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A Reflection on the Importance of Estimating Environmental Flows in Seasonal Rivers. The Case of Rivers in Central Mexico.

Pedro Joaquín Gutiérrez-Yurrita

Centro Interdisciplinario de Investigaciones y Estudios Sobre Medio Ambiente y Desarrollo- Instituto Politécnico Nacional

Abstract. Mexico is an extremely biodiverse country due to its rugged terrain, its geographical position on earth, the seas that surround it, and because it is a transition area of two biogeographic regions: Nearctic and Neotropical. Further, erosion processes over 35 million years of the water and of the wind have formed deep canyons difficult to cross for many species and that they have propitiated development of endemism and rare species by vicariance processes of speciation. The hydrographical Mexican basins reflect all this ecodiversity since they darn big desert regions, wooded zones and jungle and tropical rain forest areas until the get the two seas that border Mexican geography (Pacific and Atlantic oceans). However, one of the less studied environmental variables relating to its role in Mexico's biological diversity is the temporality of the rivers. A brief reflection on the role that the seasonal water flow of the rivers of central Mexico plays in the biodiversity of the region, is the main objective of this manuscript.

Keywords: Freshwater habitats, Running waters, Intermittently flowing.

1. Introduction

Mexico is an extremely diverse country due to its rugged terrain, its geographical position on earth, the seas that surround it, and because it is a transition area of two biogeographic regions: Nearctic and Neotropical. Further, erosion processes over 35 million yearsof the water and of the wind have formed deep canyons difficult to cross for many species and that they have propitiated development of endemism and rare species by vicariance processes of speciation. The hydrographicalMexican basins reflect all this ecodiversity since they darn big desert regions, wooded zones and rain forest areas until they get to the two seas that border Mexican geography (Pacific and Atlantic oceans) [1].All the rivers of central Mexico are regulated to a greater or lesser degree. However, not only the river suffers from human control, the entire watershed is altered in ecological structure, and thus, their overall environmental performance. Resulting in humanized landscapes left out of their management programs to conserve seasonal rivers [2].

In addition, local human populations composed in many cases by indigenous communities are the owners of the land and by law, of the natural resources of the land. So they are using their resources as much as they can. But also, the rivers in better condition of conservation, including their hydrological basin, are located in places with many social problems, and where indigenous people and other communities are in extreme poverty conditions. So, the way in which they use their natural resources is closer to the philosophy "bread for today, hunger for tomorrow" than that of the sustainability [3]. The efforts for preserving the ecological processes of these important ecosystems, connected in network with other basins are under the paradigm of the "integral ecology".

Thus, to achieve the famous sustainable development should address the management of biotic resources and water from the dual perspective of ensuring the one hand, to fulfill the social and economic goals for which it was designed water control in a given basin.And, secondly, to ensure the protection and conservation of ecosystems under such pressure that involve extractive or transformative activities. This dual consideration is shown in trying to properly manage water resources, as has been the belief that to provide a steady output of water throughout the year, meets the requirement of preserving aquatic environments

downstream. This way, an environmental flow to the amount of water that must drain the dams to minimize their impact on streams located downstream. However, most of the time these volumes of water are assigned a uniform value, which is calculated as a percentage of the annual average contribution. From this perspective, environmental flows could be defined as those flows needed to ensure an ecosystem similar to that existing before the construction of dams, even before that human activities were made apparent in the basin. From this perspective, studies of environmental flow (minimum flow regimes in channels) should be considered with an academic and practical approach [4].

Thus, management of natural resources (biotic and abiotic) is a reflection of social goals and the scientific understanding of the environment in question, giving us a historical record of both, social and scientific changes. From this perspective, it can be seen that the natural resource management has improved over the trial and error, but to date, has only rarely been possible to anticipate the new challenges posed by society and / or disasters or natural disturbances [4].

2. Objective

The objective of this paper is to reflect on the way in which we manage our water resources, with only the anthropocentric point of view of what serves us right now, without thinking of the consequences we have on the overall functioning of watersheds and biodiversity in especially those with seasonal rivers.

3. Materials and methods

3.1. Study area

Due to the vast geography of Mexico, the region that has made us think about the poor knowledge we have in the management of seasonal rivers is the Central part of México. Landscapes of the area are dominated by agricultural fields and decidous forest in middle and lowlands. Oakand pineforestsare confinated at the topof the Sierra. Central Mexico are located in the transition zone between the Nearctic and Neotropical region, covering part of the new volcanic axis and part of the Eastern Sierra Madre Oriental..

