PIECES OF THE REVITALIZATION PUZZLE: A LA COSTA DE HERMOSILLO CASE STUDY

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Restoration of desertified land is a challenge faced throughout the semi-arid and arid world. One such area in need of revitalized biotic and economic production is La Costa de Hermosillo, located in the state of Sonora, Mexico. Due to salt water intrusion of the aquifer—a result of the intensified agricultural production that began in 1945—about 80,000 ha of agricultural fields are currently abandoned. Future management options for La Costa de Hermosillo should account for biophysical, political, and socio-economic issues. This can be achieved by utilizing a participatory community development philosophy and appropriate technology techniques. Also, lessons should be learned from case studies in other semi-arid and arid areas of the world, and collaboration with scientists dealing with similar land management issues in other countries should be encouraged.

STUDY AREA

La Costa de Hermosillo is in the western section of a coastal plain near the center of the Sonoran Desert and is situated between the coast of the Gulf of California and the city of Hermosillo, Sonora, Mexico. The mean annual temperature of this region is 22° C, with maximums above 46° C and minimums close to, but staying above 0° C. Annual precipitation is in the range of 100–225 mm. The soils are extensive alluvial deposits with a mixed structure of clay, silt, and sand (Castellanos et al. 2005). The natural vegetation of the region consists of the central Gulf coast and plains of Sonora subdivisions within the Sonoran desert scrub formation (Shreve and Wiggins 1964).

La Costa de Hermosillo's Agricultural Land

Irrigated agriculture started in the area in the early 1940s with diversion of small quantities of water from the Rio Sonora to irrigate plots of corn, wheat, cotton, and beans (Moreno 1994). After a dam was built upsteam on the Rio Sonora, which decreased the flow of water for crop production, the people of La Costa de Hermosillo dug wells and tapped into an unconfined aquifer (Halvorson et al. 2003). The pumped water from the aquifer was not considered to be a limiting resource during the period of intense agricultural growth from 1945 to 1970. However, the combined impacts of a salt-water contaminated aquifer, soil salinization, an unstable economy, and poor policy were too taxing on both the land and the individual farmers. Therefore, 80,000 ha were abandoned. Of all the rehabilitations programs suggested for La Costa de Hermosillo's aquifer, none mention alternatives for these abandoned fields, which range in size from 1000 to 5500 ha (Halvorson et al. 2003; Castellanos et al. 2005).

Management Options

Halvorson et al. (2003) used the La Costa de Hermosillo case study to demonstrate how sustainable land use requires an awareness of ecological signals. When ecological signals are recognized, detrimental land management activities can be modified before ecosystem components reach severe degradation. This was not the case for the 80,000 ha of abandoned land in La Costa de Hermosillo. Some researchers have concluded that salt-water intrusion into the Valley of Hermosillo aquifer is an irreversible consequence (Steinich et al. 1998). Others acknowledge that reversing such great environmental degradation is neither simple nor well defined, but recovery is possible if future management decisions consider the biophysical, political, and socio-economic components of the

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situation (Halvorson et al. 2003). The following sections discuss pieces of La Costa de Hermosillo's revitalization puzzle. Participatory community development, appropriate technology, interdisciplinary dialogue, and international collaboration are four pieces that will serve as a foundation for the revitalization of both biotic and economic production.

PARTICIPATORY COMMUNITY DEVELOPMENT

The complex task of revitalizing degraded land must center on the people most affected by the degradation, in this case the farmers. Ecosystem restoration projects in other semi-arid and arid parts of the world have successfully applied a development philosophy called participatory community development. This philosophy is part of a family of approaches and methods that enable people to share, enhance, and analyze their knowledge of life and conditions, to create plans for the future, and to act on these plans (Chambers 1994).

Participatory development works because farmer's fields are the stage where ecological, social, and economic influences intersect. Therefore, farmers are most likely the best integrators of these factors (Haggar et al. 2001), and they will have good insight on which management components are most feasible in light of these factors. Representatives from surrounding communities (e.g., indigenous groups, non-governmental organizations, education and research institutions) can provide a diversity of ideas; however, the farmers are the main stakeholders and decision makers. For example, through participatory development, community members can reach consensus on income-generating projects, the integration of traditional knowledge, ecotourism possibilities, and environmental education curricula that are feasible for La Costa de Hermosillo.

APPROPRIATE TECHNOLOGY

The sustainability of any management option is dependent upon available resources. These resources might include components such as physical material, labor, and money. Whether the goal is to harvest rainwater, increase soil organic matter, or construct buildings, appropriate technology facilitates improvement over past technologies while at the same time insuring that the advancement is applicable and feasible for a specific use and setting. For example, technologies such as drip and pivot irrigation can improve water-use efficiency and decrease salinization while maintaining or increasing yields (Tilman et al. 2002). For an improved irrigation system to be appropriate, the material components and labor should be available locally and the system must be suitable for the water source, water quality, and topography of a specific site.

INTERDISCIPLINARY DIALOGUE

A return to an intensive agricultural system is not a realistic option for La Costa de Hermosillo's degraded land. Any single and extensive use of the land will most likely be unsustainable. However, representatives from a variety of disciplines (e.g., economists, agronomists, sociologists, engineers) can provide the farmers with a set of options for revitalizing both the land and the local economy. Options might include various forms of revegetation, small-scale income-generating enterprises, and technological advancements.

For example, in a World Resources Institute paper presenting ideas for improving irrigation management in Mexican agriculture, Puebla and El-Ashry (1989) suggest that the reintroduction of salt-tolerant and drought-tolerant native vegetation is one alternative to land abandonment. They list several species that fit this criteria and provide potential marketable properties. For example, *Amaranthus hypochondriacus* is a dryland-adapted crop with value as both a nutritious food and an ornamental.

INTERNATIONAL COLLABORATION

The above paragraphs describe revitalization pieces that encourage an active exchange of information between farmers, scientists, various community members, and local government agencies. Scientists from other countries who are involved in similar land-management decisions can also provide additional advice. In fact, more research centers are acknowledging the benefits of international collaboration when dealing with issues such as those faced in La Costa de Hermosillo, and any future management plan can be improved by recognizing lessons learned abroad and through consultation with individuals in other countries.

CONCLUSION

Land degradation and abandonment is detrimental on a number of levels. Farmers are left demoralized (Puebla and El-Ashry 1989), communities are stripped of their economic foothold, and ecosystem processes require healing. Furthermore, upon abandonment, the ecosystem often retains very little, if any, economic or social value. Rehabilitation of the land is generally not pursued (Castellanos et al. 2005). Agricultural systems in arid ecosystems are particularly fragile, as exemplified in the La Costa de Hermosillo case study. As described in this paper, revitalization of the land requires a number of pieces, including participatory community development, appropriate technology, interdisciplinary dialogue, and international collaboration. These pieces are only a few in a complex puzzle, but they can serve as a framework for eliciting additional pieces. At this point the final picture is unclear; however, beginning with a broad set of approaches proven to be beneficial in other revitalization projects is the first step toward sustainable natural resource management.

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