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Water management in Nayarit state, Mexico: General aspects and problems

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Abstract:*Global water use has multiplied by six in the last 100 years[1] and continues to grow steadily at an approximate rate of 1% per year[2]. Water use is projected to continue to increase globally based on population growth, economic development and changing consumption patterns, among other factors. World population is estimated to increase from 7.7 billion to 10.2 billion by 2017 and 2050, respectively, with two thirds of the population living in cities. Nayarit is the state with the highest availability of ground and surface water in the center-west of the country. There are 3,000 million m[3] of wastewater generated in Nayarit, for which it has 70 wastewater treatment plants, of which 79.89% are treated at the third level (with 23 plants), there are no plants that treat at the second level. Aquaculture is one of the main wastewater dischargers with more than 1,058 million m[3] (97.15%).The main uses of water found in Nayarit in order of importance were agricultural-aquaculture, public supply and industrial (excluding hydroelectricity). In Nayarit, 26% of the population lacks piped water inside their home, but the extremes are between 12.5% of the South Coast and 71% in the Mountain. The loss and wear of the biological biodiversity and the state's environmental resources inhibit regional development in Nayarit. For this reason, it is necessary for that the government of Nayarit adopt an adequate water management perspective that allows protecting and recovering the ecosystems.*

Key Word*:uses of water; agriculture; aquaculture; water distribution*

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I. Introduction

Global water use has multiplied by six in the last 100 years[1] and continues to grow steadily at an approximate rate of 1% per year[2]. Water use is projected to continue to increase globally based on population growth, economic development and changing consumption patterns, among other factors. World population is estimated to increase from 7.7 billion to 10.2 billion by 2017 and 2050, respectively, with two thirds of the population living in cities. Surface water resources will remain relatively constant compared to population development, Gross Domestic Product (GDP) or demand for water in Latin America. At the subregional level, any change will be small, ranging from -5 to + 5%, due to the effects of climate change, but the changes may be much more pronounced at the country level[3].Many countries are already experiencing water scarcity conditions and will have to cope with an ever-decreasing availability of surface water in the 2050s[4].

Currently most countries in a strip spanning 10 to 40 degrees north, from Mexico to China and southern Europe, are affected by water scarcity. As well as Australia, Western South America and Southern Africa in the southern hemisphere[5].In the early 2010s, 1.9 billion people lived in areas with severe water scarcity, and by 2050 this could increase to 3.2 billion. However, if monthly variability is taken into account, 3.6 billion people worldwide already live in water-scarce areas for at least one month per year, and this could reach 4.8 to 5.7 billion by 2050. Around 73% of affected people live in Asia[6]. Many countries are already experiencing widespread water scarcity conditions and are likely to face less availability of surface water resources in the coming decades. The importance of current water availability challenges can only be understood by comparing water withdrawal to its maximum sustainable levels. At approximately 4,600 km^3 a year, current global removals are already close to the highest sustainable levels[7], as noted in previous reports on the development of the world's water resources, global figures hide more serious challenges at regional and local level.The aim of this study was to describe the situation of water management in the state of Nayarit, Mexico and generally problematic.

II. Status of water resources in Mexico

The territorial extension of the United Mexican States comprises 1,964 million km², of which 1,959 million km² correspond to the continental surface and the rest to the insular areas. Additionally, the Exclusive Economic Zone (EEZ) should be considered, defined as the area up to 370 kilometers wide measured from the coast line. Two thirds of the territory are considered arid or semi-arid, with annual rainfall of less than 500 mm, while the southeast is humid with annual rainfall exceeding 2000 mm per year. In most of the territory the rain is more intense in summer, mainly torrential type. Annually, Mexico receives approximately 1,449,471 million cubic meters of water in the form of precipitation, of this water, it is estimated that 72.5% evaporates and returns to the atmosphere, 21.2% drains into rivers or streams, and the remaining 6.3% infiltrates the subsoil naturally and recharges the aquifers.

