, Zapopan, Tlaquepaque and Tonalá". Guadalajara, Jalisco.

This project consisted in the construction of two dams: *Calderon* and *El Salto*, and would bring three cubic meters per second. Currently the second dam is not connected to the first one and therefore they do not provide the flow that was proposed in the first place.

Today, the Calderon Dam hardly brings a cubic meter per second. In addition, the underlined plans to clean up the Lerma-Chapala-Santiago Basin, designed in the eighties, are still drawing attention. Unfortunately, both *Lerma River* and the *Santiago River* are extremely contaminated.

Another example would be the programs launched to solve the problem of flooding in the COG, which have fallen short in the magnitude of the issue. Once the raining season is over, it is admitted that there are no resources and everything remains in verbal statements.[3]

Without a doubt, another example was the *Arcediano* Dam, a project proposed in 2001 and canceled in 2009 by the cost of the wall. After having invested more than 700 million pesos in studies, it was determined that the cost of a concrete wall was the more viable than a wall made out of graduated material without taking into account these expensive studies.

In recent times, water planning takes place in most of the proposed projects but is the result of a *planning* based on the response to a *political conjuncture* and not on a deep application of a methodology that acknowledges the reality to its core, for hence raise the relevant and appropriate solutions. It is evident that the planning of the hydraulic projects focus more on solving the problem making aside the opportunity to resolve it from its origins.

Plans lean more to *increasing the supply of service*, both in water supply, as in estrangement and sanitation. It is omitted alternatives to improve the service and to take advantage of the available water resources. This tendency prevails in political speeches and even serves as a political flag for campaigns. Another regrettable problem is the *sustainability as discourse and not as action*. The approach in the field of sustainable development on the hydraulic plans lacks scientific bases.

3. EL INFORMADOR. Editorial. 'For another year' (2008, May 23) Just a few months ago, the general director of the government office, Rodolfo Ocampo, announced that they would be able to build projects such as storm collectors that would act as regulators to avoid concentration of rainwater in points of the city. The amount of water accumulated in a storm often causes severe ponding, traffic jam, and pedestrians not being able to pass through those places. These works simply were not made and must wait for better times, perhaps the next year.

For instance, the authorities have proposed to urbanize in a "sustainable" way '*El Bajío*' basin with the idea of installing environmentally friendly technologies, but without executing any geo-hydrological study of the area that would expose the present and future impacts of the constructions to the aquifer.

Hence, speech is more apparent than real, aspects such as the evaluation, monitoring, and protection of water resources before the beginning of the construction are not taken in consideration whatsoever. Themes as deterioration and restoration of the water cycle, programs for the urban hydro-sanitary system rehabilitation, educational programs or institutional administrative improvement are definitely out of the *planning* picture. The debate only centers itself on increasing the water supply to try to satisfy a thirsty, insatiable city. Another great challenge uncovered is that *population remains outside the planning process*, as there are no actions taken in this manner as informed in the SIAPA Report.[4]

It is true, though, that some sectors are invited to the planning, but to participate there are more privileged profiles than others, such as engineering. If you are not one of them, marginalization is guaranteed.

Until now, participation has become in a *system of validation* of the government proposals. Actually, there is no full recognition of the rights of the actors and even less, they have an opportunity to influence into the decision-making. This situation have risen disagreements, deepen the differences, quieted the dialogue and has led the government to become impositive.

Consequently, the absence of precise technical information required to generate a *system of measurement*, it is impossible to plan the necessary actions to solve the issue caused by inadequate management of the water. To carry out projects without the support of crucial technical information makes projects' objectives unreachable.

Instead of planning the solutions from the root of the problems, planners choose to promote projects based on particular interests that ignore the needs of the population.

4. SIAPA (2009) Second activity report 2008. L.C.P. Rodolfo G. Ocampo Velázquez. General Director. Guadalajara, Jalisco.

Due to the lack of commitment of the authorities to solve the essence of the problem, they dismiss strong, founded, sustainable proposals, and at the same time, population is sidelined in the elaboration of those.

Experts are ignored, as many sectors involved as well if they disagree with the authorities. Irrefutably, it is necessary to be a planning based on reliable on-time information to take the best choices, a government that takes account of the society and precedes the common interest before the party interests or any other.

