

Improvements In The Water Usage Efficiency Of The Mexican Valley

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Abstract

Mexico City Metropolitan Area is located at an altitude of 2300 meters above sea level has a surface of 5000 Km² and a population of 19.1 million whose water supply and usage represent a serious problem of sustainability and development.

The efficient supply and usage of water resources is crucial for a city characterized by industrial centers, a wide range of economic activities and densely populated urban areas.

In a systemic study of water sustainability, in progress at Instituto Politécnico Nacional, there were identified six sets of problem areas: 1) General issues, 2) Sources 3) Uses 4) Distribution, 5) Industry and 6) Management.

In this paper it is presented a set of solutions to the second and third partial problems: how to improve the water supply and usage of water under a sustainable development of Mexico City Metropolitan Area. First of all, there are defined several relevant subsystems, relationships and specific problems. Then it is defined a structure to analyze systemically this part of the total problem and finally some solutions are proposed in the short, medium and long term, for example avoiding the unsustainable uses of ground water sources.

Key words: Sustainable development, water supply, water usage, sustainability

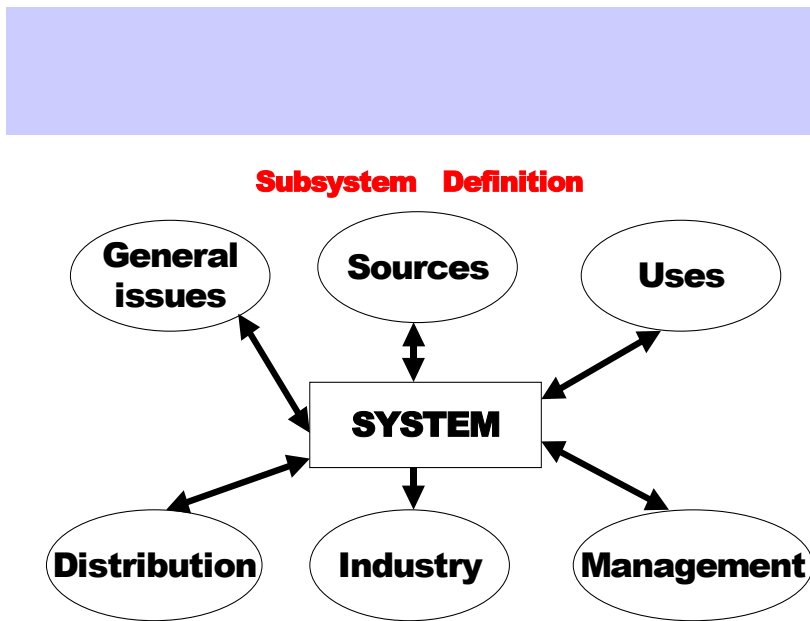
Introduction

Mexico City Metropolitan Area is located at an altitude of 2300 meters above sea level has a surface of 5000 Km² and a population of 19.1 million whose water supply and usage

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represent a serious problem of sustainability. It is a city that has no natural outlets to the sea. And it has neither an important river to supply water for its great population. Besides of that two thirds of the available amount of water for its national development is lost because it goes to the sewage .

In a systemic study of water sustainability in progress at Posgraduated Area of Instituto Politécnico Nacional, there were identified six partial problems related to the main problem : 1) General Issues, 2) Sources, 3) Uses, 4) Distribution, 5) Industry and 6) Management.



Complexity and integrality of this problem can be managed only if a holistic approach , and a hierarchical and well structured schema is built as a first stage of the study.

Now, in this matter, decision-making of Mexican government is very poor. Most of the pressure is put in short term solutions. That is why water supply is very inefficient; there is neither long-term vision nor sustainable development criteria.

In order to modify this situation, in the schema presented in Figure 2, three entities are related : sources, uses and solutions. More or less, the amount of water provided by sources is enough for this city but distribution is not a good solution so many bottle necks are generated by the system.

