Integrated Water Management

2. Case Study B: *Agricultural policy analysis in irrigation district 023, San Juan Del Río Querétaro.*
Participants: Karen Lucero Cruz (Universidad Autonoma de Chapingo), Miguel Angel Martinez

Introduction

The agricultural policy has an important role for the development of agricultural and commercial activities and in the well-being of the population in the country; the use of an agricultural policy guarantees in many occasions that the operation of programs and projects occurs adequately. The methodology used was mathematical programming, both at the farm level and at the regional level, modeling the implications of the guarantee price policy, fertilizer prices and access to irrigation water. Three models were built for the standard farms and one regional one with 5 scenarios each, and the impact on the indicated elements was analyzed.

Objectives

- Evaluation of the impact of the water and agricultural policy on the crop pattern of DDR 023, San Juan del Río, Querétaro on the well-being of the producers reflected in the income of one of them

Hypothesis/Expected Outcomes

- TBD

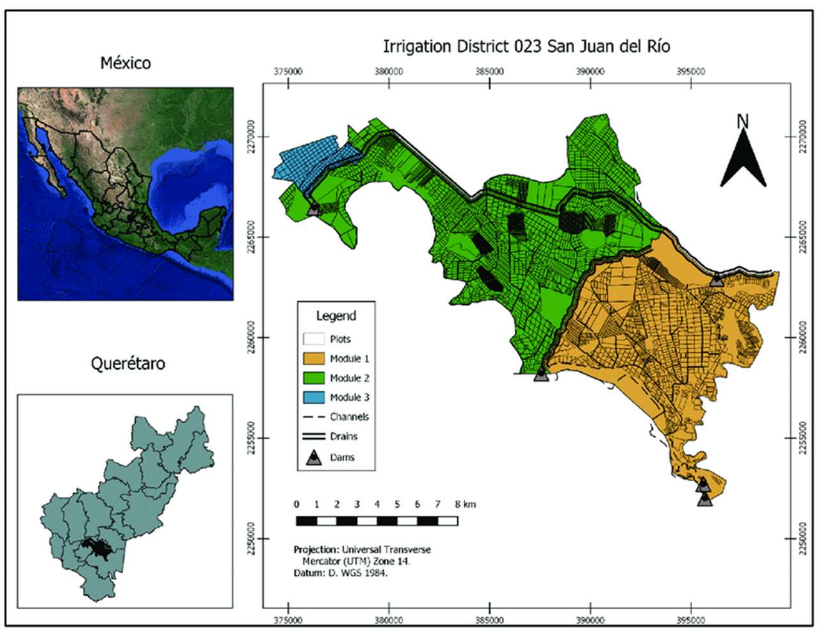

Figure A-5. Location of the Irrigation District 023 SOURCE: CONAGUA

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3. Case Study C: *Management, productivity, and evaluation of the water of the San Juan Del Río Querétaro aquifer.*
Participants: Ángeles Suhgey Garay (Universidad Autónoma de Chapingo), Ramon Valdivia

Introduction
The current conditions of greater demand for water in Mexico and the world, due to the increase in population and economic activity, the effects of pollution and climate change, the depletion of many sources of the resource and the aging of the hydraulic infrastructure, have triggered alarm signals. In this context, the institutions of an economy are very important to manage the management of water resources, their actions are reflected in proper governance. The study analyzed the state of multilevel governance in the aquifer of San Juan del Río, Querétaro, using the OECD multilevel governance method. For this, the questionnaire (with adaptations) proposed by the OECD was used.

Objectives
- To know the productivity of the water of the aquifer of the Valley of San Juan del Río, Querétaro.
- To know the state of the water governance of the aquifer of the Valley of San Juan del Río, Querétaro.
- Determine the willingness to pay to estimate the economic value of the water from the aquifer of the Valley of San Juan del Río, Querétaro.

Hypothesis/Expected Outcomes
- The economic valuation of water from the aquifer of the Valley of San Juan del Río, Querétaro will help to manage demand and a better use of the resource.