2.3.2. FAILURES IN THE ADMINISTRATION

This section is focused on the administrative aspects. A first lag is *the minimum coordination in the activities*. The institutional system that manages the water in Guadalajara integrates by the *National Water Commission* (CONAGUA, *for its acronym in Spanish)* the *Jalisco State Water Commission* (CEA, *for its acronym in Spanish)* the *Inter-municipal Potable Water and Sewerage System* (SIAPA) and the drinking water departments of the conurbation's municipalities.

Each institution generates its own agenda and they do not create an integrated one to resolve the immediate and long-term operational aspects. The institutions do most of the investment projects without adequate mechanisms of coordination.

Frequently, responsibilities are not clearly defined or properly assigned, and they face the problems without coordination, when the real situation of the problem requires a comprehensive and multidisciplinary approach.

This makes it difficult to have an integrated vision, which produces duplication of activities, overlapping of responsibilities and dispersion of resources.

A perfect example of the above is the case of the water collector in the tunnel of *Las Rosas* Avenue that collapsed by the excess of rainwater. The Jalisco Urban Development Secretary (SEDEUR, *for its acronym in Spanish)* did not listened the warnings of

SIAPA concerning the weakness in the design of the new collectors (Valdivia, 2008).

Another great challenge in terms of administration is the *financial aspect*. There is a low financial efficiency due to the lack of measurement of consumption, the shortcomings of the systems that registrate consumption and inefficient billing procedures.

This situation creates irregular charges in water bills, does not generate precise data needed for financial planning and accentuates the inability to recover the costs that would allow making investments for service improvement or reduction of the environmental and health impacts.

The efficiency of collection of charges is of 72%, which means that the rest -28%- are debts that will not be collected or long overdue. In spite of the fact that the cost of water is very low, those in debt maintain past due accounts for over 1,500 million pesos and are responsible for the financial struggles.

The *SIAPA* is hand-tied to make effective the debt collection because many of the defaulted consumers conform to the impossibility of a supply cut, which makes it hard to oblige them to pay. Back in 2007, there were 190 thousand in arrears (La Jornada, 2007).

There *SIAPA* has a total debt of 74'803,325.10 pesos. Currently, it settled that *Banorte* bank would refinance such debt to a payment period of 20 years (Chávez, 2016).

This debt limits the operation margin of the institution and it remains subject to limited state and federal resources. Another financial aspect, are the *rates* that do not reflect the true cost of water supply services and drainage. Nowadays pay $4.70 per cubic meter, which represents a half a cent per liter, when a liter of bottled water costs between a $1 and $1.50.

The cost is very low and the final user waste the water without any consideration of its true value. In the same sense, the system operator has proposed to the State Congress a fare raise, but just because it is not a politically profitable measure, is not authorized in most of the cases.

Proposed increases are justified to improve and expand the infrastructure, but generally, there is a lack of diagnoses based on measurements and assessments to justify these increases.

Institutions do not *have the qualified staff* to carry out the functions of leadership in the management of water. This is demonstrated when the technical staff and administrative personnel is exceeded by the complexity of the problems that they cannot resolve, making water more of a political issue than a technical issue.

Attributable to that short capacity, they tend to propose superficial actions without a technical-scientific support. Currently the Governor of the state of Jalisco and the City Mayor, who aspires to be governor, entangled in a sterile

debate over the allocation of water without having the exact data on the availability of clean water in the basins.

In addition, on many occasions, the technical and administrative staff do not have the required training provide an adequate service as the decision-making profile does not match to the required to operate the system. This is due, in part; to the fact that currently in Jalisco there are just a few programs specialized in water management in an integrated way.

Recently, however, the *University of Guadalajara* offers a Masters in *Management of Water and Energy* at the *Tonala University Center*.

The shortage of specialized staff for the management of water is one of the flaws that promotes the shortcomings of the hydraulic system. The appointment of officials in the strategic positions of the system corresponds merely to a political interest instead of a professional interest.

A distinct case may be the designation of former congressional representative, Rodolfo Ocampo Velasco, as director of *SIAPA* by the elected governor Emilio González Márquez in 2007. The Council of Administration of the *SIAPA* ratified this appointment despite his absolute ignorance on the subject. Backed with his public accounting degree and after arguing to be a good administrator as required, Ocampo Velasco accepted to be part of the *governor-to-be* extended cabinet. The congressman said: "I have administrative experience and whoever is in front of an organism of this kind must know well what it refers to the administration and leave the technical part in the hands of the technicians, as well as it did Toño Aldrete, who is a certified public accountant who knew how to delegate the technical responsibility in those who are specialists in the field" (Barajas, 2007).