Taking into account the outflow (exports) and inflows (imports) of water with neighboring countries, the country annually has 446,777 million cubic meters of renewable fresh water. The rivers and streams of the country constitute a hydrographic network of 633 thousand kilometers in length, in which fifty-one main rivers stand out, through which 87% of the surface runoff of the country flows and whose basins cover 65% of the continental territorial surface from the country. Groundwater plays a role of increasing importance in the socioeconomic growth of the country.Due to their physical characteristics that allow them to be used, as they function as storage dams and distribution networks, being able to extract water at any time of the year from practically any point on the surface of the aquifer.

III. Water management in Mexico

The National Water Commission (CONAGUA) is an administrative, regulatory, technical and advisory body in charge of water management in Mexico. It works through thirteen basin organizations, whose sphere of competence is the Administrative Hydrological Regions (RHA), which are formed by groups of basins, considered the basic units of water resource management and whose limits are respected by municipalities to facilitate integration of socioeconomic information.

Hydraulic infrastructure

There are more than 5,000 dams and shallow reservoirs in Mexico, some of which are classified as large dams, according to the definition of the International Commission on Large Dams. There is an incomplete registry of the shallow reservoirs, to date efforts have been made to register these small storage works, they are mostly rustic.

Hydro-agricultural infrastructure

In Mexico, the area with infrastructure that allows irrigation is approximately 6.5 million hectares, of which 3.3 million correspond to 86 irrigation districts (DR) and the remaining 3.2 million to more than 40 thousand irrigation units (UR). The Irrigation Districts are irrigation projects developed by the Federal Government since 1926, the year of creation of the National Irrigation Commission, and include storage vessels, direct diversions, pumping plants, wells, canals and roads, among others. On the other hand, the Irrigation Units are agricultural areas with infrastructure and irrigation systems, different from the irrigation districts and generally with less surface than these. They can be made up of user associations or other figures of organized producers, who associate with each other to provide the irrigation service with autonomous management systems and operate the hydraulic infrastructure for the collection, derivation, conduction, regulation, distribution and eviction of national waters for agricultural irrigation; and finally in the tropical and subtropical plains of the country, where there is an excess of humidity and constant floods. The Federal Government established the technified temporal districts (DTT), in which hydraulic works were built for the evacuation of surplus water[4].

Drinking Water and Sewerage Infrastructure

The provision of water for human consumption in the necessary quantity and quality directly affects the health and well-being of the population. This fact is recognized through the inclusion of information related to water for the population's supply in the National Catalog of Indicators, which is a set of key indicators for the design, monitoring and evaluation of public policies stipulated by the National System Lawof Statistical and Geographical Information and, administered by National Institute of Statistic and Geography (INEGI).

IV. Water management instruments

The National Water Commission (CONAGUA), the administrative, regulatory, technical, advisory and decentralized body of the Ministry of the Environment and Natural Resources (SEMARNAT), is in charge of managing and preserving national waters and their inherent assets, to achieve a sustainable use, with the co-responsibility of the three levels of government and society in general. The legal framework for the use of

national waters is broad, the Political Constitution of the United Mexican States empowers the Federal Executive Power to establish, for reasons of public interest and utility, regulatory measures to maintain control over the delivery (extraction) of waters underground nationals by issuing closures, regulations, reserves and bailouts; for its part, the National Water Law (NWL) establishes that the exploitation, use or exploitation of national waters will be carried out through concession or assignment titles granted by the Federal Executive through CONAGUA and through the Basin Organization or directly by the latter when it is competent, in accordance with the rules and conditions established by the NWL and its regulations. Similarly, for the discharge of wastewater, it is necessary to have a discharge permit issued by this same institution. As of the issue of the NWL (1992), the titles of concession, assignment and discharge permits are registered in the Public Registry of Water Rights (PRWR). In December 2015, there were 486,896 national water concession or allocation titles registered in the PRWR, corresponding to a concession volume of 85,664 million cubic meters (hm^3) of consumptive uses and 180,895 hm^3 of non-consumptive uses. It is important to note that the different legal instruments of control were issued from 1948. The NWL establishes that areas veda se determined in those aquifers where there was no mean annual availability of groundwater, so it is not possible to authorize concessions or additional water allocations to those legally authorized, by virtue of water deterioration in quantity or quality, which affects hydrological sustainability. The regulations will be for those aquifers in which there was still a mean annual availability of groundwater, which can be granted in concession or allocation, for any use, until the available volume has been achieved. When this type of regulation has been applied to a portion of the aquifer, it was called a regulated zone.