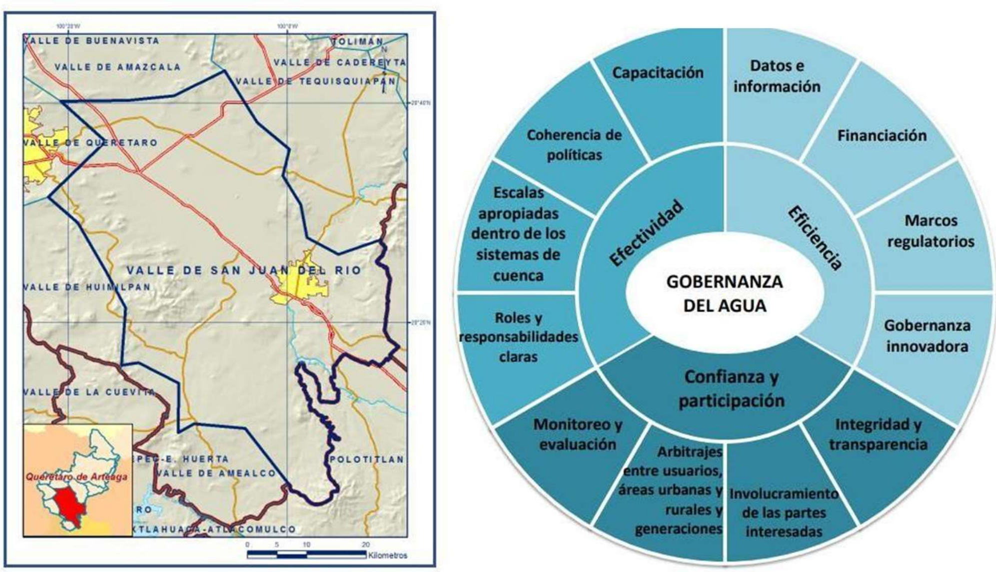

Figure A-6: Aquifer location (left), and Principles of OCDE Water Governance (right).

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4. Case Study D: *Enhancing Water Sustainability for Winery Irrigation with Treated Domestic and Internal Wastewater: Napa, California and Valle de Guadalupe, Baja California*
Participants: Marc Beutel, Leopoldo Mendoza Espinosa, Clara Medina, Thomas Harmon, Josué Medellín, J Andrés Morandé

Introduction
With the uncertainty facing water managers in arid California and Baja California, there is a growing acknowledgement of the need to diversify water sources for crop irrigation. One potential source is recycled water from wastewater treatment plants (WWTP), and a potential user is vineyards (Chen et al. 2013). Initial social concerns surrounding the use of reclaimed water for crop irrigation may have influenced the slow adoption of the practice (Fielding et al. 2017), but increased literature supporting its use has impacted local and government acceptance (Bischel et al. 2012). The growing acceptance of this practice has sparked the research interest of farmers, engineers, and biologists alike to further understand the long-term effects of soil, water, and crop quality with prolonged irrigation (Chen et al. 2015). There are many benefits to using reclaimed water for irrigation, including soil nutrient recovery, water conservation, and lessening dependence on aquifers as a water source (Toze 2006). Vineyards are generally a less water-intensive crop than other agricultural commodities. Understanding how reclaimed water for vineyard irrigation may potentially benefit wine crops is both important for determining sustainable water management options for Baja California's Valle de Guadalupe, but also serves as a successful project influencing changes in general agricultural water resource management on a larger scale. Shifting agricultural water resources in times of climatic extremes to more sustainable options can support the long-term local economy and promote similar practices in other regions of Mexico impacted by drought.

Objectives
- Understand successful water reuse irrigation systems in Napa, CA to adapt for the vineyards in Guadalupe Valley.
- Analyze water regulations in CA and MX, compare for both regions and highlight possible disparities or obstacles in applying water reuse system in MX.
- Analyze institutional constraints at both UC Merced and the University of Baja California, Ensenada for carrying out the project.
- Analyze social constraints impacting implementation at both locations.

