

## 4.4 Networking

Developing and maintaining links among collaborating universities and government ministries, departments of agriculture, and private sector aquaculturists around the world forms a significant ancillary contribution to the CRSP's research effort and to the goal of expanding the role of aquaculture in the developing world. This chapter describes linkages and connections made not only by CRSP researchers in the field and reported to the Program Management Office during this reporting period, but also those maintained by the Program Management Office. CRSP participation in scientific meetings and conferences, and contributions to scholarly publishing are also described.

### Field Linkages

#### Honduras Project

The CRSP in Honduras continues its close association with the major aquaculture groups active in the area—ANDAH and EAP (Asociacion Nacional de Acuicultores de Honduras or the National Association of Honduran Aquaculturists and Escuela Agricola Panamericana or Panamerican Agriculture School, respectively). CRSP researchers are also exploring a renewed collaborative relationship with FPX, the Honduran Federation of Agricultural and Agroindustrial Producers and Exporters. In addition, researchers have established connections with people involved in other projects and programs operating in the region, among them the World Wildlife Fund, Programa Ambiental Regional para Centroamerica (PROARCA), the USAID mission, and various government offices with interests in fisheries and the environment.

In an effort to provide greater access to timely and relevant technical material, Honduras Project Principal Investigator Bart Green coordinated the establishment of an aquaculture library at the EAP in Zamorano, Honduras. Faculty from Auburn University's Fisheries and Allied Aquacultures Department donated 66 aquaculture and fisheries books, 78 aquaculture and fisheries periodicals, and several hundred off-prints of scientific papers to the library.

CRSP researchers in Honduras have also been actively engaged in technology transfer, discussing, for example, strategies to improve fingerling production with Honduran CRSP alumni who are now active in private sector aquaculture.

University of Texas researchers have been working on developing electronic linkages with the Center for Export and Investment in Nicaragua regarding tilapia and shrimp collaborative activities and with PRADEPESCA (Regional Program for Fisheries Development Support in the Central American Isthmus), a European Union-funded project on fisheries and aquaculture active in Central America.

Faculty from the University of Arkansas at Pine Bluff who are involved in aquaculture marketing and economic analysis research have discussed a proposed CRSP survey with officials at ANDAH and with the private sector involved in the Honduran shrimp farming industry, including FPX, to engender support for this research effort.

### Peru Project

Peru project researchers met with scientists and administrators of the National University of the Peruvian Amazon and the Institute for the Investigation of the Peruvian Amazon in November 1996 to formally establish the linkage agreements and to make plans for the CRSP project. The Memorandum of Understanding among these two institutions and Southern Illinois University, Carbondale, was executed in November 1996. CRSP researchers in Peru have also been looking into potential formal collaboration with the Aquaculture Centre of the National University of Sao Paulo, Brazil.

### Kenya Project

Oregon State University and Auburn researchers involved in the Kenya project have been active in developing connections with individuals in government, academe, and non-governmental organizations throughout East Africa. The MOU between Oregon State University's Department of Fisheries and Wildlife and the Department of Fisheries under the Kenya Ministry of Tourism and Wildlife was authorized in March 1997.



*Mathias Wafula (left) and current Head-of-Station Bethuel Omolo (second left) discuss ideas for Work Plan proposals with Provincial Fisheries Officers during a CRSP-sponsored workshop held at Sagana Fish Farm in September 1997.*

Other groups with whom Kenya project staff have been in contact include:

- Aquaculture for Local Community Development Programme (ALCOM), Harare, Zimbabwe;
- ALCOM Tanzania;
- Regional Cooperation in Scientific Information Exchange—Western Indian Ocean (RECOSCIX), a program involved in the dissemination and management of information in the marine sciences, serving marine science research units all over East Africa;

- Peace Corps Congo;
- Fisheries Research Institute, Uganda;
- Department of Fisheries and Watershed Management, Institute of Renewable Natural Resources, University of Science and Technology, Ghana; and
- InterCRSP Natural Resources Management Project in Cape Verde, The Gambia, Mali, and Senegal.

