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BAJA PROJECT BRIEF

STRATEGIES FOR SUSTAINABLE WATER SUPPLY AND MANAGEMENT FOR LORETO, BAJA CALIFORNIA SUR, MÉXICO

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ON THE WEB AT http://www2.bren.ucsb.edu/~baja//Bajagp_html/Home.html SPRING 2010

Loreto, Baja California Sur

Loreto at-a-glance…

- 12,000 residents
- 60,000 visitors annually, inspired by the adjacent Loreto Bay National Marine Park
- Per capita water use is 27-42% higher than average for household purposes
- A single aquifer provides freshwater for the population
- The aquifer is already being overdrawn, and tourism growth will increase pressures on the aquifer supply
- Overdrawing creates a risk to human health and the community's socio-economic well-being

Introduction

Loreto is situated in the rugged desert of Baja California Sur , México, between the Sierra Giganta mountain range and the Gulf of California. The diverse flora and fauna of the adjacent Loreto Bay National Marine Park inspire the tourism-based economy. Although the recent U.S. economic downturn stalled growth, existing and proposed development projects could significantly increase the local population within the foreseeable future.

Loreto's arid climate severely limits freshwater supplies. The entire population is served by the San Juan Bautista Londó aquifer (SJL), which is already being overdrawn. As a result, there are indications that geothermal salts, metals or other contaminants are affecting water quality in the aquifer. While potability is not yet affected, tourism-inspired growth will exacerbate the problem.

Overdrawing of the SJL aquifer results from various factors. These include inefficiency, overuse, and the cultural and institutional situation of water management in Loreto, which results in a lack of experience and high turnover of decision makers. Collectively, these challenges undermine the sustainability required for the community's social and economic well-being—now and in the future.

To sustain the aquifer and, therefore, the social and economic welfare of the tourism-dependent Loreto community, proposed solutions to overcome freshwater supply limitations must be holistically considered. Further, water management must account for both current and future population needs. Therefore, our strategies for water management in Loreto are motivated by *sustainability,* defined here as maintenance of freshwater quality and supplies so that the community can capitalize on economic opportunities that unfold over time. This is the basis for our project goal and supporting objectives.

Project Goal

Identify and propose optimal water management strategies to sustainably meet the freshwater needs of current and future residents, without compromising Loreto's ability to economically benefit from tourism

Project Objectives

1) Create a dynamic analytical framework to structure and inform water management decision-making

2) Propose a means of overcoming the current political and institutional limitations of water management in Loreto

Methods

In order to fully consider the scope of the challenges, we addressed the absence of sustainability in two ways: **1)** we created a dynamic analytical framework to structure and inform water management decision-making, and to evaluate opportunities to both augment supplies and minimize overuse and inefficiencies, **2)** we proposed a means of successfully contending with the political and institutional limitations of water management in Loreto.

To balance the difficulties of limited supply and excessive demand, we selected locally relevant quantitative and qualitative criteria to evaluate possible solutions within a multi-criteria analysis (MCA) framework. Our MCA design provides a structured methodology to optimize water management decisions. Equally important, the MCA can be reapplied locally by decision makers as circumstances change in Loreto.

To account for both present and future water needs in Loreto, we modeled solutions for the current population and two likely population growth scenarios--17,000 and 25,000. We chose nine specific evaluation criteria relevant to local water management decision-making. We also selected seven alternatives to either increase supply or decrease demand in the arid, water-limited climate. Five of the alternatives apply to all population the scenarios, and two only apply to future population scenarios.

Evaluation Criteria

- Investment costs
- Operational costs
- Environmental impacts
- Energy use
- Expected yield
- Confidence in yield
- Time to implementation
- Technical sophistication
- Infrastructure requirements

- The low water **conservation program** consists of an education campaign focused on changing water use habits to reduce water demand by 5%. The high water conservation program incorporates financial incentives for the installation of low-flow domestic fixtures in existing homes to reduce water use by 22%.