In addition to such designation is also the brother of the Governor, Samuel González Márquez, who did not have any experience in the public sector, being administrator by profession, was appointed Sanitation Manager with a gross monthly wage of $99,000.00 pesos. Also, stands out the case of the appointment of two former aldermen; they were very close to the governor and *awarded* with two positions in which neither had a natural profile: Abraham Cisneros was appointed Commercial Manager and Paulo Colunga Perry, Administrative Manager (Partida 2007).

More people were rewarded with well-paid top positions with less or none experience in water topics: Manuel de la Cerda, former Director of Municipal Public Services of Zapopan, was appointed Technical Manager; while the financial area remained in the hands of former Director of Social Development of Zapopan and former officer of the *COPLADE*, Mario Juárez.

To open spaces for these new appointments, it did not matter

for the new Board of Directors to spend $8'816,000.00 pesos to get rid of ten staff members, most of them experts and in charge of the technical management at least during the recent three administrations.

One by one, each with a quite important pay settlement, in addition to Hernández Amaya, Luis Aceves Martínez (*Manager of Sanitation*), José Julio Agraz (*Manager of Potable Water and Sewerage*), Enrique Cerón Mejía (*Administrative Manager*), Fernando Ascencio Arias Hernández (*Financial Manager*) and Luis Manuel Espino Beltrán (Commercial Manager), among others.

Crucial things seemed non-important in *SIAPA* at that time. For example, the irreversible debt of 1,500 million pesos, the need for new equipment to monitor leaks in the piping system, a need for renewed collectors system in practically the entire metropolitan area or unexpected expenses such as the drainage that was placed next to the overpass of the avenues *López Mateos–Las Rosas*.

Another issue to be resolved is the *insufficient attention to the citizens' demands*. There are six teams of four workers to respond to four sectors in which is divided the metropolitan area of Guadalajara. The service coverage for over 4 million inhabitants is limited.

Two system workers who came to repair a leak in a house were interviewed but asked not to be identified to avoid possible reprisals. They stated that there is insufficient staff to meet in a timely manner to the demands of citizenship. This statement was supported by Mr. Manuel Salazar González, interunions relations secretary of the Union Workers of the *SIAPA* in the *Mexico-Germany Symposium* (México-Alemania) "Our Water Every Day" (Salazar, 2008).

To ask to the Director of SIAPA in 2007, if there was a delay in the daily reports, he replied:

> *Yes, of course, that is the problem. We had a response capacity in the theme of storm drains and wellbores more or less of 60 percent per*

> *month, means that every month we had a lag of 40 per cent that was adding to the daily reports. Therefore, the seriousness of the problem that we were living, today of that lag that we had accumulated -if I am not mistaken- as much as two thousand reports that had not been treated right now, we already have a 50 percent improvement in that lag.*[5]

Combined with the above, there is the *lack of transparency*. There are obstacles to access to public information. Not having basic technical information represents a set back to create the system's action plan due to the lack of measurement, but there are also obstacles to facilitate existing information to citizens. This information may be technical, financial or about performance of the agencies. There is no access to memories of calculation of the built infrastructure or duly dimensioned blueprints that would enable an understanding to the system's operations in its different stages. Given this circumstance, the citizen and the experts remain marginalized from basic information to get a thorough knowledge of the current situation of the operation of the system.

Without a question, one of the most important weaknesses in the planning and management of the water system, it is the *absence of citizen participation* in decision-making. Planning is carried out in the highest spheres of power without taking into account the needs of the citizens; it is assumed that the participation of citizens is unnecessary since the executers handle the technical aspects. There prevails a marked ignorance on the common citizen, who keeps apart from the problems, the debates, the importance of recognizing good or bad operation of the system and the importance of their participation in the solution of water problems.