Within Kenya, CRSP researchers have met with representatives of the Kenya Marine Fisheries Research Institute (KMFRI) and of the Kenya Fisheries Department. CRSP work plan activities have been shared with these groups, and CRSP researchers have put forward graduate thesis subjects for university students. Possible ways in which KMFRI and the Fisheries Department can collaborate with the CRSP have also been discussed.

Locally, the PD/A CRSP is seen as a source for information and recommendations on semi-intensive aquaculture in the area. Kenya project staff have met with fisheries officers from the Nairobi and Embri districts to discuss fish culture activities and problems in these districts. The CRSP may be able to assist by providing recommendations for ponds in higher elevations, thus borrowing from its work in Rwanda.

Private sector involvement by Kenyan project staff includes contacts with several prospective tilapia farmers in Kenya and Rwanda.

During a visit to the Sagana Station, the University of Arkansas at Pine Bluff researcher involved in the Kenya project met with project staff, University of Nairobi graduate students who may become involved with CRSP activities as part of their graduate studies, and fisheries policy makers.

## **Thailand Project**

University of Michigan researchers involved with the Thailand project have also been active in seeking out connections with representatives of local and regional governments, non-governmental organizations, and private industry.

During the reporting period, researchers met with the Director General of Livestock, Fisheries, and Veterinary Science of Laos People's Democratic Republic to discuss the potential for CRSP collaborative work in that country. A follow-up visit is planned for next year. CRSP researchers also attended a workshop entitled "Establishment of a national aquatic resources management institute" sponsored by the Mekong River Commission. Other participating organizations included the Food and Agriculture Organization of the United Nations (FAO), the International Development Research Center (IDRC), the Japan International Cooperation Agency (JICA), and others.

CRSP researchers also collaborated with staff of an FAO/Belgium project based in Cambodia on a problem related to cage culture and water quality on the Tongle Sap River.

Collaboration with Vietnamese aquaculture counterparts is progressing by means of a CRSP visit to Research Institute for Aquaculture No. 3 in Nhatrang and meetings with provincial fisheries officers in Minhai on the Mekong delta. In addition, the Asian Institute of Technology (AIT) has a collaborative relationship with Research Institute for Aquaculture No. 1 in North Vietnam, whereby two AIT doctoral students have been conducting thesis research on development of tilapia culture in North Vietnam.

Within Thailand, CRSP scientists maintained strong connections with government fisheries stations and fish farmers throughout the country, making visits to stations and farms in Udorn, Sakhon Nakhon, Kalasin, Roi Et, and Khonkhen Provinces. Researchers also assisted a local charity organization in Chiang Rai by providing advice on backyard catfish-tilapia integrated culture.

Contact was also established with the Udorn Development Foundation in Thailand, whose work focuses on integrated upland agriculture and aquaculture.

Auburn University social scientists have been in direct contact with ICLARM, engaging in a publication exchange. Auburn University social scientists assisted ICLARM by commenting on an evaluation strategy and design, and they have also been in contact with researchers at Cantho University in Vietnam.

## **Linkages Reported by Cross-cutting Projects**

**D**ata Analysis and Synthesis Team (DAST) researchers at OSU have worked collaboratively with staff of FAO. The final report of work on a Global Information System (GIS) for assessment of fish farming potential in Latin America has been completed. Continuing collaboration will involve a GIS to assess aquaculture potential in Africa. As of the time of this writing, water temperature projections had been made for the Africa GIS project, and the POND<sup>®</sup> bioenergetic models were in the process of being refined for use in predicting fish performance for pond systems in Africa.

Other collaborative work by DAST members included organizing a visit to OSU by a faculty member of the Department of Fish Culture and Fisheries, Wageningen University, The Netherlands. During that visit OSU CRSP participants attended a seminar on the research activities of the work being conducted in The Netherlands and discussed future areas of collaboration between Wageningen University and the CRSP.