3.2. Holisticconceptual frameworkof watershed management

A modern way of addressing problems in the management of natural resources is the holistic approach to the study of natural systems. This approach integrates all relevant information on the socio-economic users of the resources of a watershed, with information gathered from the ecological processes of the ecosystems involved in the operation of the basin. It is understood, then, that a hydrological basin is the basic unit of operation, where the interactions between water, earth, air and human activities are very narrow and dependent on each other.For holistic studies provide a basis for decision making, it is necessary to overcome two major challenges: social and environmental issues.

Social challenges: Large bodies of epicontinental water built in Mexico (big dams) and the regulation of riverbeds of Central Mexico, are used for various purposes, the most important are:1) irrigation; 2)power generation; 3)drink water supply; 4)recreation; 5)aquaculture and,6) fishing.

Environmental challenges

Conservation of the ecological processes of ecosystems from the hydrological basins under the pressure that involve the extractive or transformative activities

Under this scenario, the study of river ecosystems is built from two perspectives, scientific and realistic. Scientific, because it must be analyzed in detail the structure and functioning of all ecosystems involved, particularly the seasonal river (analyze each section of the river by separately and together, and reservoirs), with all the existing anthropogenic modifications. From this information, calculate the flow that would ensure the integrity of ecological processes in the watershed. And realistic, because in no case should be questioned the priority uses of water resources, while respecting the principle of environmental services to be implemented to manage aquatic environments and overall basin.

Under the scientific perspective must be taken into consideration, at least the following factors:

1) Morphology and topography of the basin in general and the particular channel;

2) Physicochemical characteristics of water and geology of the basin;

3) Average monthly flow rates or contributions of each river basin as well as the hydroperiod and water regime of eachtype of river bed habitats (places with or without vegetation, vegetation types and substrates, rocks, pools, etc.);

4) Trophic resources (community structure of benthic, neuston, periphyton, hydrophytes, etc.).

Under the practical perspective, taking into account real indicators of socioeconomic status of users of the basin:

1) Benefits that would havefor the management of water in the short, medium and long term;

2) Existing and potential benefits to keep the water system and the natural or historical flow.

3.3. General methodology

The methodology for estimatingenvironmental flowsis divided into threesteps:

1) We have to divide the river into stretchs orsections, depending on theconceptualization that we have of them [5]. A sectionis the area of a river that is considered continuous with the upper and lower subsequent sections. While a stretch of the river is the area of the river that has different characteristics clearly marked with the adjacent top and bottom. In the first case, the riveris considered as a continuum of ecological data, where the water goes down is a consequenceof what has occurred upstream, on the other hand, a part is a portionof the rivermore orless independentof other sections. For instance:

Head:Productionsystemis less than respiration(P< R)

Middle stretch: Production and respiration of the system are equal (P = R)

Mouth: Productionis greater than the respiration (P >R)

2) We must consider that the rivermay have regulated sections and unregulated sections. The unregulated sections should be used as units of measurement of mean monthly flows estimated contributions from natural run off, with a value of probability of occurrence of a given event. In the sections regulated is taken into account the amount of water used for each of anthropocentric activities that poured through the gates of the reservoirs.These flows should be estimated in each part of the river located between two controlled reservoirs.

3) The third step is anecological and socioeconomic assessment of the basinunder management. The ecological assessment emerges from the scientific characterization of the ecological structure and functioning (natural resources and environmental services). Among all the factors are especially important to consider the hydroperiod and fish community. The first is because it will indicate the amount of water and the speed of the current should carry the channel at each weather season. The second is because the community structure and composition of fish populations remain more stable over time, especially with constant flow seasonally.

Within the economic and social assessment must take into account the current and potential uses of all resources of the basin, and the services to be offered in case the system is keeping unchanged its natural (unregulated). By establishing a natural resources asset class, is in a position to be accounted for as assets inexpensive produced products, for which, it must be assigned monetary values (prices, production costs, costs of depletion and degradation, etc. .), in order to integrate the other cash flows of the economy and to calculate the Domestic raw Product (6):

$$K_{t+1}= K_t+(I-D_{Kept})–(AG_{Kenpt}+AG_{Kanpt}+DG_{Kanpt})+(DI_{Kenpt}+DI_{Kanpt})+(R_{kept}+R_{kenpt}+R_{Kanpt})$$

Where: Kt +1 = total assets at the end of the period; Kt = total assets at the beginning of the period; AGKenpt = depletion of non-produced economic assets; AGKnapt = depletion of non-produced environmental assets; DGKanpt = degradation of assets environmental non-produced; ΔIKenpt = change in non-produced economic assets; ΔIKanpt = change in non-produced environmental assets; Rkept = re-produced economic assets; Rkenpt = revaluation of non-produced economic assets Rkanpt = reevaluation of environmental assets not produced.