Hypothesis/Expected Outcomes
- The case study shows that distribution systems to transport recycled water from the WWTP to end users can be expensive, and that addressing water quality considerations are critical for stakeholder buy into use recycled water at vineyards.

Table 1. Water Quality Standards for Recycled Water Use in California

Water Type	Parameter	Quality Criteria
Disinfected Tertiary: oxidized, filtered and disinfected	Total Coliform	• Median concentration < 2.2 MPN/100 mL in any 7 days of analyses • < 23 MPN/100 mL in more than one sample in 30 days

		• < 240 MPN/100 mL at any time
	Turbidity for Filtration Using Natural Undisturbed Soils or a Filter Bed	• Average turbidity < 2 NTU in 24 hours • < 5 NTU more than 5 percent of the time within 24-hour period • < 10 NTU at any time
	Turbidity for Filtration Using Microfiltration, Ultrafiltration, Nanofiltration or Reverse Osmosis	• < 0.2 NTU more than 5 percent of time in 24 hours • < 0.5 NTU at any time
Disinfected Secondary 2.2: oxidized and disinfected	Total Coliform	• Median concentration < 2.2 MPN/100 mL using last 7 days of analyses • < 23 MPN/100 mL in more than one sample in 30 days
Disinfected Secondary 23: oxidized and disinfected	Total Coliform	• Median concentration < 23 MPN/100 mL in any 7 days of analyses • < 240 MPN/100 mL in more than one sample in 30 days
Un-disinfected Secondary: oxidized, not disinfected	None	None

Adapted from CDPH (2009)

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5. Case Study E: *Dynamic modeling of groundwater storage in an arid zone, considering the effect of a climatic index*
Participants: David-Eduardo Guevera-Polo (UDLAP), Carlos Patino

Introduction
The water crisis is already happening. In this context, promoting integrated water management cannot be postponed in order to achieve water security. However, historically groundwater has played a minor role in it, despite the fact that in many regions it represents the main source of supply for different uses and plays a substantial role in ecosystems. The main challenge to incorporate groundwater into integrated water management is its understanding as a system and one of the aspects that is not usually considered for this purpose is its relationship with climatic processes. There is statistical evidence that suggests that climatic oscillations significantly influence the availability of groundwater. However, the statistical approach does not consider water uses and land use change in its analyses. The present study seeks to describe the storage of groundwater considering the influence of a particular climatic index, the uses of water and the use of land, using the system dynamics approach. This approach will make it possible to describe the groundwater system under different climatic, demand and land use change conditions and propose actions that allow its incorporation into integrated water management.

Objectives
- Describe the storage of groundwater, associated with a climatic index, water uses and land use, in an aquifer in an arid zone using a dynamic simulation model, to propose tactical and/or strategic management actions of the water.
- Develop a dynamic simulation model through the identification of the system's structure, the definition of its borders and the mathematical description of the processes that influence it, to understand the behavior of the system.
- Implement the model in a pilot arid aquifer to validate its results and demonstrate its usefulness for proposing tactical and strategic water management actions.
- Based on the results of the model and the use of various scenarios, propose tactical and/or strategic actions for groundwater management to ensure the satisfaction of the demands for the different uses and for environmental protection.

Hypothesis/Expected Outcomes
It is feasible to develop a dynamic simulation model to describe the storage of an aquifer in an arid zone, considering the effect of a climate index through its influence on precipitation patterns, together with water uses and soil characteristics. Furthermore, this model will be useful to propose tactical and/or strategic actions to increase the efficiency of groundwater use.

Research Questions
1. How to describe the storage of groundwater in an aquifer in an arid zone for a monthly scale considering the effect of a climate index, change in land use and groundwater extraction?
2. What are the variables to which groundwater storage offers greater sensitivity?
3. Is the influence of the climatic index significant on the recharge of the aquifer?
4. Do incidental recharges make a significant contribution to storage?
5. What tactical and/or strategic actions can be implemented in the aquifer to favor the efficient use of groundwater?
6. Do the protection of recharge zones and induced recharge represent leverage points in the groundwater system?