It is also observed, that the citizen participation is underestimated, since it is not considered strategic for the solution of the problems. It diminish the possibility that, domestic savings of aware citizens, represents

5. Interview with Rodolfo Ocampo Velázquez. Director of *SIAPA*. "Chapala RAMSAR" site event. August 28, 2007. Http://www.siapa.gob.mx/noticia_entrevista28_8.html

one significant highpoint in the series of actions to optimize the delivery of the resource. The citizen is only a receiver of the services but not an actor in the solution of the problems. It is clear that the absence of participation not only hurts interests of various groups, but also limits the response capacity to the complex problems of the water cycle and the urban hydro-sanitary system. However, some organized groups of society have raised their voices to denounce this relegation, demanding participation and pointing the abuses and errors inside the administrative offices of the water system (López, 2007).

To complete the section of the administrative lapses, it is perceivable a marked disorganization reflected in the lack of coordination of actions between the institutions, that limit their ability to respond to the serious and complex problems that arise on a daily basis.

This problem is further complicated when the main decision-makers in this institutions do not have the technical capacity to face them or to design relevant proposals through a strong, overwhelming leadership. This deficient capacity is shown in the poor attention of the daily demands of users who have to wait indeterminate lapses of time to obtain the expected resolution.

Furthermore, another consequence of the limited administrative capacity is the poor management of the financial resources that have led the organism to a serious debt and to have a poor collection of resources on account of the services provided. So that the capacity of the institution is limited by the scarcity of economic resources to finance actions and plans in the short, medium and long term.

These limitations have generated lack of confidence of the society in the operational institution because they do not count with on-time or history information systems and the exact information about the state of the water resources and also, ostracize the citizen from any involvement.

It is necessary to initiate a public policy that includes reform all the institutional aspects that allow public entities to solve basic administrative problems, to maintain and preserve the water cycle, operate efficiently the hydro-sanitary system and provide adequate services to the population.

CONCLUSIONS

After having raised the theoretical framework in relation to a sustainable management of water and stating the main challenges in the management of water in the city, valuable conclusions will be presented that can facilitate, in a future, the design of public policies that provide a response to the major problems that have been described.

First, it can be concluded that the system does not operate with the criteria that brings the sustainable development through the integral management of water. There is no coordinated development between water, land and other resources; disordered urbanization has affected water resources.

Economical results translate into a very expensive system, in investment, in operation and lacking of appropriate maintenance. *SIAPA*'s debt is a proof of that, expensive investments have been made but have not yielded the expected results.

On the other hand, social benefits are limited because there are still areas where water does not arrive with regularity. There is a big gap between the people of marginalized areas having a hard time getting water with the people who have equipment of high consumption and waters hundreds of square meters.

Secondly, the principles of *good governance* cannot apply to the management of water in the conurbation of Guadalajara. With regard to the *effectiveness,* water policies in every level of the government still have undefined, clear, sustainable goals and objectives.

A proof of that comes with the lack of coordination in activities where each order of government is doing what it can, as declared by the Director of the State Water Commission in a debate held in April 2016, "*academics say what needs to be done and us, who operate, do what we can*" (Muñoz, 2016).

Now, referring to *efficiency,* the benefits of a sustainable management of the water and the well-being, at the lowest cost to society, are not maximized.

There are poorly defined projects since their very beginning; such is the case of the *Arcediano Dam* or the project of *La Zurda-Calderón*, where the first was not executed, but cost over 700 million pesos, or the second one, that remains unfinished with a large amount of money invested on it as well.

Moreover, the confidence and participation are absent, because the inclusion of actors into the public debate regarding water is neither propitiated nor guaranteed which has led to have a permanent mistrust in everything related to the public sector. Cannot govern the water of the hand of the citizens.

Thirdly, the attention to the water cycle deterioration is zero. Persists in the public speeches, that there must be an increase in the volumes of water. It may come from anywhere, regardless of the environmental, economic and social costs. To leave aside the water cycle, is compromising the availability of water in the next 20 years (UNESCO, 2015).

It is necessary that the authorities understand that the water cycle is damaged and its restoration is a high priority to ensure the survival of future generations.

The decision-makers in the public affairs of water must establish the

water cycle as a point of departure for the design, implementation and evaluation of public policies, if not, it would be to condemn the city to the extreme shortage in the coming years.

Fourthly, the physical failures are the result of a deficient management in every aspect, from planning to the actual administration. In this matter, the contributions of the *integral management of water* are not seriously considered in the planning and management of water because they are not based on an analysis of the current state of water resources and therefore cannot be set goals and objectives or implement any strategies to monitor them.

It is a great challenge to move from a centralist management model, with a paternalistic attitude toward a decentralized and interdependent model to facilitate the coordinated participation between government and society to resolve such a complex problematic.