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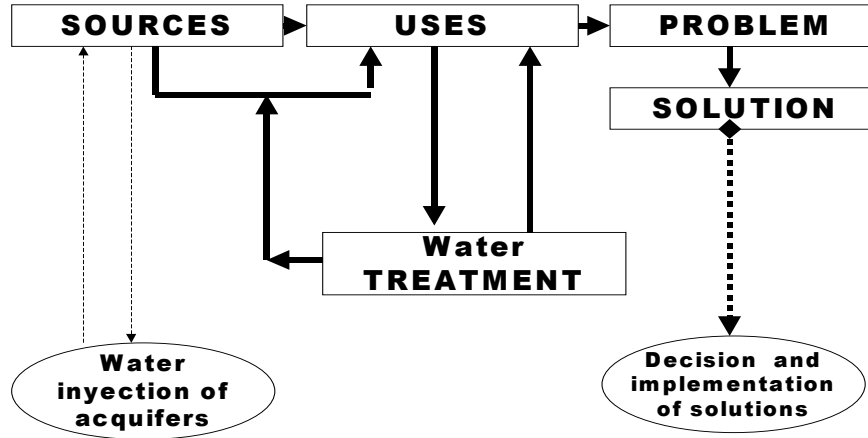


Figure 2 SCHEMAS FOR WATER SYSTEM ANALYSIS

In this paper a set of solutions is proposed in relation to the second and third partial problem: How to improve the water supply and usage efficiency under a frame of sustainable development of Mexican Valley. First of all relevant subsystems are defined, its relationships are analyzed and several specific problems are studied. Finally, the solutions are proposed and classified in short , medium and long term.

Diagnosis

The water system of the Mexican Valley has many problems and its performance is not very good. In spite of having enough rain, a lot of people do not have access to drinking water services. Unfortunately, the final balance is not appropriate for Mexico City: a lot of streets and lands are flooded on rainy months, many neighborhoods do not have drinking water, treatment water versus not treatment water is very low, less than 25%, so industry uses most fresh water instead of treated water as it should be, most tariffs are lower than costs and Mexican people have not developed a responsibility to use water efficiently.

