Stockholm Environment Institute

Robust Decision Support: how SEI helps California regions plan for sustainable water management

SEI fact sheet
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In recent years, California has worked toward sustainable water management, with regions developing plans to replenish depleted aquifers and balance economic and environmental needs. The Stockholm Environment Institute helps local agencies in this effort, through the creation of a shared "mental model" of their watersheds.

Such models have been particularly helpful for regional plans under two state-supported efforts: Integrated Regional Water Management (IRWM) and the Sustainable Groundwater Management Act (SGMA). IRWM aims to help regions manage water to achieve social, environmental, and economic objectives; SGMA requires all the state's groundwater basins to be sustainable by 2042.

The formulation of these plans often involve stakeholders with different – and sometimes conflicting – interests and perspectives. For instance, farms turn to groundwater as a backstop during a drought, while cities rely on groundwater as their primary source. To bring diverse interests to the table, SEI uses a process called Robust Decision Support (RDS), based on concepts developed by the RAND Corporation[1]. The outcome is a shared mental model of available opportunities and potential trade-offs for various objectives.

In this process, stakeholders work to arrive at a common understanding of their water resources system, the major uncertainties confronting it, and the potential management strategies that could be employed in maintaining its sustainability. SEI's work in two basins illustrates how RDS can be applied for both groundwater and IRWM plans.

Yuba River Basin: IRWM support

Supported by the Water Foundation in California, SEI worked with stakeholders in the Yuba River Basin from 2013 through 2015. Researchers relied on the RDS approach, using what is known as the XLRM framework. The framework includes four components to inform robust strategies:

- Exogenous uncertainties (X) are factors outside decision-makers' control that can influence outcomes (such as population growth)
- Levers (L) are the options that can improve outcomes (such as new regulations)
- Analytical tools help relate (R) uncertainties to identified management options
- Performance metrics (M) help decision-makers and stakeholders evaluate and compare potential outcomes

Photo (above):
Alfalfa sprinkler © PHIL HOGAN, USDA

1 Lempert, R.J., Popper S.W., Bankes, S.C. (2003). Shaping the Next One Hundred Years. http://www.rand.org/pubs/monograph_reports/MR1626.html

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As part of this process, SEI used its Water Evaluation And Planning (WEAP) system to build a computer model of the complex Yuba basin. A quantitative analysis showed that the Yuba system is particularly vulnerable to climate change and to potential environmental regulations that would require water releases to the Delta.

SEI quantified the trade-offs and co-benefits of various strategies and futures, and used visualization techniques to foster a discussion among stakeholders. This shared mental model of the system proved valuable in finding solutions among diverse stakeholders, including groups that often have opposing interests, such as farmers and environmentalists.

The WEAP model showed the effect, across multiple interests, of strategies from the Yuba Integrated Regional Water Management (IRWM) plan. The analysis found that most of the individual strategies would not reduce the regional vulnerabilities of the system. In particular, urban conservation projects, while helping local constituencies, would not significantly decrease vulnerabilities; this is because of the very small proportion of total water used by the non-agricultural sector. The conclusion was that a portfolio, including multiple strategies, is needed for cross-sectoral regional impact.

Yolo County: supporting groundwater management

Every year, California's groundwater basins supply the state with more than one-third of its water – with some communities relying on them exclusively for their water needs. Over the years, this use has depleted aquifers and threatened groundwater sustainability.

The Sustainable Groundwater Management Act (SGMA) aims to reverse this depletion. But its implementation is a challenge; new local groundwater sustainability agencies are tasked with formulating the first-ever groundwater sustainability plans (GSPs).

SEI began working in recent years with Yolo County stakeholders to develop their GSP, building on its previous work with the Yolo County Flood Control and Water Conservation District to study groundwater management[2,3]. The District was exploring the possibility of investing in groundwater infrastructure to improve water service and financial stability, in the face of future water shortages. SEI used the RDS approach to elicit concerns and objectives, and to evaluate the performance of various strategies under consideration.

Using a WEAP model of the basin, SEI used three aspects of the system to define sustainability: groundwater levels, financial viability, and water reliability. Climate, land use change, and new regulations (such as the Sustainable Groundwater Management Act) were expressed as major uncertainties by the stakeholders, and were articulated in the model as uncertainty scenarios. SEI analysed the performance of various management strategies in the future using the three sustainability dimensions, under different uncertainty scenarios. One of the important contributions of this study was the testing of different rules that might be formed in response to SGMA, and what implications they might have for all three dimensions of sustainability.

Looking ahead

Despite substantial differences in water availability between Yuba and Yolo, a common narrative has emerged that both are vulnerable to climate, land-use change and new regulations. In both cases, using the RDS process has enabled SEI to bring together stakeholders based on a shared understanding of the future impacts of management strategies – and to spur creative thinking about the best paths forward.

2 Mehta, V. K., Haden, V. R., Joyce, B. A., Purkey, D. R. and Jackson, L. E. (2013). Irrigation demand and supply, given projections of climate and land-use change, in Yolo County, California. *Agricultural Water Management*, 117(0). 70–82. DOI:10.1016/j.agwat.2012.10.021.

3 Mehta, V., Young, C., Bresney, S., Spivak, D. and Winter, J. (2018). How can we support the development of robust groundwater sustainability plans? *California Agriculture* 72(1):54-64. Published online March 13, 2018. DOI: 10.3733/ca.2018a0005

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