There is a need for a public policy that integrates the values of sustainability and its derivatives concepts to transit from a model based on the excessive consumption of water resources to one that uses them rationally. It is important to mention that the concept of *IUWM* is not considered part of the projects planning. Instead of integrating the rainwater sphere with the supply and sanitation spheres, the city is promoting mega construction sites to dislodge immediately the rainwater runoff, which should recharge the aquifer.

This the current case in which the government promotes the investment of five billion pesos to solve the problem of flooding through the construction of collectors and channels to move away rainwater runoff. In 2016, is scheduled the first 800 million pesos to fold down the floods without taking advantage of other strategies or hard data available.

Fifthly, the failures in management are manifested mainly in the poor planning of water resources, as well as in its poor administration. Planning is done without first-hand information, which makes impossible to take correct decisions and giving place to probability to be the sole criteria of planning.

Without data cannot be measure, so you have to measure to decide. It was remarked that this planning does not accept the contributions of the society, mainly those coming from the academic sector (Del Castillo, 2016c), which has not allowed for a serious debate between authorities and experts to come up, in a coordinated way, with concrete actions to solve the problem from its core.

About the administrative part, it is observed that there is a great disorder that is reflected in the lack of coordination of actions between institutions. Then, an unbearable debt that restricts the scope of operation, the choice of non-suitable profiles for the management of water, as well

as the lack of transparency in the management of information and financial resources. The out-of-control administration hits the deficient operation of the system (*physical failures*) and as time passes by, administrative complexity increases as debts keep growing, the system deteriorates, the population demand more water and the scope to achieve a sustainable management of water is moving away ever further.

Finally, there is a true concern, as we do not know with accuracy if we have enough time to resolve these issues. If we think of the time that the water cycle has been damaged in the past 50 years, the time that has passed without a rehabilitation of the hydro-sanitary system and the accumulation of administrative problems; the questions that arise would be:

¿Do we have all the time to correct the course?

¿How much time remains for us to return the negative inertia before the availability of water collapses?

If you take into account the UN's report on water resources we could say that we do not have much time to reverse the damage, in such way that these challenges must be addressed as soon as possible to start with this great integral restoration that guarantees the life of current and future generations.

REFERENCES

Anonymous (2016a) *Definition of precise and correct management*. Management and administration. Retrieved on 19 May 2016 from http://www.gestionyadministracion.com/empresas/definicion-de-gestion.html

Anonymous (2016b) IV. Notes for a definition of management. Retrieved on 19 May 2016 from http://www.mecd.gob.es/servicios-al-ciudadano-mecd/dms/mecd/servicios-al-ciudadano-mecd/catalogo/cultura/mc/cegc/capitulos/CEGC_NOTASDEFGES.pdf

Barajas, Eugenia (February 20, 2007) "despite not knowing the area, Rodolfo Ocampo will be the holder of the SIAPA". Daily *La Jornada* ,Jalisco

Gro Harlem Brundtland, (1987). *World Commission on Environment and Development: Our Common Future*. New York, USA.

Carapia, Fernanda (May 16, 2016) *Cerro del Tesoro, lost to constructions*. Newspaper NTR Guadalajara. Retrieved on 20 May 2016 from Http://www.ntrguadalajara.com/post.php?id_nota=39159

Chávez, Váctor (April,18 2016) Refinancing SIAPA'S debt. Newspaper: The West. Retrieved on May 19, 2016 from: Http://www.oem.com.mx/eloccidental/notas/n4138712.htm

Del Castillo, Agustin (May 2, 2016a) "*Metropolitan Aquifers Overexploited in 100 million m3*". *Newspaper Milenio*. Retrieved on May 19, 2016 from http://www.milenio.com/region/Acuiferos-metropolitanos-sobreexplotados-millones-m3_0_736126404.html

_____. (3 May 2016b) "The MAG wasted 1,200 mdp of water at first." *Newspaper Milenio*. Retrieved on May 19, 2016 from http://www.milenio.com/region/MAG-desperdicia-mdp-agua-primera_0_730726950.html

_____. (13 May 2016c) "The water cycle in the MAG seriously deteriorated". Newspaper Milenio. Retrieved on May 20, 2016 from http://www.milenio.com/region/ciclo-agua-MAG-gravemente-deteriorado_0_736726542.html

D. V. Spracklen, S. R. Arnold & C. M. Taylor (2012). *Observations of increased tropical rainfall preceded by air passage over forests*. Journal Nature. Volume 489, Issue 7415. Retrieved on May 21, 2016 from: http://www.nature.com/nature/journal/v489/n7415/full/nature11390.html

Global Water Parternship (2009) *Manual for the Integrated Management of Water Resources in watersheds.* Stockholm, Sweden.

