Land-Use and Land-Cover Change in Sonora, Mexico: Trajectories of Agricultural Intensification and Consequences for Non-Agricultural Ecosystems

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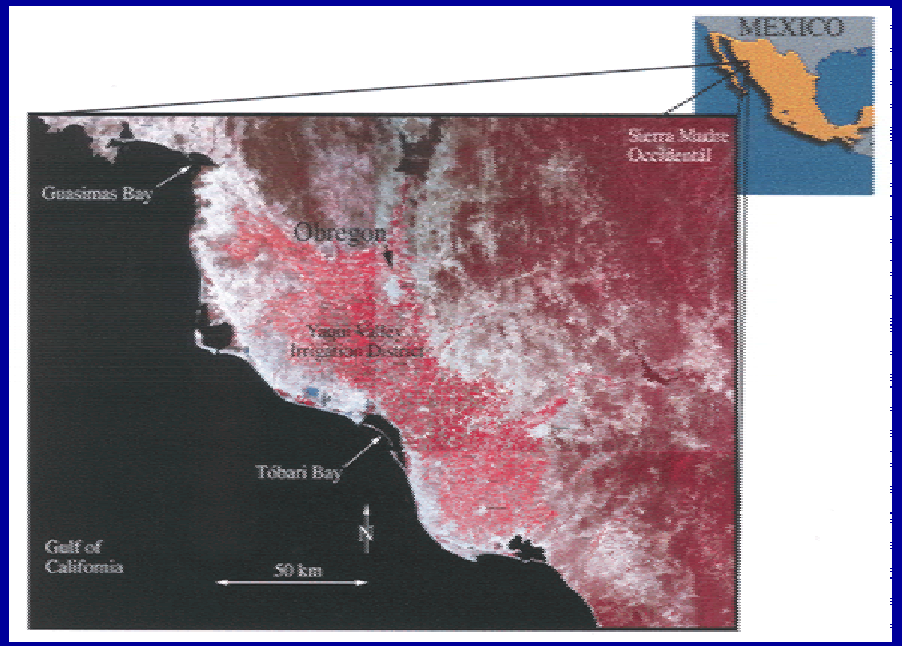
Http:www.cnr.berkeley.edu/benninglab/YaquiValley/

Apr 3-5, 2000

Objectives and Approach

The objective of this proposed research is to evaluate the causes and on- and off-site consequences of agricultural development in the Yaqui Valley of northwestern Mexico.

We analyzed the critical links among agricultural policy and agricultural extent and productivity within the Valley, as they have changed over the last fifty years and continue to change. In addition, remote sensing data were used to evaluate the off-site consequences of these agricultural land-use decisions for land-use and land-cover in the surrounding region, focusing on 1) the expansion of (and use change in the coastal and scrub ecosystems at the edge of the Yaqui Valley); and 2) alteration of native ecosystems as a result of transfers of anthropogenic nitrogen from the Valley.



The Yaqui Valley is the home of the Green Revolution for Wheat.

Results

Change in land use in the Yaqui Basin over the past 3 decades has included:

- Minor expansion in irrigated land area (6% increase since 1973) (Fig A);

