

## Stanford University and Mexican Researchers Gather in Sonora, Mexico for Fourth Annual Yaqui Valley Conference Held October 16-18, 2002

On October 16, 2002, twenty-five researchers gathered for three days to attend the fourth annual Yaqui Valley Integrated Regional Study conference to discuss the past, present and future conditions of agriculture and aquaculture development in the Yaqui Valley, Sonora, Mexico. The conference included Stanford University professors, graduate and post-doctorate students from the Schools of Earth Sciences and Engineering and from the Center for Environmental Science and Policy (CESP), and Mexican researchers from The International Maize and Wheat Improvement Center (CIMMYT), National Water Commission (CNA), and the Center for Conservation and Use of Natural Resources (CECARENA).



Professor Pamela Matson, a co-principal investigator on the project, opened the conference up with an overview of the goals and objectives of the sustainability study and what it means for the Yaqui Valley. The Yaqui Valley is a region of rapid demographic, economic, and ecological change. Situated on the west coast of mainland Mexico on the Gulf of California, between the Rio Yaqui and Rio Mayo, the Valley currently comprises 225,000 ha of irrigated wheat-based agriculture, but it has recently added aquaculture to its landscape. It is the

birthplace of the Green Revolution for wheat and one of Mexico's most productive breadbaskets. Today, the Yaqui Valley's agriculture, livestock and aquaculture activities are of critical economic importance to Mexico. However, continued intensification of agriculture, expansion of aquaculture, and urban development threaten the sustainability of the land and coastal waters. Matson noted that the project's research objectives, which address dimensions of agricultural variability and vulnerability, the impact of institutions and policies, water resource management, and dynamics of the coastal zone, are extremely timely and critical, both in terms of Valley decision making, and because what is learned there will be useful in many other regions around the world.

Throughout the first day of the conference seventeen researchers presented brief reports on results from research underway in Yaqui's agricultural district, hydrologic systems, and coastal systems. The results provided a greater understanding of what drives land and water resource use change and the resulting consequences, the role of institutions and impact of national and international policies, aquaculture development and the effect on estuaries of upland land use change, and the burgeoning role of the livestock sector. Together, the reports revealed the integrative nature of research in this area and created a comprehensive picture of the current state of sustainability in the Yaqui Valley.





Also covered during the conference was the importance of disseminating research results, having an impact on policy, and future planning. On the second day of the conference, members broke into working groups to talk about research planning. They discussed major questions and research strategies as well as ways in which to integrate local communities and institutions to facilitate the recommended changes in land, water and coastal policies. While the questions proposed at the conference highlight the challenges that lie before the investigators, the interdisciplinary nature of the research and cooperative support and

contribution of local Mexican researchers has created a framework within which to implement effective change within the Valley.

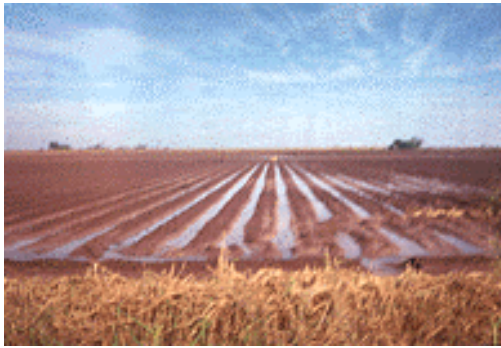
At the conclusion of the conference, members outlined future research objectives and created an effective research strategy. In the realm of water resources, there is a need for greater understanding and modeling of water resources, quality and uses under different climate conditions. Such knowledge may enable researchers to forecast sustainability, water availability and geographical information. Work to be done in the coastal zone includes assessment of the impacts and direction of future growth of the aquaculture industry on the ecosystem and competing social interests, investigating how changes in the upland systems affect estuaries, and how the estuaries work. Finally, in the agricultural sector salinity studies, new technologies to increase fertilizer use efficiency, and the interactions between livestock, water and crops deserve further investigation.

In each sector additional research is needed to examine the impact of liberalization policies on land use and the function of institutions in the decision making process. This is particularly relevant in the agricultural sector where market mechanisms have not stimulated the desired change, such as in the use of fertilizer. It is necessary to identify key policy players and to determine how institutions can work together on a regional and national level.



Research completed up to this point makes it clear that changes in the balance among land uses (e.g., agriculture, livestock, and aquaculture activities) are likely to dramatically affect both ecological and biogeochemical processes and the economic and political constituencies in the Valley. Like many agricultural and coastal systems around the world, the Yaqui Valley is subject to increasing developmental pressures. Unlike many other areas, however, the Yaqui region is in relatively early stages of development, and development alternatives that could foster win-win outcomes among various economic and environmental objectives are still possible.