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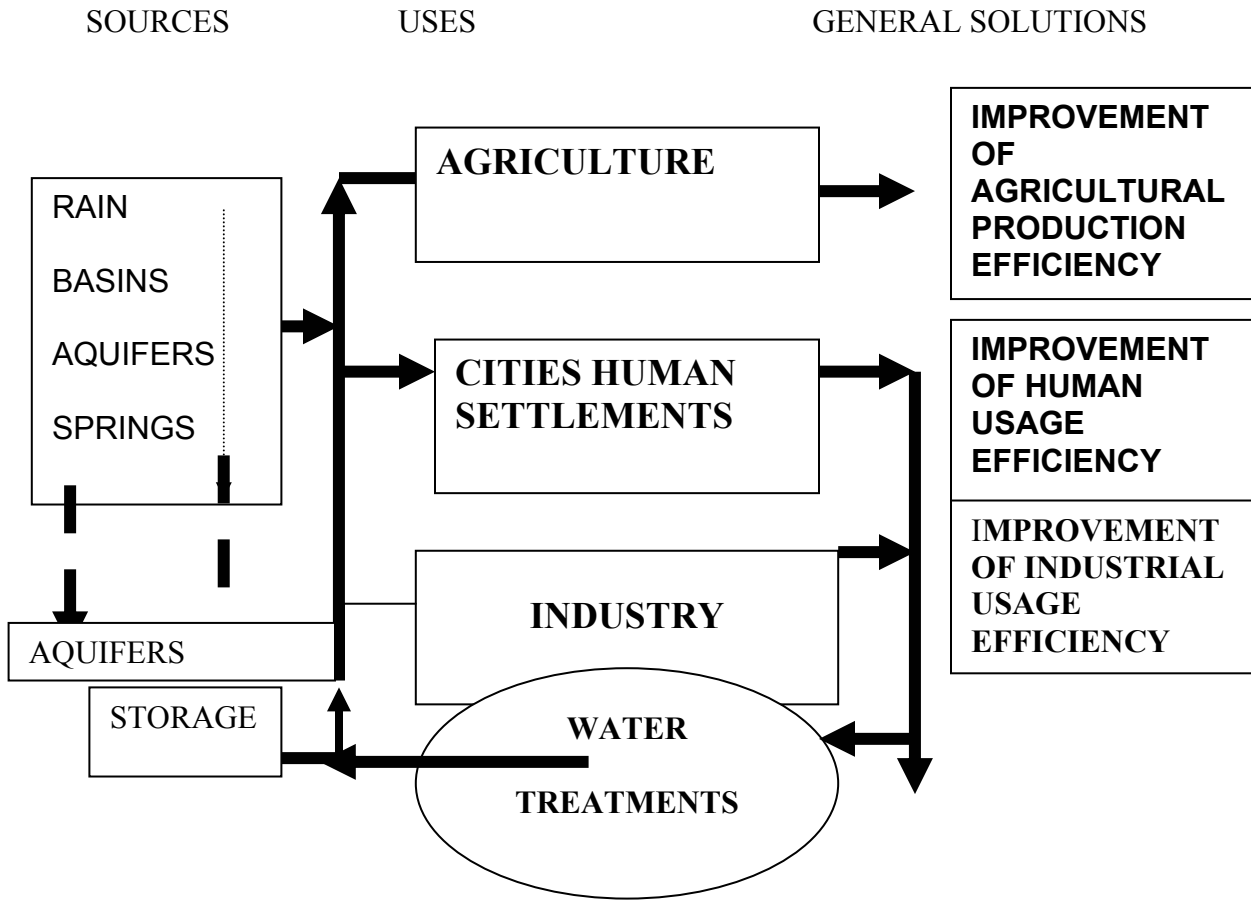


Figure 3. WATER UTILITY MANAGEMENT

In general terms, the city has deteriorated networks, strong maintenance problems, leaks, illegal inlets, inefficient service, anarchical growth, subsidized tariffs and a very poor planning.

Brief Description of the Problem Situation

The problem of distribution and usage of water in a great city is not something that can remain isolated of its social, industrial, and economic model of development. Upon being the water the most elementary resource for living together, its uses have a high priority for society.

The model of growth of Mexico and specifically of Mexico City lacks of urban order and lacks of vision upon the future demands derived from the growing plan. Besides of that there is a very limited participation of government in leading national development.

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Water Sources

The sources of water supply of the valley of Mexico are diverse aquifers, some springs fed by subterranean little deep slides and by the Basins of Lerma and Cutzamala, both located in the State of Mexico. This last basin is 300 kilometers far from Mexico City.

The main water supply fountain for metropolitan area of Mexico City is exploitation of aquifers. This circumstance besides its population growth rate, its accelerated rhythm of construction, its limited green areas and a traditional paving of streets, all provokes a severe reduction of areas for aquifers recharge.

Many years ago it was certain equilibrium among the water extracted and infiltrated, when the extraction of the water of aquifers of the valley was carried out, but this equilibrium was lost when more water was extracted in relation to the recharged amount. This practice provoked differential sinkings that affected buildings structures and subterranean installations, as well as water distribution networks and drainage systems

Regarding this situation, it is observed other problem: lack of a data base upon the volumes of water extracted from deep systems of wells, number and identification of authorized private users in the basin, volumes of obtained residual water, industrial and agricultural water requirements. All data is necessary for each entity.

Water Administration

The basin of the valley of Mexico, that supplies drinking water to Mexico City, is shared for three geographical-political entities: the Federal District, the State of Mexico and the State of Hidalgo. That is why it has not been possible up today to have an integral water administration. Several conflicts and efficiency losses have been provoked by this circumstance.