At the University of Davis, California, a doctoral student has been assisted in his work on modeling integrated agriculture and aquaculture systems by a connection with ICLARM in Malawi. The student has used data collected by ICLARM in Malawi on aquaculture and agriculture experiments. The data complements PD/A CRSP data.

Dr. Claude E. Boyd met with representatives of NACA, the Network of Aquaculture Centers in Asia Pacific, in Bangkok to discuss possible collaboration on environmental issues in aquaculture. A similar discussion is also underway with the director of the Ministry of

Fisheries for the Loreto Region, where CRSP activity is taking place. In addition, researchers from the Royal Thai Government Department of Fisheries collaborate with CRSP researchers on work related to soil sampling in Thailand.

During the year C. E. Boyd made use of CRSP data in his service as a private sector consultant to numerous enterprises and organizations involved in shrimp farming in Ecuador, Tanzania, Thailand, Malaysia, Indonesia, and West Australia.

### Program Management Office Linkages

In addition to the linkages developed by researchers, the Program Management Office also maintains ties with numerous other organizations, including some commercial fish producers in the U.S. and in host countries. A partial list of these CRSP linkages follows:

American Association for the Advancement of Science (AAAS)  
American Fisheries Society  
American Tilapia Association, United States  
Association for International Agriculture and Rural Development (AIARD)  
Bean/Cowpea CRSP  
Board for International Food and Agricultural Development (BIFAD) Washington, D.C.  
Cairo University, Egypt  
Catholic University of Leuven (CUL), Belgium, Rwanda  
Consortium for International Earth Science Information Network (CIESIN), Washington, D.C.  
Consultative Group on International Agricultural Research (CGIAR), Washington, D.C.  
CRSP Steering Council  
Department of Fisheries, Udorn Thani, Thailand  
Escuela Agrícola Panamericana (EAP), Honduras  
European Economic Community  
European Inland Fisheries Advisory Commission (EIFAC)  
Food and Agriculture Organization of the United Nations (FAO), Rome, Italy  
Aquaculture for Local Community Development Programme (ALCOM)  
Inland Water Resources and Aquaculture Service  
Institut Pertanian Bogor (IPB), Indonesia  
Integrated Pest Management CRSP  
International Center for Aquaculture (ICA), Auburn University, Alabama  
International Center for Living Aquatic Resources Management (ICLARM), Philippines  
International Development Bank (IDB)  
International Development Research Centre (IDRC) of Canada  
International Sorghum and Millet (INTSORMIL) CRSP  
National Agricultural Library, Washington, D.C.  
National Inland Fisheries Institute (NIFI), Thailand  
National Technical Information Services, (NTIS) Springfield, Virginia  
Network of Aquaculture Centers in Asia Pacific (NACA)  
North Central Regional Aquaculture Center (NCRAC), Michigan  
Peanut CRSP

Post Harvest CASP  
Small Ruminant CRSP  
Soil Management CRSP, Honduras  
South East Asian Fisheries Development (SEAFDEC), Philippines  
Southern African Development Community (SADC)  
Special Program for African Agricultural Research (SPAAR), Washington, D.C.  
Sustainable Agriculture and Natural Resources Management (SANREM) CRSP  
The University of the Philippines in the Visayas  
United States Department of Agriculture (USDA), Washington, D.C.  
United States Fish and Wildlife Service, Washington, D.C.  
University of Washington, Seattle, Washington  
Western Regional Aquaculture Consortium (WRAC), Seattle, Washington  
World Aquaculture Society (WAS), Baton Rouge, Louisiana

## Participation in Scientific Meetings and Conferences

**C**RSP 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.

Kwei Lin attended annual meeting of Network of Aquaculture Centers in Asia-Pacific (NACA) in Bangkok, Thailand. Participants included 12 representatives from member countries and international organizations. He also took part in a workshop on “Danish-Southeast Asian collaboration in tropical coastal ecosystems research and training” in Bangkok, sponsored by the Danish Cooperation for Environment and Development (DANCED), a technical cooperation program between the Government of Malaysia and the Government of the Kingdom of Denmark.