Now, what is needed is to assign monetary value (price) to each non-produced assets (natural resources) involved in the above equation, for which there are basically two methods: the net income method and the user cost method (7). The first value units are based on the difference between income, with the current market value of the estimated inflation rate by the Bank of Mexico, and total costs of resource use. The

second method assesses the application based on the cost of exhaustion, which is estimated as a part of the present value of expected net income over the lifetime of the resource.

Figure1 shows the production of benefits to both consumptive use (ie: water for irrigation) and non-consumptive use (ie: contemplation) and quasi-option values (bequest value, existence value, support and value option value) that ultimately are willingto pay. Finally, in responseto all types of benefits and costs of the option is not taken as a result of a decision, you should make an assessment of recovery of the affected ecosystems, whether real or potential.

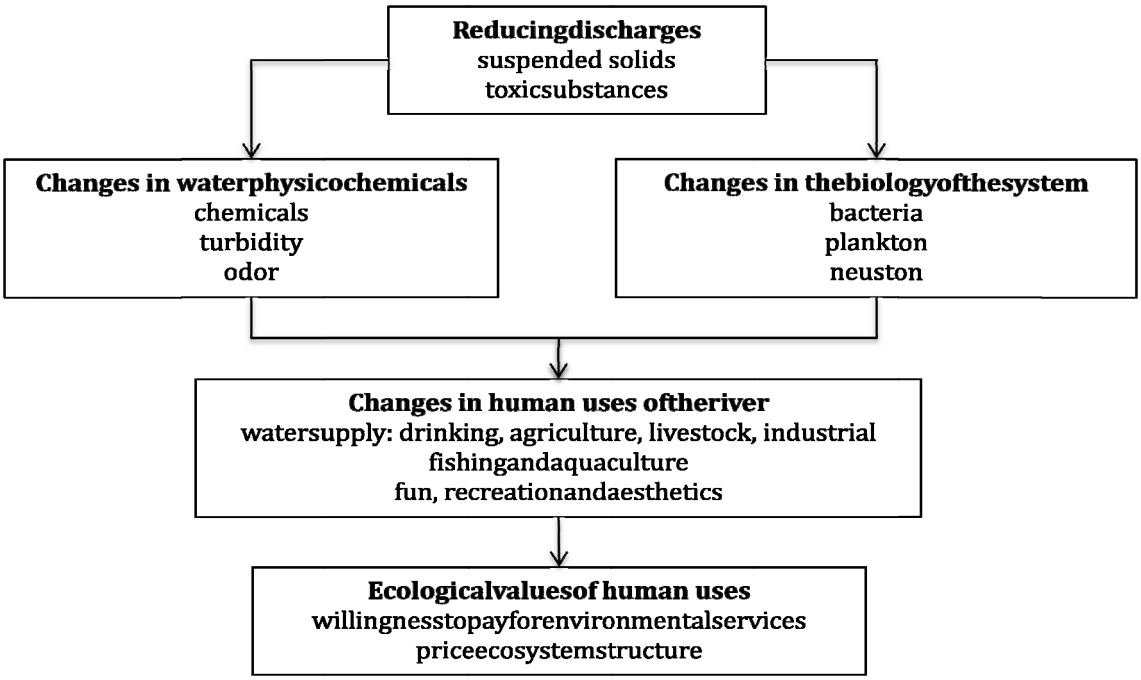

Fig. 1: Benefits to conserve ecological structure and seasonality of rivers

4. Conclusions

The use of natural resources in the natural areas best preserved is more intensive than in other areas and their rate of environmental deterioration and ecological degradation is higher.

The difference in degradation areas is that in the best conservation areas, are the indigenous groups who make use of those resources with its technological capabilities and knowledge of the environment. However,their low social status, not short-termproduction options, move the peasants tosell their landto large international corporationswith big capitalfor exploitation with modern machinery.

Communities of indigenous people, besides losing what little they have, will moveto the cities oremigrate to the United States.The field was abandoned and the ecological integrity of ecosystems resilient will be lost before the next decade.

The seasonal river management issues should have geophysical, biological, ecological, social, and above all, economic aspects. A region with severe problems in living standards is notable to protect their ecosystems without first satisfying their basic needs and some pleasures.

Finally, we have to remember that seasonality of the rivers of central Mexico is one of the variables that promote high biodiversity of the region. Care, it is worth.

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