

# A Global Experiment on Tilapia Aquaculture: Impacts of the Pond Dynamics/Aquaculture CRSP in Rwanda, Honduras, the Philippines and Thailand

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Fish harvest at the Rwasave Research Station operated by the University of Rwanda-Butare. About 20-km distance is the Ministry of Agriculture's National Fish Culture Demonstration Center at Kigembe. Rwasave was seriously damaged during the recent period of unrest.



PHOTOS BY J.J. MOLNAR

*The Pond Dynamics/Aquaculture Collaborative Research Support Program (PDA/CRSP) is a global research network organized to generate basic science that may be used to advance aquaculture development. One of a family of research programs funded by the United States Agency for International Development (USAID), the CRSP focuses on improving the efficiency of aquaculture systems.*

*The PDA/CRSP began work in 1982 in Thailand, and subsequently in the Philippines, Honduras, Rwanda, Indonesia and Panama. Research continues today in Thailand, the Philippines, Honduras, the US and, until recently, Rwanda. At all the sites, the goal is the same: to identify constraints to aquaculture production, and to design responses that are environmentally and culturally appropriate.*

The PDA/CRSP has conducted a global experiment for over ten years. Researchers have conducted a series of standardized research trials at each site, establishing baseline data on physical chemical, and biological processes as they relate to fish growth. The research network has focused on tilapia (*Oreochromis niloticus*), although some sites have devoted attention to marine shrimp and other locally significant species. Here, we examine the impact of the network's investigations with tilapia.

The focus of the effort has been on fertilization and feeding practices. In addition, a highly diverse set of investigations specified the relative effects of various organic inputs, inorganic fertilizers, feeding strategies, species combinations, water parameters and other variables on fish production. Because the main impacts of the PDA/CRSP are telegraphed to producers through national institutions, it is reasonable to connect its presence to the general level of pond-based aquaculture practice.

Cross-national comparative data were obtained from fish farmers in four countries. A common interview guide and data matrix provided an initial framework for contrasting and understanding the practice of tilapia culture. The data were intended to complement experimental and biological information about how tilapia are grown and used. The findings show how farmers feed their fish, whom they sell them to, and what kinds of problems they are experiencing. Most farmers use a diverse assortment and combination of vegetative inputs, manures and livestock feeds. Concentration on one input with supplementation from one of the other categories is the norm. Farmers seem to organize their tilapia enterprise around an existing resource or underutilized input. The tilapia enterprise is most often valued as a complement to an existing farm activity (such as poultry), especially among small- and medium-scale operators.

## Factors Affecting the Impact of the Program

Tilapia growers in each of the countries face vastly different institutional systems supporting tilapia production. The impacts of the PDA/CRSP are muffled by the inherent characteristics of the research process, the nature of institutional functioning in developing countries, and the dynamism of the information environment for aquaculture technologies. The communication process linking experimental pond to farm practice involves several layers of translation and transmission.



The Comayagua research station, known as El Carao, north of Tegucigalpa, Honduras. Long-term PDA/CRSP research on tilapia was conducted at this site.

Experimental findings reflect controlled conditions and careful measurement of a focused set of factors. Farm conditions reflect variable physical and management situations that often mitigate the impact of effects identified by repeated experimental trial. Experimental findings must be accumulated from many studies and modified in certain ways to generate a robust field recommendation. In essence, an internal process of recognition and acceptance must take place within national research and extension systems before the findings become farm-level practice; typically, the greater