In September 1996 Claude Boyd presented “Recent advances in aeration technology” at the INFOFISH conference held in Kuala Lumpur, Malaysia.

Jim Diana delivered a presentation on “Consequences of cage culture in reservoirs—case study of Cirata Reservoir, Indonesia” in Vientiane, Laos, at a Mekong River Commission workshop in March 1997.

At the National Aquaculture Extension Conference held 9-10 April 1997 in Annapolis, Maryland, Shree Nath conducted a demonstration of the POND<sup>®</sup> and AquaFarm software developed by John Bolte, Doug Ernst and Nath at the Department of Bioresource Engineering, Oregon State University. He also presented “Planning, design, and management tools for aquaculture” at the conference poster presentation.

In April 1997 Claude Boyd spoke before the Global Aquaculture Alliance in Tegucigalpa, Honduras on “Examples of best management practices (BMPs) for shrimp farming.”

Bart Green was a member of the Organizing Committee of the IV Central American Symposium on Aquaculture that took place in Tegucigalpa, 22-24 April. The meeting was co-sponsored by the ANDAH (National Association of Honduran Aquaculture) and the Latin American chapter of World Aquaculture Society. Green worked closely with ANDAH personnel and members of the Organizing Committee. Green served as a co-editor for the Symposium Proceedings. In addition to Green, David Teichert-Coddington and Claude Boyd attended the symposium and were presenters.



*Thailand project Co-Principal Investigators Jim Diana and Kwei Lin.*

In June 1997 C.K. Lin led a seminar for Thai fisheries officers on “Trends of future development and water uses in freshwater aquaculture in Thailand” at the invitation of the Royal Thai Department of Fisheries.

Lin also spoke in July at an IFREMER meeting about coastal environmental management for sustainable aquaculture in Jakarta, Indonesia, on sludge production and management for intensive shrimp culture ponds. While in Jakarta, Lin spoke on opportunities and challenges for aquaculture in the ASEAN region before members of the International Agribusiness Management Association.

The following papers were presented at the 1997 Annual Meeting of the World Aquaculture Society in Seattle, Washington, by CRSP researchers:

Bolte, J. and S. Nath. POND<sup>®</sup>: A decision tool for warmwater aquaculture.

Boyd, C.E. Environmental issues in aquaculture.

Boyd, C.E. Water quality in laboratory soil-water microcosms with soils from different areas of Thailand.

- Ernst, D.H., J.P. Bolte, and S.S. Nath. Application of decision support software for aquaculture facility design.
- Fitzpatrick, M.S., W.L. Gale, W. Contreras, and C.B. Schreck. Masculinization of Nile tilapia (*Oreochromis niloticus*) by short-term immersion in methyl dihydrotestosterone.
- Green, B.W., D.R. Teichert-Coddington, G.H. Ward, and C.E. Boyd. Collaborative research to support sustainable shrimp culture in Honduras: A model program.
- Jamu, D.M. and R.H. Piedrahita. A nitrogen and organic matter cycling model for an integrated aquaculture-crop system.
- Kapetsky, J.M., S. Nath, and J.P. Bolte. A fish farming GIS for Latin America
- Lu, Z. and R.H. Piedrahita. Modeling of temperature and dissolved oxygen in stratified aquaculture ponds using stochastic weather variables.
- Molnar, J., T. Hanson, and L. Lovshin. Doing science, growing fish, teaching people: Human capital impacts of the pond dynamics aquaculture CRSP.
- Nath, S., J.P. Bolte, and D.H. Ernst. A fish bioenergetics model for pond aquaculture
- Yi, Y. and C.K. Lin. An integrated rotation culture system for fattening large Nile tilapia in cages and nursing small Nile tilapia in open ponds.

