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Managing Groundwater in Mexico

Introduction

Water is essential for human and ecosystem development. Both our present and our future depend on its conservation and efficient use. Sufficient quality water for everyone is indispensable for sustainable development. The planet has enough fresh water to achieve this; however, challenges continue to be posed that demand an immediate response with creative, innovative solutions involving everyone.

The international community has done great deal of work to contribute to water resource sustainability and ensure equitable access to drinking water and sanitation without endangering ecosystem health. By 2015, 147 countries had reduced the number of people without access to potable water by half, and 95 more nations did the same for sanitation services. The Millennium Development Goals successes show that worldwide actions actually work and that the way forward for ensuring sustainable development involves international cooperation and different sectors joining forces.

Despite the big advances, however, important challenges persist. Water scarcity continues to affect more than 40 percent of the world's population, and this figure is expected to rise as a result of climate change. The degradation of our water resources affects marginalized populations more than the rest since they depend directly on nature for their subsistence and their settlements are concentrated in high-risk areas.

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The World's Groundwater

Changing the paradigm worldwide for water management in general and groundwater in particular is undoubtedly necessary. Improving the system creates better conditions for achieving sustainable development, and by contrast, maintaining the current rhythm of overexploitation threatens the security of the economy, the ecosystems, and people themselves.

The United Nations estimates the world's total volume of groundwater at 13.3 million to 60 million cubic kilometers. It is the main source of water for agriculture (67 percent), followed by its use for public urban consumption (22 percent), and finally, self-supply for industry (11 percent). Over the last 50 years, groundwater extraction has tripled and is increasing at a rate between 1 and 2 percent annually. This is due mainly to its consumption in countries like India, China, the United States, and Pakistan, which use about 50 percent of all the groundwater extracted.

Groundwater in Mexico

Mexico is no exception. Its hydrological conditions are very diverse, contributing to enriching our natural and cultural heritage, but also increasing our vulnerability to the effects of extreme hydro-weather phenomena, such as droughts and flooding, and posing challenges for sustainable water management. Although the central and northern parts of the country produce 87 percent of the country's gross domestic product and concentrate about 77 percent of the population, they only enjoy 31 percent of the water resources. The South, on the other hand, with its abundant water supplies (69 percent of those available), has a smaller population and contributes less to overall national wealth. These spatial variations combine with seasonal changes, since 68 percent of annual precipitation falls between June and September.

Given this variability, groundwater has played a central role in Mexico's development. Our country's 653 aquifers irrigate more than 2 million hectares, and supply more than 70 percent of cities and 50 percent of industry. Having balanced aquifers is indispensable for achieving food security, ensuring the availability of water during droughts, stopping subsidence, increasing the amount of water, and maintaining a balance with surface water.

Groundwater is a common resource susceptible to overexploitation. The lack of information about its characteristics and behavior, together with the dearth of effective management instruments, contribute to the deterioration of its quality. These factors also negatively impact ecosystems because natural springs and wetlands disappear, and, with them, the fauna and vegetation that depend on them. The reduction in groundwater levels makes extraction increasingly difficult, requiring new technologies and increasing investment. Together with this, we are facing problems of subsiding and cracking soil, which endangers the security of transportation and hydraulic infrastructure, among other kinds, and that of people themselves.

Considering the importance of groundwater for achieving the Sustainable Development Goals, the UNAM Water Network, in coordination with the National Water Commission and other institutions, called on the international community to exchange experiences for more efficient, sustainable management of aquifers at the 9th International Symposium on Managed Aquifer Recharge, held in Mexico. The outcome was the following six directives for sustainable groundwater management.

Sustainable Groundwater Management Directives[1]

1. *Recognize aquifers and groundwater as critically important, finite, valuable, and vulnerable resources*

Aquifers are valuable geological, hydrologically interconnected systems through which groundwater circulates or is stored. They mitigate 50 percent of the world's water needs and make water supplies resilient during droughts. This underground water is a limited resource and, in many places is strongly connected to surface water bodies. Many aquifers contain very old groundwater deposited thousands of years ago and are nonrenewable unless purposefully recharged. Since groundwater is un-

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derground, it is not visible and generally not well understood.

2. *Halt the chronic depletion of groundwater in aquifers on a global basis*

Today, groundwater supplies in many of the world's aquifers are unsustainable, resulting from overexploitation and a lack of proactive management. Evidence of depletion includes chronically declining groundwater levels, loss of groundwater storage, water quality degradation, land surface subsidence, seawater intrusion, surface water depletion and loss of springs, base flow, and associated groundwater dependent ecosystems. Depletion can cause irreversible damage and deprive future generations of the resource. Actions need to be taken immediately to invest the required resources to regulate and actively manage groundwater quantity and quality as needed to halt chronic depletion, water quality degradation, and achieve sustainability in the next 25 years.