## Field Research in the Agricultural and Livestock sectors



During the week prior to the Conference, Stanford researchers led by Dr. Rosamond Naylor, Professor Walter Falcon and Dr. Ivan Ortiz-Monasterio, interviewed officers at key agricultural credit institutions in an attempt to understand the why these institutions often recommend the application of excessive amounts of fertilizer to wheat crops, and whether these recommendations affect farmer behavior. This investigation stems from research begun in 1992 by Professor Pamela Matson and Dr. Naylor to examine the use of fertilizers in the intensive wheat systems of the Yaqui Valley.

Results of this initial study indicated that farmers could use less fertilizer and receive comparable yields from their crops. Despite the economic incentives and ecological benefits, farmers did not respond to the market mechanisms and are currently using even more fertilizer than in the past. The recent interviews with the credit institutions revealed that their agricultural consultants still recommend heavy fertilizer use to farmers who receive credit. The farmers are not required to follow these recommendations but they often do because of uncertainty about optimal dosages. The Stanford researchers concluded, however, that the specific basis for determining loan size was not a reason for the large dosages farmers choose to use.

Drs. Naylor, Falcon, and Ortiz-Monasterio, plus Research Fellow Matt Evans, also found time to investigate the growing pig industry that currently consumes over half of the wheat produced in the Valley. They interviewed pork producers and representatives of the Sonoran pork association in an effort to understand whether pig farming is likely to increase and what measures are being taken to mitigate environmental impacts related to pork production. They concluded that policies affecting the pricing of grain in Sonora were key variables now that the Mexican tariff is being removed on pig meat as a consequence of NAFTA agreements.



## The Initiation of Estuary Research

Meanwhile in the southwest corner of the Yaqui Valley, Stanford Professor Stephen Monismith and Esther Cruz of the Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM), Mexico, initiated a project measuring currents and other physical properties in Tobarí Bay. They enlisted the help of local fishermen and their boats—as well as students from ITESM, and Stanford graduate students Juan Bustamante and Michael Beman. Working throughout the day and night to capture a full twenty-four hour tidal cycle, currents were measured along transect through the Bay using an



Acoustic Doppler Current Profiler (ADCP). More such studies are planned for the following two years, and over time these data will be used to understand the complex circulation patterns found in Tobari, eventually contributing to a greater understanding of how coastal ecosystems are influenced by the rapid development of the Yaqui Valley.

### Conference Field Trip



On the final day of the conference, participants enjoyed a field trip that spanned the land-sea system. The group met the head of the irrigation district at Canal Bajo to learn about conjunctive use in the Valley. As the Valley enters its sixth year of drought, water administrators must devise new measures to allocate limited water resources. Particularly as urbanization within the Valley continues to grow, water demands are increasing while the surface and groundwater supplies are decreasing. Farmers within the Valley feel the pressure most directly and are diversifying their crops to include less water intensive crops. In the meantime, farmers face lower production levels, threats of unemployment and competition over limited water resources with the growing urban sector.

The next stop included a visit to one of Stanford graduate student, John Harrison's field sites where he has spent the past four years analyzing nitrogen dynamics in surface waters draining the Yaqui Valley agricultural district. Nitrogen fertilizer can flow downstream to coastal ecosystems and can lead to over-enrichment and ultimately the suffocation of fish and invertebrates, toxic and nuisance algae blooms, sedimentation and biodiversity loss. Harrison has measured a significant relationship between levels of dissolved nitrogen fertilizer and nitrous oxide emitted from drainage canals. Nitrous oxide traps light energy and re-radiates it as heat making it an important greenhouse gas.



The field trip also included a visit to a shrimp farm in Tobari to look at aquaculture development. A biologist at the farm relayed the successes and challenges of the shrimp farming industry, including the industry's vulnerability to viruses, diseases and natural disasters such as hurricanes. Shrimp aquaculture has led to rapid rates of land use change and loss of coastal ecosystems. The causes and consequences of rapid aquacultural growth are the focus of PhD studies by Amy Luers.

## Conclusion

The Valley is thus an extraordinary laboratory for policy analysis as well as for hydrologic and biogeochemical research. It is sufficiently constrained spatially to allow researchers to account for most sectors. At the same time, the Yaqui Basin is on a trajectory of change that is similar to many middle-income regions of the world. The sentiments of those leaving the conference included a profound sense of accomplishment over what has been done, excitement and enthusiasm for what remains to be completed, and hope that the Yaqui Valley project may become a model of successful, integrated scientific inquiry capable of helping the region become more economically, ecologically and socially sustainable.



The Center for Environmental Science and Policy wishes to thank the Packard Foundation for sponsoring the Yaqui Valley Conference and for its continued support of Stanford research in the Valley.