Shree Nath and Doug Ernst, Department of Bioresource Engineering, Oregon State University have done preparatory work for their session entitled, "Computer Tools for Siting, Designing and Managing Aquaculture Facilities," at the 1998 WAS meeting in Las Vegas, Nevada. The session will be co-sponsored by the Bioengineering Section of the American Fisheries Society and the Aquacultural Engineering Society. The session will feature 15 and 30 minute presentations from invited speakers and will cover regional- and facility-scale tools developed for aquaculture. A special issue of the Aquacultural Engineering journal will also be devoted to the topic.

## CRSP Contribution to Scholarly Publishing

CRSP researchers are significant contributors to scholarly literature in the fields of aquaculture and sustainable development. The following represents the published work of CRSP participants during the reporting period.

- Boyd, C.E. and J.R. Bowman, 1997. Pond bottom soils. In: H.S. Egna and C.E. Boyd (Editors), Dynamics of Pond Aquaculture. CRC Press LLC, Boca Raton, pp. 135-162.
- Boyd, C.E. and P. Munsiri, 1997. Water quality in laboratory soil-water microcosms with soils from different areas of Thailand. *Journal of the World Aquaculture Society*, 28(2):165-170.
- Contreras-Sánchez, W.M., M.S. Fitzpatrick, R.H. Milston, and C.B. Schreck, 1997. Masculinization of Nile Tilapia (*Oreochromis niloticus*) by single immersion in 17 $\alpha$ -methyl dihydrotestosterone and trenbolone acetate. Fourth International Symposium on Tilapia in Aquaculture. (Accepted.)
- Diana, J.S., 1997. Feeding strategies. In: H. Egna and C. Boyd (Editors), Dynamics of Pond Aquaculture. CRC Press LLC, Boca Raton, pp. 245-262.
- Diana, J.S., C.K. Lin, and Y. Yi, 1996. Timing of supplemental feeding for tilapia production. *Journal of the World Aquaculture Society*, 27:410-419.



- Egna, H.S., 1997. History of the Pond Dynamics/ Aquaculture Collaborative Research Support Program. In: H.S. Egna and C.E. Boyd (Editors), Dynamics of Pond Aquaculture. CRC Press LLC, Boca Raton, pp. 19-52.
- Egna, H.S., C.E. Boyd, and D.A. Burke. 1997. Introduction. In: H.S. Egna and C.E. Boyd (Editors), Dynamics of Pond Aquaculture. CRC Press LLC, Boca Raton, pp. 1-18.
- Engle, C.R., 1997. Optimal resource allocation by fish farmers in Rwanda. *Journal of Applied Aquaculture*, 7(1):1-17.
- Engle, C.R., R. Balakrishnan, T.R. Hanson, and J.J. Molnar, 1997. Economic considerations. In: H.S. Egna and C.E. Boyd (Editors), Dynamics of Pond Aquaculture. CRC Press LLC, Boca Raton, pp. 377-396.
- Green, B.W., 1997. Inclusion of tilapia as a diversification strategy for penaeid shrimp culture. In: D.E. Alston, B. W. Green, and H. C. Clifford (Editors), Asociación Nacional de Acuacultores de Honduras and the Latin American Chapter of the World Aquaculture Society. IV Symposium on aquaculture in Central America: focusing on shrimp and tilapia, 22-24 April 1997, at Tegucigalpa, Honduras, pp. 84-93.
- Green, B.W., K.L. Veverica, and M.S. Fitzpatrick, 1997. Fry and fingerling production. In: H.S. Egna and C.E. Boyd (Editors), Dynamics of Pond Aquaculture. CRC Press LLC, Boca Raton, pp. 215-244.
- Kapetsky, J.M. and Nath, S.S., 1997. A strategic assessment of the potential for freshwater fish farming in Latin America. FAO COPESCAL Technical Paper, No. 10, FAO, Rome. In press.
- Kelly, A.M. and C.C. Kohler, 1997. Climate, site, and pond design. In: H.S. Egna and C.E. Boyd (Editors), Dynamics of Pond Aquaculture. CRC Press LLC, Boca Raton, pp. 109-134.
- Lin, C.K., D. Teichert-Coddington, B. Green, and K. Veverica, 1997. Fertilization regimes. In: H.S. Egna and C.E. Boyd (Editors), Dynamics of Pond Aquaculture. CRC Press LLC, Boca Raton, pp. 73-108.
- Molnar, J., T. Hanson, and L. Lovshin, 1996. Impacts of the Pond Dynamics/ Aquaculture Collaborative Support Research Program as a development intervention. *NAGA: The ICLARM Quarterly*, 19(2):31-40.
- Munsiri, P., C.E. Boyd, B.W. Green, and B.F. Hajek, 1996. Chemical and physical characteristics of bottom soil profiles in ponds on Haplaquents in an arid climate at Abbassa, Egypt. *Journal of Aquaculture in the Tropics*, 11:319-326.
- Nath, S.S., 1996. Development of a decision support system for pond aquaculture. Ph.D. Dissertation, Corvallis, Oregon: Oregon State University, 273 pp.
- Piedrahita, R.H., S.S. Nath, J. Bolte, S.D. Culberson, P. Giovannini, and D.H. Ernst, 1997. Computer applications in pond aquaculture - modeling and decision support systems. In: H.S. Egna and C.E. Boyd (Editors), Dynamics of Pond Aquaculture. CRC Press LLC, Boca Raton, pp. 289-324.
- Seim, W.K., C.E. Boyd, and J.S. Diana, 1997. Environmental considerations. In: H.S. Egna and C.E. Boyd (Editors), Dynamics of Pond Aquaculture. CRC Press LLC, Boca Raton, pp. 163-182.
- Shrestha, M. and C.K. Lin, 1996. Determination of phosphorus saturation level in relation to clay content in pond mud. *Journal of Aquaculture Engineering*, 15:441-459.
- Shrestha, M. and C.K. Lin, 1996. Phosphorus fertilization strategy in fish ponds based on sediment phosphorus saturation level. *Aquaculture*, 142:207-219.