Water Uses

Balancing the needs of different water users is the most important elements to manage this resource. A megacity has all users in competition: agricultural production, energy, human settlements and industry. Perhaps the most critical use is to ensure drinking water for

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people, having at the same time a proper balance between water supply for other uses and wastewater.

In Figure 3, the three main water users are presented : domestic, industry and agriculture. Agriculture usage consumes more water, between 70 and 80% of total consumption. The other two uses are in competition. If a country has a strong industry and a great population in both cases the consumption is high. Mexico as an undeveloped country as Mexico, with a no very large population and a weak industry , has low consumption by these uses, so agriculture usage is the highest.

It is very hard to change the structure of consumption, because it depends on the economy and the other characteristics of a country .

Decisions on water management are a top priority. People and groups are involved, small business and corporate enterprises, urban and rural households. In the following we analyze the three main uses of water in order to propose some solutions:

Water Use for Agriculture

It takes 3000 liters of water per person to produce a daily intake of food. Most of the water used in agriculture is from the rainy season: only 10% is provided by irrigation.

Agriculture requires the highest amount of water but is not easy to diminish it because this consumption depend on agricultural methods of production. The problem involves many technical, economic and social questions. There are few solutions to improve efficiency in this activity, but most of them are large scale projects or state supported irrigation's systems in order to increase agricultural production at a lower cost.

Water for Industrial Use

As industry is a promoter of economic growth it is necessary to implement plans to make strong links between related goals of industrial development and sustainable management of water. To achieve this goal the main action is focussed to add value to products and raw materials.

The industrial value added per unit of water used varies enormously by country, by industrial sector depending of the value of the product and the value placed upon the water used in processes. Successful process modifications can be implemented through proper benchmarking studies.

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Perhaps the most critical position against industry is the pollution and waste that is damaging and destroying ecosystems. That is the case in Mexico although its industry is not very strong.

It is accepted that pollution has a direct economic impact on industry. Clean water is required but if it is not considered that other water qualities can be used, water shortages and quality water deterioration are created in long term.

SOLUTIONS

There are many solutions for improving water usage efficiency. It is possible to identify hundreds or thousands of specific actions. Although, from a systemic point of view it is better to determine a set of possible few main intermediate strategies or general solutions. In this sense following we present several main solutions:

- Enforcement of existing regulations
- Improvement of the hydric system operation and maintenance , including leak elimination
- Improvement of hydric system management
- Avoid subsidized tariffs as possible
- Improve and diversify water treatments, selecting optimal wastewater treatment technologies in each case. Raw material and energy recovery from waste
- Improvement of water usage efficiency in agriculture
- Stream separation in human settlements. Separation of white water and black water
- Investment on cleaner production processes and improvement of used water efficiency in industry
- Engineering design and solution implementation

Enforcement of existing regulations

National Regulations related to water ownership, planning, exploitation and usage are contained in articles 25, 26 and 27 of the Constitution and in the National Water Law. The water planning is made by individual hydrological basin, as this is the place where rainfall, seepage and runoff occur.

In order to clarify several aspects in law is necessary to modify current laws to establish the rules for achieving the Mexican State governs national development using water as a support and making easier to coordinate the involved institutions.

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Improvement of the hydrological system operation and maintenance including leak elimination

One of the most important factors that diminish the efficiency in the use of water in Mexico is the existence of many leaks in the supply system. This problem is observed in large and small neighborhood networks. The losses by this concept are estimated in 30% of the total volume of supply, 8.3 cubic meters by second.

The main causes of the deterioration of the network are lack of maintenance, shortage of investments and lack of a renewal policy.

Generally, the pluvial precipitation in the season of rains is presented enough abundant in a short period of time. As consequence, by its abundance water has to be ousted with readiness to avoid floods in the city, but due to its little duration, it is no possible to store it or utilize it in aquifer recharge, neither to take direct advantage so it is left to drain out of the valley.