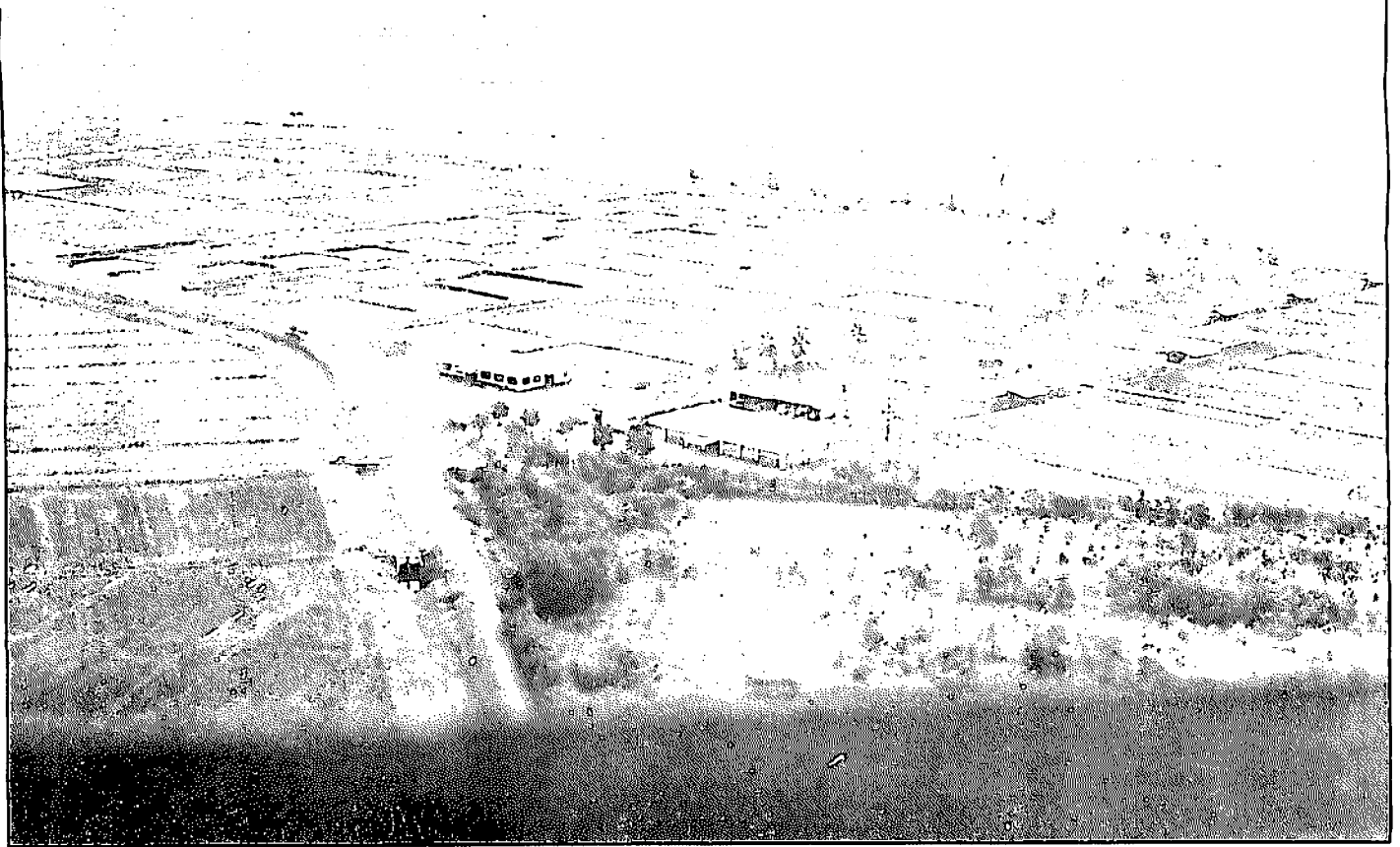
the deviation from conventional understanding, the slower the process of internal diffusion. Other factors also intervene.

In Thailand an extensive and well-trained network of Department of Fisheries research stations and extension offices is augmented by a broad set of colleges and universities that provide baccalaureate and postgraduate training in aquaculture. An aggressive private sector supports a widespread network of producer services in Thailand.

Large feed companies also promote tilapia culture in the Philippines, though an extensive private sector fingerling supply has yet to de-

velop there. Nor is the network of producer services as well developed as in Thailand. The Philippines has several university programs in aquaculture, but not the extensive network of research and extension offices found in Thailand. Central government support for most kinds of extension work has been withdrawn.

Honduras faces fundamental difficulties with an underdeveloped marketing system and an uneven set of consumer preferences for tilapia. The public sector in Honduras is under great financial stress and is widely lacking in public confidence over its ability to deliver



*The Freshwater Aquaculture Center at Central Luzon State University in Muñoz, Nueva Ecija, Philippines. Adjacent to a government research station and university departments, these facilities are also home to British ODA and ICLARM tilapia research projects.*

services and provide assistance in an effective and reliable manner. Coupled with inadequate operating funds, the agencies serving aquaculture have high levels of turnover in extension and research leadership and technical support staff. These conditions limit the support that can be given to farmers.

