

## VI. Project Development

The CRSP, with its extensive international network of researchers, is well positioned to identify needed areas of research and opportunities for aquaculture development. The focus of CRSP efforts under the new grant will consist of research in production systems and capacity building through research support activities. Production systems research will concentrate on specific themes in the areas of production optimization, social and economic aspects, and environmental effects. Research support activities are proposed in information management, networking, and human capacity development.

In developing the *Continuation Plan 1996-2001*, the PD/A CRSP undertook an analysis of constraints to aquaculture. That analysis revealed several major factors that limit the development of sustainable aquacultural systems. The constraints identified are in areas of: aquacultural productivity, environmental effects, socioeconomic, information management, networking, human capacity, and target economies. The structural changes needed to remove constraints to target economies are beyond the scope of this program. However, the CRSP is specifically designed to address the other constraints through its multidisciplinary systems approach to the task of generating information and developing more sustainable production technologies.

During the reporting period, CRSP researchers visited Zimbabwe, Malawi, Niger, Kenya, and Tanzania to evaluate potential sites, develop inter-regional contacts, attend meetings, and participate in aquaculture activities in the region. Sagana Fish Culture Farm in Kenya was selected as the most promising site for a renewed CRSP presence in East Africa. An MOU between the Kenya Ministry of Tourism & Wildlife/Department of Fisheries and Oregon State University is presently in the final stages of negotiation. Ghana has also been visited recently and shows promise as a potential companion site and/or networking opportunity.

The Honduras site at La Lujosa in Choluteca will continue to be the prime Central American site, with additional activities funded at the El Carao freshwater station in Comayagua. Other Central American countries are being considered as possible companion sites. In South America, the Universidad Nacional de la Amazonia Peruana aquaculture facility at Iquitos has been selected as a new prime site. Bolivia and Ecuador are being considered as possible companion sites. AIT in Bangkok will continue to serve as the prime CRSP site in southeast Asia, with possible linkages to a site in Indo-China. The CRSP will likely also increase involvement in the Philippines, under the terms of a Request for Proposals to be issued in early 1997.

New U.S. institutional collaborators include: Southern Illinois University at Carbondale, University of Arizona, University of Oklahoma, and University of Texas. As noted above new host country institutional collaborators are the National University of the Peruvian Amazon and the Kenya Ministry of Tourism & Wildlife/Department of Fisheries. University of Delaware, University of Pittsburgh, and Michigan State University did not secure funding for projects this year but remain part of the CRSP network and will be eligible to apply for funding in response to Request for Proposals issued in subsequent years.

Development work also took place within the United States. Shree Nath traveled to the Southern United States, stopping at Auburn University, Mississippi State University, the Delta Branch Experimental Station, Mississippi, the University of Arkansas at Pine Bluff, and private farms where catfish, baitfish, and striped bass were raised. He used information gathered to assess the relevance of OSU/DAST activities (particularly the continued development of the POND<sup>®</sup> software) to pond aquaculture in the region. POND<sup>®</sup> was subsequently calibrated and validated for channel catfish, and can be used to assess feed and water requirements for this species. The recently revised fertilization guidelines in the software should also be useful to assess fertilizer needs for baitfish aquaculture.

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*In Honduras, CRSP research has been instrumental in developing efficient farming practices for shrimp farming that will assist in lessening nutrient loads in the Gulf of Fonseca.*

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## Development of Sustainable Aquaculture Systems

**A**quaculture is projected to continue filling an important niche as a food source and cash crop in developing countries. The greatest challenge of aquaculture development is to help create systems that are self-sustaining.

In southern Honduras, CRSP researchers are making progress in developing efficient farming practices for shrimp farmers and in determining the carrying capacity of the Gulf of Fonseca. An understanding of the Gulf's carrying capacity will give development planners information needed to insure the protection of the estuarine environment surrounding the gulf. The impact of the CRSP as a research and education project is evidenced by the increased awareness on the part of Honduran shrimp farmers that the health of the Gulf of Fonseca and its estuaries is essential for their continued economic survival. CRSP's research results have encouraged farmers to secure the long-term health of the Gulf, for example, by showing that they can lower their feed costs while lessening the nutrient load in the estuary. Further research will continue to integrate environmental issues with production concerns.