In spite of there is a detailed statistics about supply and consumption of water in Mexican Valley, it is hard to define a quantitative balance of water used in this area. Nevertheless a very important solution to improve water usage efficiency is to plan a new balance, which considers increased amounts of aquifer recharge, reuse and treatments and a new set of different water qualities as well as different related uses.

Improved hydrological system management

Some solutions to the problem of water in the Valley of Mexico require the investment of important amounts of money, this demands strong resources of capital. The undeveloped countries as Mexico, are characterized for having financial shortage of resources, among others causes, this owes to a low economic recuperation by the application of tariffs under real costs and granting of subsidies. The starting point for this effort is to meet all parameters which define system performance. The final objective is to improve accountability, transparency and performance.

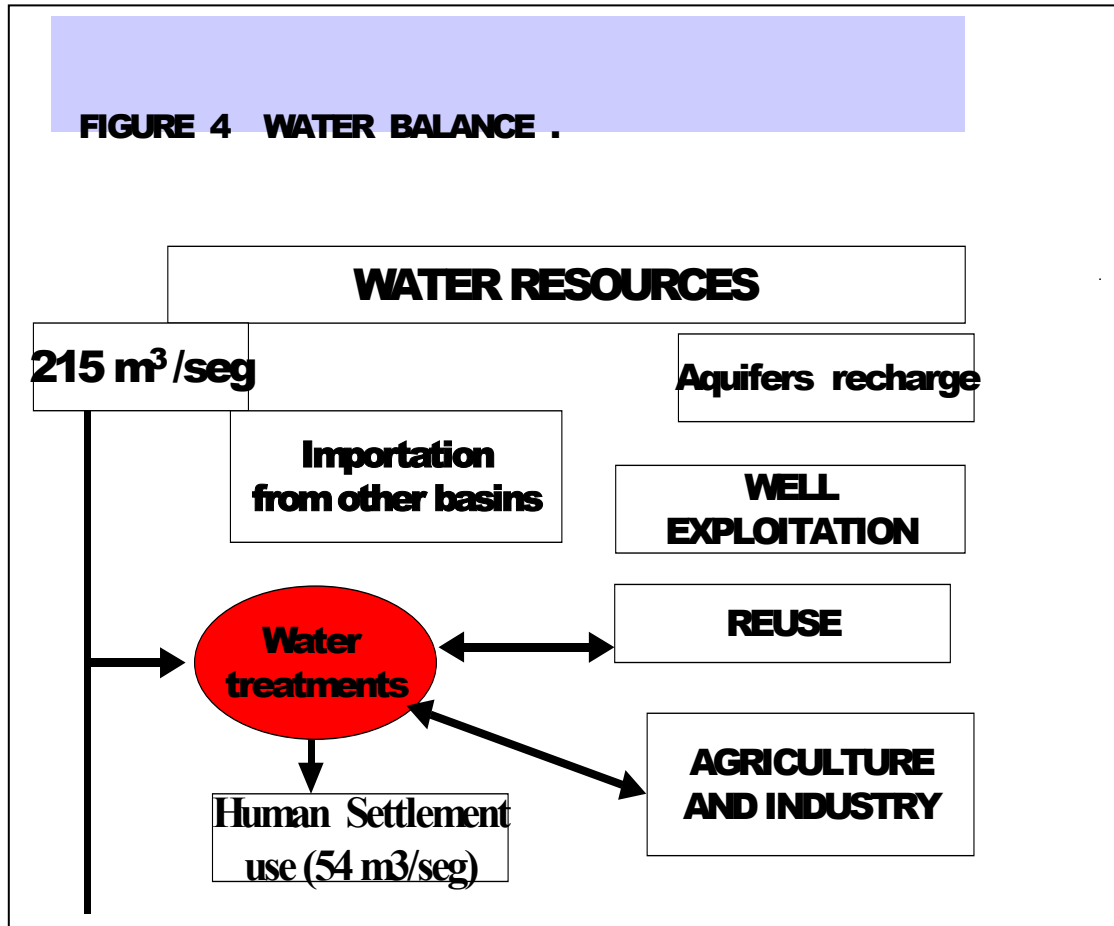
This solution requires a better planning, a better coordination, better information systems, better policies and a good decision making.