3. *Aquifer systems are unique, need to be well understood, and groundwater should be invisible no more*

All aquifer systems are unique and diverse in physical characteristics and other features. As such, aquifer systems can be complex, difficult, and expensive to evaluate, but must be well understood for effective management. Increasing the knowledge of aquifers is essential to developing a foundation for sustainable management of groundwater resources. The basic elements include, but are not limited to, the nature of the aquifer geometry and chemical and physical characteristics, local hydrologic cycle and interconnectedness of aquifers, confining layers (aquitards) and overlying local and regional surface water systems, groundwater flowpaths and gradients, water budget and availability, current and future demands on the system, and an assessment of how land uses and climate change may affect local hydrology and water quality.

This information is expensive to collect, and significant investments of resources are needed to increase independent data collection and dissemination in order to improve understanding over time. Needed also are continued efforts to improve tools and innovative technologies for less costly and higher value information. The government and private industry can help provide the resources to support academia to train the future workforce, managers and scientists, and researchers to develop improved tools and technologies. Finally, the knowledge and data on aquifer systems should be shared widely so that groundwater is invisible no more.

4. *Groundwater must be sustainably managed and protected, within an integrated water resource framework*

Sustainable management of groundwater includes increasing and sustained investment in groundwater, appropriate policies and regulations, legal framework, institutions with sufficient authority and accountability, and development and implementation of comprehensive and adaptable management plans. The legal framework should address the process and actions for assigning, accounting, and allocating water rights, and the mechanism for resolving conflicts and disputes.

Groundwater management institutions should cover the entirety of each aquifer system, including recharge source areas and connected surface water systems, and should have the authority and accountability to sustainably manage groundwater. The groundwater management institutions should consider the interests of all beneficial uses and users of groundwater, and be integrated with surface water management institutions to manage connected systems. Institutions should have the authority to conduct studies, register and monitor wells, measure and regulate extraction, implement capital projects, freely share data and information, and assess fees to cover the cost of groundwater sustainability. Responsible management institutions should ensure that all share the cost of groundwater sustainability equitably. Federal or state governments should provide the backstop and intervention as necessary if groundwater management institutions are unsuccessful in sustainably managing groundwater in their jurisdictional areas.

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Management plans should include a sustainability goal, measurable objectives, an adequate understanding of the physical system and hydrology, monitoring program and protocols, a planning horizon of no less than 50 years, management component projects and actions to achieve sustainability, and integration of land use decisions. Management component projects and actions to be considered in management plans include conservation, water reuse, stormwater capture, managed aquifer recharge and demand reduction. Recycled water and stormwater should be put to beneficial use and developed as resources. Water markets and water trades and transfers should also be tools employed in sustainable groundwater management.

5. *Managed aquifer recharge should be greatly increased globally*

Managed aquifer recharge (MAR) is defined as the increase in groundwater recharge over natural infiltration processes as a result of interventions designed to enhance groundwater storage and quality. It is recognized as a key groundwater management component that is utilized widely for long-term sustainability. MAR . . . helps to increase the storage and availability of water from aquifers, may improve the quality of groundwater through natural subsurface treatment processes, and increases groundwater storage to supplement supplies during dry cycles or severe and prolonged droughts. This makes it important to promote MAR application in management plans, provide appropriate incentives for local users to implement MAR, and institute training of specialized personnel in this area. MAR needs to be employed much more widely in order to replenish depleted aquifer systems and sustain groundwater resources in the future. MAR should be implemented where economically viable in suitable aquifers that can accept a sufficient quantity and quality of water at an adequate recharge rate, within areas where groundwater use is being actively managed.

6. *Effective groundwater management requires collaboration, robust stakeholder participation and community engagement*

Groundwater is a shared, local resource, and collaboration and robust participation of community stakeholders and leadership overlying the aquifer system, including stewards of the environment, provide invaluable tools and a pathway toward the collective action needed to manage groundwater resources sustainably. Community engagement is an important social tool and can be a driving force for fostering trust, acceptance, and support for the management actions and costs, and ultimate compliance to adhere to the actions implemented. . . . Community engagement should include encouraging local leadership in key roles to nurture sound decisions and promote compliance with needed actions.

Management institutions will need to identify and engage these varied interests and determine how their involvement will be integrated into the decision-making, coordination, and implementation processes necessary to achieve groundwater sustainability. Further, the engagement of the local community is an ongoing and never ending process to achieve and maintain resource sustainability.[2]

Conclusions

The coming years will be decisive for moving toward a new paradigm of sustainability for hydric resources that takes into account joint management of surface and groundwater and recognizes reuse and recharge as fundamental pillars of that. VM

Notes

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2 http://www.ismar9.org/Doc/sustainabledirectives.pdf. [Translator's Note.]