Water quality concerns are also on the research agenda in Thailand. Studies of deep, rain-fed ponds help farmers determine the most efficient and effective fertilizer regime to boost yields while maintaining water quality. CRSP researchers at all sites demonstrate a concern for the effects of aquacultural production on the environment.

Biotechnology opens alternative avenues for the production of monosex tilapia. Although the Egypt project ended during this reporting period, research begun under that project is being continued in the United States, focusing on the safe use of masculinizing hormones with a special emphasis on minimizing impacts on humans, fish, and the environment.

## Accessibility of CRSP Aquaculture Research Data

The CRSP Central Database is the largest repository of standardized warm water aquaculture data, containing over one million observations of pond variables made at PD/A CRSP field sites around the world. In May 1996 responsibility for maintaining and managing the Central Database was transferred from University of Hawaii to Oregon State University. The Central Database has since been re-organized, and the result is a resource with relational structures and an efficient means for data access and publication.

The database is now managed using Microsoft Access and consists of only one computer file containing multiple data tables. A user and investigator interface to the Central Database is now available on the WWW at: [http://biosys.bre.orst.edu/crspDB/crspDB\\_frame.htm](http://biosys.bre.orst.edu/crspDB/crspDB_frame.htm) with a link to the PD/A CRSP homepage and other aquaculture-related web sites. In addition, users will also be able to access a mirror site (currently under construction) at the Consortium of International Earth Science Information Network (CIESIN).

The OSU/DAST also has plans to coordinate with other research organizations in an effort to establish a network of aquatic related databases and to develop a standardized system for data reporting.

## Participation in Scientific Meetings and Conferences

CRSP researchers contribute to the general aquaculture community through their participation in scientific meetings and conferences in the United States and abroad.

During this reporting period, CRSP researchers participated in the following activities.

**James Diana** served as Chair of the Resource Ecology and Management Program, School of Natural Resources and Environment, University of Michigan.

**Jim Bowman** took part in a West Africa InterCRSP meeting in Niamey, Niger. The subject of the discussion was, "Technology Development and Transfer to Improve Natural Resources" in September 1995, sponsored by the InterCRSP.

In October 1995 **Yang Yi** and **C.K. Lin** attended the Fourth Asian Fisheries Forum in Bangkok, Thailand, presenting a paper entitled, "An integrated cage culture system in earthen ponds: stocking densities of caged Nile tilapia (*Oreochromis niloticus*)." Also in October **Jim Bowman**, **Wayne Seim**, and **Karen Veverica** participated in the Working Group on the Future of ALCOM, FAO, in Harare, Zimbabwe.

**C.K. Lin** led a Environmental Impact Assessment on a shrimp farming project in Tanzania, in November 1995, sponsored by NORAD. **Karen Veverica** took part in the ALCOM Technical Consultation on Extension Methods for Smallholder Aquaculture, in Lilongwe, Malawi, in November 1995, presenting a paper entitled, "Aquaculture extension in Rwanda" (co-authored by Veverica, N. Hishamunda and P. Nyirahabimana).

**James Diana** served as program chair for the Midwest Fish and Wildlife Conference in Detroit, Michigan, in December 1995.

**Claude Boyd** and **C. K. Lin** together chaired the Technical Program Committee of the 1996 World Aquaculture Society meeting in Bangkok, Thailand, in January 1996. Other CRSP participants who served on the Technical Program Committee included: **Peter Edwards**, **Gary Jensen**, **Raul Piedrahita**, **Chinanthorn Sritongsuk**, and **David Teichert-Coddington**.

The following papers were presented at WAS '96 by CRSP Researchers:

- Alimuzaman, C., and C.K. Lin. Aeration effects on erosion and water circulation in round and rectangular ponds.
- Boyd, C.E. Effective use of chemical treatments in shrimp pond management.
- Boyd, C.E. Environmental and sustainability issues in aquaculture in the United States.
- Boyd, C.E. Nature and dynamics of pond soil organic matter.
- Boyd, C.E. Phosphorus adsorption capacity as an index of phosphorous status in soils of aquaculture areas in Thailand.
- Diana, J.S., and C.K. Lin. Supplemental feeding for production of Nile tilapia (*Oreochromis niloticus*).
- Edwards, P. Integrated farming and sustainability.
- Engle, C.R. A multi-stage approach to estimating industry supply of catfish.
- Green, B.W. Chemical and water budgets for fish ponds.
- Green, B.W. Effects of pond management strategy of yield characteristics of Nile (*Oreochromis niloticus*) and blue tilapia (*Oreochromis aureus*).
- Hopkins, K.D. Culture technologies and future prospects for the culture of tilapia in saline water.
- Jensen, G.L. Aquaculture quality assurance efforts in the United States.
- Lin, C.K., and S. Kaewchum. Application of bioremediation in intensive culture of black tiger shrimp (*Penaeus monodon*).
- Lin, C.K. Water quality and nutrient budget in intensive shrimp culture ponds.
- Molnar, J. Institutional and farm-level impacts of aquaculture research: consequences for tilapia culture in Rwanda, Honduras, The Philippines and Thailand.
- Muthuwan V., and C.K. Lin. Water quality and nutrient budget in intensive shrimp culture ponds.
- Piedrahita, R.H. Dissolved oxygen modeling in tropical aquaculture ponds under the Pond Dynamics/ Aquaculture Collaborative Research Support Program.
- Piedrahita, R.H. Water quality modeling for aquaculture water reuse systems.
- Shrestha, M.K., and C.K. Lin. Recycling of absorbed pond mud nutrients as a fertilizer to rooted crops.
- Szyper, J.P. Observation and management of stratification, mixing, and dissolved oxygen in tropical culture ponds.
- Teichert-Coddington, D.R. Management and effluent quality of semi-intensive shrimp farms.
- Veverica, K.L., W.K. Seim, T.J. Popma, and E. Rurangwa. Pond dynamics and tilapia production resulting from in-pond composting.

Poster presentations were made at WAS '96 by these CRSP participants:

- Bolte, J.P., S.S. Nath, P. Darakjian, and J.M. Kapetsky. 1996. Regional-scale analysis of aquaculture development potential.
- Nath, S.S., J.P. Bolte, and D.H. Ernst. 1996. Simulation models and economic optimization techniques for pond aquaculture.
- Newman, J.R., T.J. Popma, and W.K. Seim. 1996. Effects of temperature on maximum feed consumption and growth of juvenile Nile tilapia.
- Phelps, R.P., K.L. Veverica, R.S. Weyers, and J.J. Duffy. 1996. Induced spawning of the red snapper, *Lutjanus campechanus*, using three different hormone treatments.
- Yi, Y., and C.K. Lin. 1996. An integrated cage culture system in earthen ponds: biomass of caged Nile tilapia (*Oreochromis niloticus*).

In February 1996 **Raul Piedrahita** and **Doug Ernst** attended the Annual Meeting of the Technical Committee of the Western Regional Aquaculture Consortium in Sacramento, California. Ernst was an invited lecturer and held a session called, "Computer tools for aquaculture management and design."

**C.K. Lin** took two field trips to Vietnam in 1996 under AITs aquaculture outreach program.

**Martin Fitzpatrick** and **William Gale** attended the Western Regional Conference on Comparative Endocrinology in Berkeley, California, in March 1996. Gale presented a paper entitled, "Binding characteristics of a gonadal androgen receptor in Nile tilapia (*Oreochromis niloticus*)."

In April 1996 **Hillary Egna** took part in an InterCRSP West Africa Natural Resources Management meeting in Washington, D.C.

**C.K. Lin** attended the World Aquaculture Society 1996 mid-year board meeting in Baton Rouge, Louisiana.

**Jim Bowman**, **Pierre-Justin Kouka**, and **Hillary Egna** attended the Natural Resources Management InterCRSP Conference for West Africa, held in Saint Louis, Missouri, in July 1996.

Also in July **Hillary Egna** and **Martin Fitzpatrick** attended the International Congress on the Biology of Fishes, in San Francisco, California. Fitzpatrick presented a paper entitled, "Masculinization of Nile tilapia by short-term immersion in methylidihydrotestosterone."

**Raul Piedrahita** attended a conference entitled, "Successes and Failures in Commercial Recirculating Aquaculture," in Roanoke, Virginia, in July 1996.