The reserve areas have been specific areas of the aquifers in which limitations have been established in the exploitation, use of part or all of the available water, in order to provide a service, implement a restoration or conservation program. The Executive may declare the total or partial reservation of national waters for the following purposes: domestic and urban public use, generation of electrical energy for public service, and guarantee the minimum conditions for ecological protection, including the conservation of vital ecosystems. The areas veda have been those specific areas of the regions or hydrological basins in which no additional water uses were authorized beyond those legally established and these are controlled by specific regulations, by virtue of the deterioration of the water in quantity or quality, by the impact on hydrological sustainability or damage to surface water bodies.

V. Rights for exploitation, use or exploitation of national waters

Natural and legal persons will be obliged to pay or the right over the national waters that they use, exploit or take advantage of, either in fact or under the title of allocation, concession, authorization or permission granted by the Federal Government. Also those that permanently, intermittently or accidentally discharge sewage into rivers, basins, vessels, marine waters and other deposits or water currents, as well as into soils or infiltrate them in lands that are national assets or that may contaminate the subsoil or the aquifers. Likewise, there are those that use, enjoy or take advantage of goods in the public domain of the federation in the ports, terminals and port facilities, the federal maritime zone, the levees, channels, vessels, current areas and nationally owned warehouses.

VI. Participation mechanism

Basin councils and subsidiary bodies

The NWL establishes that the basin councils will be collegiate bodies of mixed integration, which will be instances of coordination, concertation, support, consultation and advice between CONAGUA, including the corresponding basin organization, and the agencies and entities of the federal instances, state or municipal, and representatives of water users and society organizations in the respective basin or hydrological region.In the process of consolidation of the basin councils, the need to address very specific problems in more localized geographical areas was seen, for which reason auxiliary bodies called basin commissions were created, which serve sub-basins; watershed committees for micro-watersheds; groundwater technical committees (GTC) and clean beach committees in the country's coastal areas.On the other hand, the clean beach committees stand out, which aim to promote the sanitation of the beaches, basins and aquifers associated with them, as well as prevent and correct contamination of Mexican beaches, respect biodiversity and make beaches competitive for both national and international tourism, as well as raising the quality and standard of living of the local population.

National water planning 2013-2018

The Political Constitution of the United Mexican States establishes national development planning as the axis that articulates the public policies of the government of the republic, as well as the direct source of participatory democracy through consultation with society. The National Development Plan 2013-2018 (NDP) establishes the national goals and major objectives of the public policies of the government of the republic regarding the water sector and is part of the water planning and programming established in the National Water

Law. Water planning is mandatory for the integrated management of water resources, the conservation of natural resources, vital ecosystems and the environment.

VII. Status of water resources in the state of Nayarit

The state of Nayarit is located in the northwest portion, with a continental surface of 27,815 km^2, it borders to the north with Sinaloa and Durango, to the east with Zacatecas, to the south with Jalisco and to the west with the Pacific Ocean, and is politically divided into 20 municipalities, with a total population of 1,233,797 inhabitants, of which 857,219 are in the urban area and 366,578 in the rural area, belong to the Hydrological-Administrative Regions: Lerma Santiago Pacífico and Pacifico Norte. According to data from the Statistics of Water in Mexico, 2016, the concessioned volume of water is 1,332.8 hm^3, for agricultural-aquaculture use 1,110.8 hm^3, for public supply 115.8 hm^3, for the self-supplied industry 106.2 hm^3 and for electric energy (excluding hydroelectricity) 0 hm^3. It is the state with the highest availability of ground and surface water in the center-west of the country. There are 3,000 million m^3 of wastewater generated in Nayarit, for which it has 70 wastewater treatment plants, of which 79.89% are treated at the third level (with 23 plants), there are no plants that treat at the second level. Aquaculture is one of the main wastewater dischargers with more than 1,058 million m^3 (97.15%). The content of the State Development Plan (SDP) presents a proposal for multisector planning to promote the social, economic and territorial development of Nayarit, with the aim of formulating, managing and executing a portfolio of strategic projects and, as items of regional development, indicates drinking water.