- **Infrastructure upgrades** include repairs and upgrades to the urban water distribution infrastructure. These upgrades would capture the 35% of water currently lost through system inefficiencies or leaks between the aquifer and water users.

- **Desalination** can provide an unlimited water supply, but with high costs and energy requirements, as well as significant potential impacts on the Loreto Bay National Marine Park. The small desalination plant would provide enough water for tourist developments of up to 500 people, and the large desalination plant would satisfy the freshwater needs of the entire region.

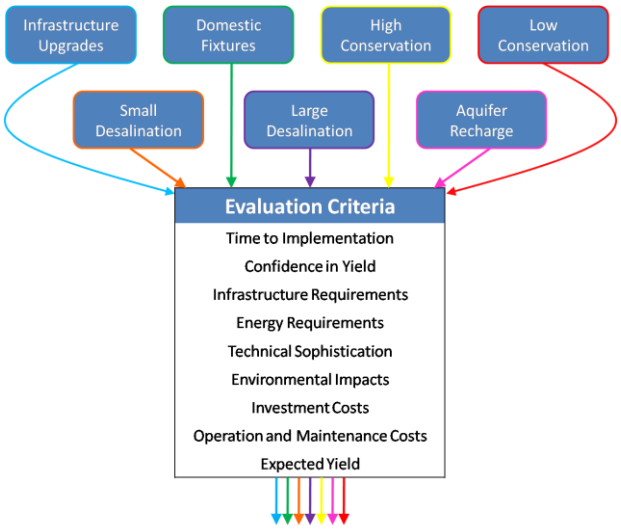
- Future scenarios include installation of **low-flow domestic fixtures** in all new development projects to reduce household water consumption through low flow toilets, showerheads, and faucet aerators. This alternative would achieve an expected water savings of 26% in each new household.

- **Managed aquifer recharge** (MAR) can augment aquifer water supplies. Given the low precipitation, community size and aquifer characteristics, MAR is limited to direct injection of reclaimed wastewater in future population scenarios. The current wastewater supply is already sold for irrigation.

These alternatives were incorporated into the MCA model individually and in combined programs to identify optimal solutions. As the basis of evaluating we assigned weights to the various criteria to reflect their relative importance in decision-making.

We ran the model in two stages for each population scenario. The first run ranked all alternatives and combined programs of alternatives. The second run included only options that compensate for the aquifer overdraft. Finally, we tested the sensitivity of the model results by using multiple weighting schemes as well as a parameter meant to penalize less optimal solutions.

Flow chart of MCA methods:



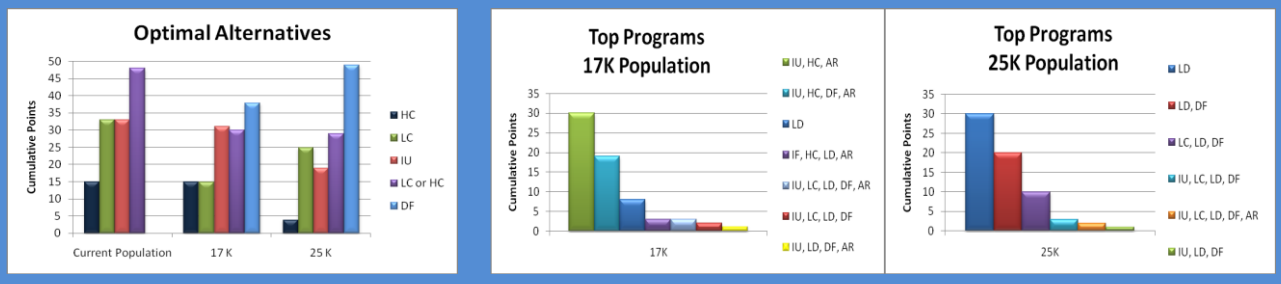
Results

The results of the MCA model show that demand-side measures to reduce the amount of water extracted from the aquifer--specifically conservation programs to reduce per capita use through education or installation of water-efficient fixtures, and infrastructure upgrades to capture water currently lost in the distribution system--should receive precedence at all population levels, whether alone or in combined programs with other alternatives.