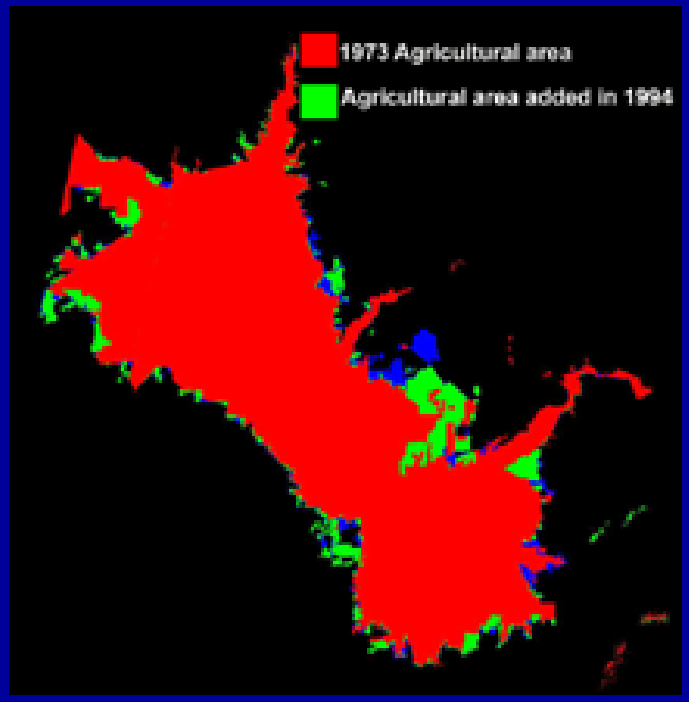


Fig A. Agricultural area expanded by less than 6% since 1973.

- Major increases in yields and production (increasing from <3 to 5.5 T/ha) (Fig B), due to improved wheat varieties and subsidized increases in fertilizer use;

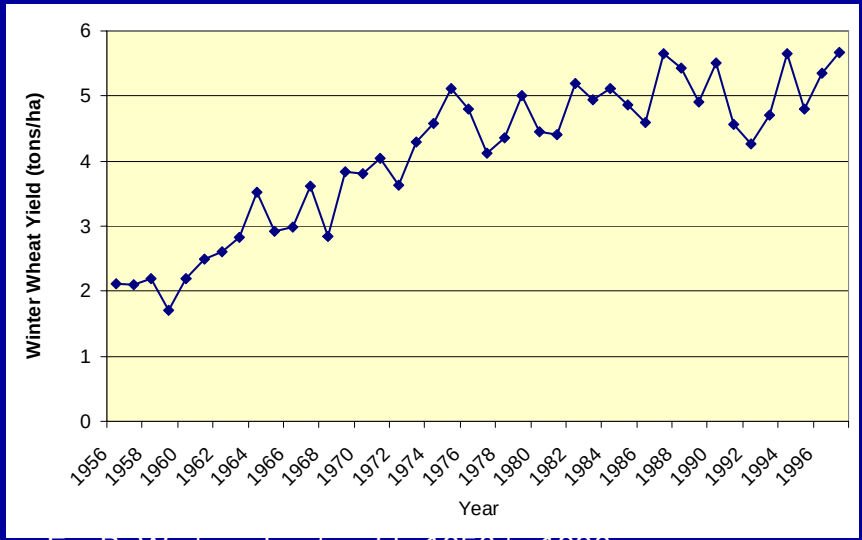


Fig B. Winter wheat yields 1956 to 1996.

Results (Con't)

Change in land use in the Yaqui Basin over the past 3 decades has included:

- Dramatic increases in land use change *outside* of the irrigation district, including increases in coastal development and conversion to aquaculture due to changes in coastal access and land ownership policies (Fig C and Fig D); increasing urbanization (Fig E); increasing livestock production; and biogeochemical changes in the surface water systems.

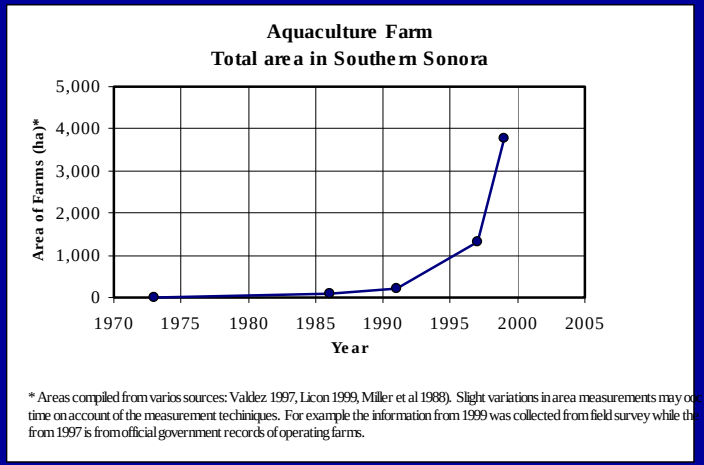


Fig D. Increase in total area of aquaculture farms 1970 to 1999.