- Teichert-Coddington, D.R., D. Martinez, and C.E. Boyd, 1997. Solubility of selected inorganic fertilizers in brackish water. *Journal of the World Aquaculture Society*, 28(2):205-210.
- Teichert-Coddington, D.R., D. Martinez, E. Ramirez, J. Harvin, W. Toyofuku, R. Zelaya, and B.W. Green, 1997. Semi-intensive shrimp pond management and quality of effluents. In: D.E. Alston, B. W. Green, and H. C. Clifford (Editors), *Asociación Nacional de Acuacultores de Honduras and the Latin American Chapter of the World Aquaculture Society. IV Symposium on aquaculture in Central America: focusing on shrimp and tilapia*, 22-24 April 1997, at Tegucigalpa, Honduras, pp. 203-204.
- Teichert-Coddington, D.R., T.J. Popma, and L.L. Lovshin, 1997. Attributes of tropical pond-cultured fish. In: H.S. Egna and C.E. Boyd (Editors), *Dynamics of Pond Aquaculture*. CRC Press LLC, Boca Raton, pp. 183-198.
- Veverica, K., 1997. The Pond Dynamics/Aquaculture CRSP-Sponsored. Proceedings of the Third Conference on the Culture of Tilapias at High Elevations in Africa, Research and Development Series 41. International Center for Aquaculture and Aquatic Environments. Alabama Agricultural Experiment Station, Auburn University, Alabama, 26 pp.
- Veverica, K.L. and J.J. Molnar, 1997. Developing and extending aquaculture technology for producers. In: H.S. Egna and C.E. Boyd (Editors), *Dynamics of Pond Aquaculture*. CRC Press LLC, Boca Raton, pp. 397-414.
- Ward, G.H., 1996. A strategic approach to carrying-capacity analysis for aquaculture on estuaries. In: United States/Japan Natural Resource Panel on Aquaculture, United States-Japan Cooperative Program in Natural Resources. Sea Grant, Texas A&M University, 24:71-84.
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