Our analysis also shows that, while high costs and energy use, as well as potential environmental impacts, generally make desalination a suboptimal option compared to other alternatives, it may eventually be necessary if the population grows beyond the capacity of other programs to compensate for the aquifer overdraft.

These findings provide important guidance to implement more sustainable water resource management for both current and future populations in Loreto. At the same time, our MCA framework includes the flexibility to be updated and employed by decision makers in Loreto, as priorities or circumstances shift over time. However, both the successful implementation of the optimal alternatives identified by our analysis, and the effective use of the MCA framework as a decision-making tool depend on successful navigation of the political situation in Loreto.

Cumulative points based on frequency of ranking in the top three for alternatives and combined programs, across all weighting schemes. Optimal Alternatives Legend: HC, high conservation; LC, low conservation; IU, infrastructure upgrades; DF, low-flow domestic fixtures; AR, aquifer recharge; LD small desalination; HD, high desalination



1st Model Run **2nd Model Run**

Political Considerations

As a result of the complexities of water management in México, institutional capacity is limited in Loreto. The water manager is appointed by the new municipal president every 3 years, due to the Mexican prohibition of re-election. The high turnover of the role, frequently combined with a lack of professional experience in water management, creates significant discontinuity. However, an opportunity exists to create a government-funded community-based council, called **COTAS**, to influence and provide continuity to decision-making in Loreto. Since Loretanos have consistently shown a strong interest in civic matters and community sustainability, a **COTAS** in Loreto could be an effective means of influencing water management decisions in the social, environmental and economic interests of the community.

Recommendations

Through the process of this project, we identified a number of opportunities to address the multi-dimensional water challenges in Loreto and encourage sustainability. Following are the recommendations for our client Eco-Alianza de Loreto, A.C.:

1) Prioritize demand-side measures. Infrastructure upgrades, and conservation measures such as education and domestic fixtures should take precedence over new water supply projects.

2) Develop & implement aggressive conservation programs. Conservation should be a critical component of any water management program in Loreto, and include some combination of education, community outreach, and implementation of water-saving household fixtures.

3) Create a Loreto COTAS. Formal community involvement can provide both continuity and a sense of ownership over decision-making, and thus inspire more effective water management.

4) Use the MCA as a decision-making tool. The dynamic MCA framework should be employed by water managers and/or a Loreto COTAS to guide decision-making and justify water management recommendations.

5) Introduce an environmental review of desalination projects. Benefits of new freshwater supplies should be weighed against the costs to the environment and energy demands on the isolated state energy grid.

6) Consider renewable energy-powered desalination. Where desalination is necessary, solar-powered desalination should be considered.

7) Solicit a comprehensive aquifer study. A comprehensive assessment would provide a better basis to determine the sustainable yield of the San Juan Bautista Londó aquifer.

8) [Re-]Consider water tariffs. Tariffs that reflect actual water use can supplement conservation efforts in Loreto.

9) Propose means of addressing agriculture overdraft. While agricultural use is outside local jurisdiction, a COTAS could propose measures to track actual water use and promote high use efficiency technologies.

Through these recommendations, and the underlying analysis that produced them, our project provides Eco-Alianza with the ability to influence the direction of water management in Loreto. In particular, Eco-Alianza can support efforts to reduce water demand by developing and carrying out education programs in conjunction with conservation initiatives. More broadly, by encouraging implementation of the recommended strategies, Eco-Alianza can further its mission to advocate for sustainable use of natural resources and the environment on behalf of the local community.

ECO-ALIANZA DE LORETO, A.C.
LORETO, BAJA CALIFORNIA SUR
LORETO ECO-ALLIANCE

Our client, Eco-Alianza de Loreto, A.C. is a non-profit organization whose goal is to promote sustainable governance of natural resources and the environment on behalf of the community of Loreto.
Eco-Alianza's mandate includes advocacy for the preservation and protection of the region's water resources through policy initiatives, community involvement, and public education and outreach.

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