

WATER RESOURCES DEGRADATION IN A SEMIARID ENVIRONMENT. BUSTILLOS AND LOS MEXICANOS LAGOONS (CHIHUAHUA, MÉXICO)

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1. INTRODUCTION

The extent and geographic diversity of Mexico causing an uneven distribution of water in the northern half of the country, providing a constant rainfall deficit. Water resources are insufficient to population concentration levels, and the development of the sectors of economic activity established in this area. Water scarcity has led to a constant and increasing hydraulic exploitation, altering the balance of the natural water cycle (CONAGUA, 2009). Water crisis in Mexico provides alarming statistics, with more than 12 million people who have no access to drinking water, and water supply networks are in poor condition, with a volume water loss of about 35% (PALACIOS y ESCOBAR, 2010).

Urban growth, industrialization and development of agricultural activities interact with the natural processes of the hydrological cycle qualitatively and quantitatively. Products that are extremely difficult to detect and require complex filtering systems to be neutralizing (ORREGO, 2002), unleashing harmful effects on human health and aquatic biota.

In the mid-90s, the federal government developed a set of standards by the Ministry of Economy (1996) to regulate the management and use of wastewater (NOM-001-SEMARNAT-1996), establishing the maximum permissible limits of contaminants in water discharge to water networks and domestic goods. But given the present situation, becomes clear that these efforts have been insufficient and should be strengthened with new interventions to better use of water and the anticipation of this resource for the coming decades.

This paper aims to assess the state of surface water in the endorheic basin of Laguna Bustillos, this important wetland area of special environmental interest, is threatened by strong pressure from agricultural and industrial activities. The main objective set is to determine the surface water quality, through a series of chemical, physical and microbiological parameters and identify the causes and problems associated with specific contaminants as well as the establishment of alternative solutions in water management environment.

2. MATERIAL AND METHODS

The study area, in the municipality of Cuauhtémoc, is located in the central part of the state of Chihuahua (Mexico). It is a broad transition zone between the foothills of the Sierra Madre Occidental and the Mexican plateau, forming a high plain with an average altitude of around 2,000 meters. The morphology set a endorheic drainage basin of 4,072 km², where little streams feed the lagoons of Mexico, and Bustillos (CONAGUA, 2016).

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For proper evaluation of the water quality level, first the stream flow was calculated through measuring the flow velocity and the determination of its cross sectional area. During the period 2010-2011 three phases of sampling were conducted in 15 randomly chosen points located within the catchment area. The three replicates of sampling were conducted during the day July 15, 2010, November 15, 2010 and March 15, 2011. The dates correspond to three different periods of precipitation, in order to obtain in the analysis mean values where not interfere the volume flows in the sampled sections.

The analytical processes to determine the level of water quality in the basin study established the conditions of the integral water quality, following the method of SMITH (1990). These analyzes may have very specific momentary conditions, hiding the quality of water status, so it is convenient to use biological indices that show a larger degree of alteration of these aquatic ecosystems (ALBA-TERCEDOR y SÁNCHEZ-ORTEGA, 1988). Therefore, we calculated an water quality index (WQI) according to the methodology developed by the University of Wilkes (2006), which uses a simple calculation using nine parameters: Turbidity, pH, Dissolved Oxygen (DO), nitrates, total phosphorus, total dissolved solids (TDS) and temperature, related to Biochemical Oxygen Demand (BOD) and some bacterial species (coliform).

3. RESULTS AND DISCUSSION

Dissolved oxygen is one of the most important indicators of water quality, showing the health of aquatic systems. The results extracted in the analyzes determine values extremely contrasted DO as the sampling areas. Very poor rates are observed in streams located in the nearby of industrial activities, especially the production of dairy products. Sampling carried out on the banks of the lagoons show more adequate levels of DO, although with significant fluctuations depending on the sampling phase. This reflects the dependence of these wetland industrial production phases, with improved levels episodes contributions natural waters by precipitation.

In water analysis, the variable that most influences its low quality, in addition to the DO, is the turbidity. This physical indicator of water shows its limitations for human consumption in virtually all sampling points, where the maximum permissible limit for drinking water is 5 nephelometric turbidity units (NTU), (NOM-127-SSA1 -1994). Excessive turbidity values observed in both lagoons, in some cases concentrations exceed 1000 NTU. Only in the third phase of sampling something reduce the high levels in the lagoon of Bustillos, associated to the same time of increased DO led by the contribution of natural flows. Other results only denote the deteriorating state of these lagoons suffering almost continuous supply of waste from industries which are carried by streams, increasing turbidity due to suspended solids and microorganisms.

In the bacteriological analysis, have been found in all residues samples of fecal coliform bacteria, most of them with contaminating quantities that exceed the limits specified by the NOM-127-LASS-1994, indicating that water is not it is suitable for human consumption. Only the results obtained in the lagoon of Mexicans show acceptable values, due to lower human pressure that records this wetland, which is less affected by the disposal of urban waste water.

Finally, have been obtained results of the WQI index that can be used to compare of data from water quality of these lagoons with other similar environments, which requires predefined comprehensive water quality as components of optimization criteria standards (STRASKRABA y GNAUCK, 1995; AMADO *et al.*, 2006; RAMOS *et al.*, 2016). Note is the high water pollution in all sampled areas with WQI values that do not exceed the value of the 50% threshold that determines the passage of a water level of poor quality.

4. CONCLUSIONS

The peculiarity of these habitats located in semiarid environments determines the existence of highly sensitive and vulnerable to changes caused by environmental changes spaces. The scarcity of water determines the importance of this element, therefore pollution of water

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resources even further limited their use, especially for human consumption. Using tools fast and representative diagnosis, such as WQI, ensures an integrated assessment of water quality, which is critical in making decisions for the management and control of health risk.

The main sources of pollution of water resources are agriculture practices, discharges of wastewater of populations of Anahuac and Cuauhtemoc and, to a greater extent, industrial waste treatment. Human activities are the most influential in the deterioration of surface water factor, to be alarming in the case of Lake Bustillos, where the need to review systems water sanitation is evident, due to the lack of efficiency of plants existing treatment industries. The establishment of an adequate supply of safe water is essential, since it has been observed that the levels of contamination of the main waterways have increased alarmingly due to increased agricultural and industrial activity in recent years.

Transformation of natural habitats caused by important processes of deforestation, erosion and overexploitation of aquifers, requires the implementation of government plans that establish procedures for integrated management to restore and maintain the environmental sustainability of the environment, to allow the viability own of agricultural production and existing urban settlements.

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