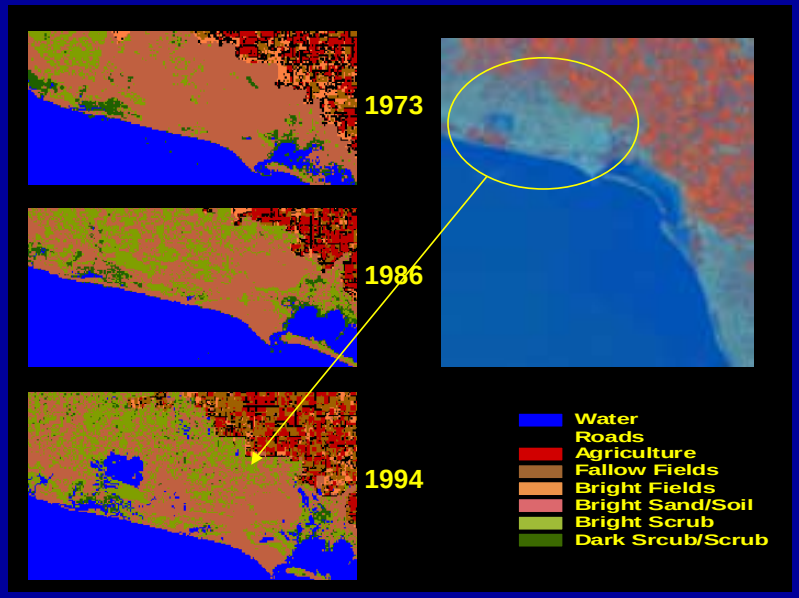


Fig C. Yaqui Valley land-cover 1973, 1986 and 1994.

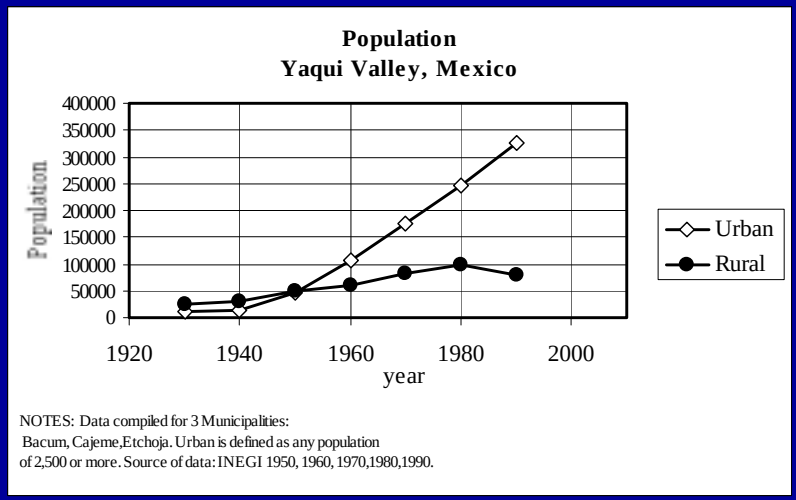


Fig E. Population growth in urban and rural areas 1920 to 2000.

Conclusions

- In the Yaqui Valley, intensification of wheat agriculture during the Green Revolution preceded and in fact influenced expansion of land use change in the coastal area and an increase in livestock production in the last decades. Land use changes were driven by changing national policies that affected subsidies, increased access to coastal resources, and encouraged diversification by the private agricultural land owners.

- Publications:

  Matson, P.A., R.L. Naylor and I. Ortiz-Monasterio. 1998. Integration of Environmental, Agronomic, and Economic Aspects of Fertilizer Management. Science 280:112-115.

  Naylor, R.L., Falcon, W.P. and A. Puente-Gonzalez, “Policy Reforms and Mexican Agriculture: View from the Yaqui Valley (Sonora)”. Economic Working Paper Series, CIMMYT, Mexico,D.F. 2000 (forthcoming).

  Lewis, J. “The Impact of Agrarian Law Reform on Ejidos in the Yaqui Valley, Sonora”, Submitted Land Economics.