Avoid subsidized tariffs as much as possible

The lack of enough financial resources for modernization of the water system is due to low tariffs, subsidies of different kinds, and high operation costs. There are not enough capital resources to invest in new projects, deep maintenance or irrigation systems

Then it is necessary to change this situation, defining tariffs which level be sufficient for achieving a sustainable service with acceptable quality.

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Improve and diversify water treatments

In Mexico the treated proportion of water, is approximately of 24% ($8.3 \text{ m}^3/\text{s}$) regarding the total of water that enters to the System: this is lower than international standards. Independently of the reasons of the under treated residual volume of water, many times drinking water is used for uses that they would require a smaller quality of water

The best solution is to treat residual water and canalize it to different destines or reuses according to the total balance of needs. The partial or total purification of water should be done in a greater proportion, preferably in situ, to avoid damages of this water, produced to the human health because of its contamination,

Stream separation in human settlements and separation of white water and black water

As Mexico City is a megacity the main water consumption is drinking water for more than 20 million inhabitants. That is why is important to modify the technical bases for construction of buildings and houses of the city to separate two streams and

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reusing one of them. It is possible reuse the used water in other services that require less quality, as gardening or water close service.

Improvement of water usage efficiency in agriculture

Modernization of the irrigated agriculture is essential to ensure a higher water usage productivity. Irrigation institutions must respond to farmers to achieve reliable delivery of water. It is also needed a better management system with increased transparency. Modernization requires of targeted investment projects and improved infrastructure and organization and upgraded capacities of farmers and water managers. Some other solutions are listed below:

- Introduce water management in agriculture to give farmers enough encourage, guide, appropriate policies and incentives to improve water productivity
- Avoid government tend to neglect agricultural development in favor of industrial or urban- activities. In fact the Mexican government does not promote either of these activities.
- Produce more food, with a better quality using less water per unit of output.
- Apply new and clean technologies to ensure environmental sustainability and water saving,

Investment on cleaner production processes and improvement of water efficiency used in industry

The productivity of water used in industrial activities can be increased by means of several strategies : environmental and water auditing, matching water quality to use requirements, on-site water recycling and reuse rather using freshwater where it is possible and selecting better industrial processes in which water is used with more high efficiency-.

It is very hard water recycling and receiving all the wastes. This is not technically or economically feasible: that is why a zero effluent discharge is the ultimate goal of companies and municipalities.

Engineering design and solution implementation

Future investments in water sector should be on providing technology and infrastructure and modernizing the total system. Revenue should be sufficient to cover operation and

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maintenance costs. Water projects require serious study implementation through decentralized organizations closely linked to users.

Conclusion

There were identified six partial problems related to the problem of improvement the water usage efficiency: 1) General Issues, 2) Sources, 3) Uses, 4) Distribution, 5) Industry and 6) Management . This problem can be managed only with a holistic approach and a hierarchical and well structured schema .

There are many solutions for improving water usage efficiency. It is possible to identify hundreds or thousands of specific actions. Although, from a systemic point of view it is better to determine a set of possible few main intermediate strategies or general solutions: Enforcement of existing regulations, Improvement of the hydrological system operation and maintenance , leak elimination ; Improvement of hydrological system management ; avoid subsidized tariffs as possible

Improve and diversify water treatments, Improvement of water usage efficiency in agriculture; Separation of white water and black water

Investment on cleaner production processes and improvement of used water efficiency in industry and engineering design and solution implementation

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