VIII. Water management in Nayarit

By Decree 7869, the H. Congress of the Free and Sovereign State of Nayarit, represented by its XXIV Legislature, decrees the Drinking Water and Sewer Law of the State of Nayarit, published in the Official Newspaper on October 4, 1995; whose purpose is to regulate the "State Drinking Water and Sewerage System" to achieve a comprehensive sustainable development; the presentation of public services for drinking water, sewerage and sanitation; the organization and operation of the operating agencies of the "State Drinking Water and Sewerage System"; the recovery of the expenses and costs of investment, operation, conservation and maintenance of the "State Drinking Water and Sewerage System" and the public service of conduction, supply, purification, distribution or transport of water that presents individuals. On the other hand, the State of Development of the State of Nayarit 2017-2021, establishes a series of guidelines regarding water; in relation to the 8 Millennium Development Goals (MDG) defined by the United Nations in the year 2000 and which became the 17 Sustainable Development Goals of the 2030 Agenda, specifically Goal 6, which states: Guarantee the availability of water and its sustainable management and sanitation for all; In relation to this, an effort was made to align with these international instruments, establishing a series of guiding axes and strategic axes, which are indicated below.

Based on the citizen consultation, for the integration of the SDP, results of the research process were obtained and through a series of instruments, it was sought to know the problems and demand that the Nayarita society experiences, wants, and that affects their well-being[8].A problem that has been considered serious by the population is the lack of public services, 26.45% of the inhabitants identify the lack of these as an important difficulty in their daily life, this problem includes drinking water. In relation to the unbalanced economic and social development between the regions of the state, some indicators have been selected from a traffic light (green, yellow and red). The South region has all its indicators in yellow, while the North and North Coast regions have three in yellow and red: the indicator of piped water outside the home, considered an aspect of marginalization and low quality of life. Emphasizing this last indicator, it should be noted that in Nayarit, 26% of the population lacks piped water inside their home, but the extremes are between 12.5% of the South Coast and 71% in the Mountain.

On the other hand, with respect to environmental deterioration, the SDP indicates that the loss and wear of the biological biodiversity and the state's environmental resources inhibit regional development. The negative externalities generated by bad productive practices and which have caused pollution effects, danger of resource depletion and a set of effects of environmental deterioration, highlight in this productive-environmental interaction the inappropriate uses of water for agricultural production and aquaculture, due to the pollution generated and the overexploitation of wells. In this sense, the disintegrated management of water is a factor of unsustainability, which does not guarantee access to the entire population and that makes ecosystems and production systems misuse, sometimes threatening the depletion of the water. resource or the higher costs of its use. In relation to the conservation and balanced use of natural resources, the SDPhas been forceful in pointing out that the wealth of water resources in the state of Nayarit is not being adequately used and many of these face pressure due to pollution and bad processes. productive practices that are generating a great deterioration of basins and beaches. On the other hand, the lack of public investment means that a significant percentage of the population does not have guaranteed access to safe drinking water and within their homes, in addition to the fact

that sanitation systems are lacking in comprehensiveness that improves hygiene practices. and reuse of the resource. For this reason, it is necessary for that the government of Nayarit adopt an adequate water management perspective that allows protecting and recovering the ecosystems that are integrally linked to this resource, such as forests, mountains, wetlands, rivers, seas and oceans, and that avoids contamination, improve treatment systems and ensure greater water efficiency.

IX. Conclusion

The main uses of water found in Nayarit in order of importance were agricultural-aquaculture, public supply and industrial (excluding hydroelectricity). In Nayarit, 26% of the population lacks piped water inside their home, but the extremes are between 12.5% of the South Coast and 71% in the Mountain. The loss and wear of the biological biodiversity and the state's environmental resources inhibit regional development in Nayarit. For this reason, it is necessary for that the government of Nayarit adopt an adequate water management perspective that allows protecting and recovering the ecosystems.

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