Global Water Parternship (2012). *Governance of water*. Retrieved on May 9, http://www.gwp.org/es/TOOLBOX/TEMAS-TRANSVERSALES/Agua-y-Gobernanza/

EL DÍA (July 11th, 2007) calls SIAPA to the goodwill of municipalities and institutions.

López, Mario (October 03th, 2007) "*The citizen agenda of water in Guadalajara*". Daily La Jornada Jalisco. Http://www.lajornadajalisco.com.mx/2007/10/03/index.php?section=opinion&article=002a1pol

Muñoz, Mario (April 21th, 2016) *Authorities deny shortage of water supply in the metropolis*. *Newspaper El Informador*. Retrieved on May 19, 2016 from Http://www.informador.com.mx/jalisco/2016/657065/6/autoridades-niegan-desabasto-de-agua-en-la-metropoli.htm

United Nations (2014). *International Decade for Action.* New York, EU: Recovered on May 9, 2016 from Http://www.un.org/spanish/waterforlifedecade/iwrm.shtml

NTX (Jan 19, 2015) "Operation of macro plant costs 20 MDP monthly". Newspaper *El Informador*. Retrieved May 19, 2016 from Http://www.informador.com.mx/jalisco/2015/571359/6/operacion-de-macro-planta-cuesta-20-mdp-mensualmente.htm

Nuño, Analy (March 4, 2016). "800 million pesos to mitigate floods". *The daily newspaper NTR*. Retrieved on May 20, 2016 from: Http://www.ntrguadalajara.com/post.php?id_nota=32227

OECD (2015). *Principles of governance of the water of the OECD*. Retrieved May 10, 2016 from https://www.oecd.org/gov/regional-policy/OECD-Principles-Water-spanish.pdf

Partida, J. CARLOS (April 12, 2007) "SIAPA requires creation of 126 more places, refers its director, Rodolfo Ocampo". Daily La Jornada Jalisco.

Pérez D, J. R. (2016) *United Nations Statics Division*. The Planning for the Integrated Management of Resources. National water resources institute INDRHI Dominican Republic. Retrieved on May 9, 2016 from: Http://unstats.un.org/unsd/envaccounting/workshops/domrepublic2007/IWRM.ppt.

Perez V. Rebeca (July 7, 2015) "Calculated losses insurers by 180 mdp." The daily newspaper NTR. Retrieved on May 19, 2016 from: Http://www.ntrguadalajara.com/post.php?id_nota=8703

Salazar, Manuel (November 2008). The Union of SIAPA. "The Water Symposium México-Alemania". Guadalajara, Mexico.

SIAPA (2012) New Aqueduct Chapala-Guadalajara. Retrieved on May 19, 2016 from http://www.ceajalisco.gob.mx/caa/docs/2012/foro_agua/15_acueducto_chapala_gdl_salvador_carranza_siapa.pdf

Tamayo, R. (April 23, 2016) *"Works not hamper pollution of the Santiago River"*. Newspaper *El Informador*. Retrieved on May 19, 2016 from: Http://www.informador.com.mx/jalisco/2016/657424/6/obras-no-frenan-contaminacion-del-rio-santiago.htm

UNESCO (2015) *The United Nations World Water Development Report 2015: Water for a Sustainable World*. A-Water. Paris, France.

VALDIVIA, Jorge and MARTIN, Ruben (July 1th, 2008) in Las Rosas, SEDEUR and SIAPA, "Responsible". Public newspaper.

Valencia Juan C., Díaz Nigenda, Juan J., Vargas Martínez Lourdes (s.f.) *The integrated management of water resources in Mexico: a new paradigm in the management of water*. Retrieved on May 9th, 2016 from: Http://www2.inecc.gob.mx/publicaciones/libros/528/gestion.pdf

Van, Begin (2011). *Training Kit SWITCH*. ICLEI - Local Governments for Sustainability, EuropeanSecretariat. Freiburg, Germany.