In Rwanda, ethnic conflicts have swept aside much of the progress made in aquaculture over the last two decades. Assuming peace and public confidence can be restored in the short term, the need and potential for aquaculture success is clearly present. No private corporate actors are organizing infrastructure or producer services in Rwanda. The University of Rwanda has facilities and programs to provide trained aquaculture graduates. The government's limited ability to make a financial commitment to aquaculture makes the likelihood of any broad initiative for extension to be low. In contrast, farmer interest and enthusiasm for aquaculture is high.

Farmers were asked about the main things preventing larger harvests. Honduran farmers noted "my understanding" as the major obstacle to obtaining larger harvests from their ponds. Water quality was the biggest issue in Thailand and the Philippines, an issue referred to simply as "the pond" in Rwanda. Manure

and compost availability was the obstacle most frequently cited in Rwanda. These findings underscore the significant contribution of PDA/CRSP research activities toward the demystification of the pond as a growth environment for fish. Productivity advances for the majority of family farm operators will stem from basic understandings of the pond system that will diminish the risk of crop loss and enhance yields from a given set of resources. Many of the basic parameters of fish culture have been established in useable form; the translation and dissemination of these principles remains a daunting task.

### **Program Relationships to Government and Industry**

Aquaculture succeeded in Rwanda because its diffusion was properly supported during an extended period of peace in the countryside. The technology was appropriate to the setting and it met critical needs for cash income, nutrition, food security and enterprise diversity. Producers found ready markets for their fish among their friends and neighbors, as well as in organized markets in towns and urban centers. The PDA/CRSP provided sound sci-

ence and organizational guidance to an extension network that provided an extended period of support to individuals and groups beginning the practice of fish culture. The ethnic unrest that troubles Rwanda and much of Africa in the 1990s presents fundamental obstacles to aquaculture development.

In Honduras, the PDA/CRSP effort was well positioned to contribute to the development of national institutions, but the location was some distance from the North Coast areas where a large-scale tilapia industry is established. A solid science program and a wide network of interpersonal and interorganizational contacts multiplied the impact of the research program. High personnel turnover and weak institutions dampen the impact of PDA/CRSP technology on the farm level, though the success of program training alumni keeps the promise of fish culture alive among farmers.

The Philippine effort contributed to baseline research on tilapia production issues, but the impacts in this country are largely overshadowed by the efforts of ICLARM and the British Overseas Development Agency (ODA) that have had a sustained presence of personnel in the country and much larger budgets for conducting research. Certain

domestic agencies have been active proponents of tilapia technology. Program efforts have been multiplied, however, due to the extensive network of US-trained personnel and their interest in the PDA/CRSP. The Project ties to large-scale tilapia producers are limited in the Philippines, but the effort has been a beneficial influence on the national research program conducted by the public sector in the main production areas in the country.

The Thailand effort was best positioned to conduct high-quality, world class research. The Asian Institute of Technology provided a supportive environment for the conduct of experiments and data analysis. The presence of other dynamic aquaculture researchers and a small, but highly productive cadre of aquaculture social scientists augmented the impact of the PDA/CRSP by providing ties to other projects in other parts of the country. The Thailand Department of Fisheries has been an enthusiastic collaborator. Other projects provided baseline social data about tilapia producers and access to technology transfer mechanisms otherwise unavailable to the effort. The extensive network of industry contacts maintained by PDA/CRSP researchers also multiplied the influence of their research efforts on the burgeoning Thai aquaculture industry.

## Technology Transfer

The PDA/CRSP has done extensive work in each nation detailing optimum paths to tilapia production using the predator species, growing conditions, and input materials found in each setting. The technology transfer process is at core a series of communication steps that relay new findings and perspectives to technical representatives in government research and extension systems, as well as to hatchery managers and others in commercial sector roles that feature regular contact with tilapia growers.

The findings of the PDA/CRSP are mainly channeled through interpersonal processes. PDA/CRSP scientists interact with station personnel, sharing insights and perspective on the technology of aquaculture. These influences are then retransmitted to farmers and others who have contacts with station personnel, particularly if the station personnel have training or leadership roles. Through interpersonal contacts, PDA/CRSP

scientists impart a holistic understanding of pond dynamics and fish behavior that is difficult to obtain solely through the printed word or other formal means.

PDA/CRSP scientists have had direct impacts on farm practice through the various

communications. Journal articles and meeting presentations convey research results to the scientific community. Reprints may circulate among some institutional participants in the host country, but rarely do they reach the farm level. Findings of this sort require two sorts of trans-



*Alphonse Rubaguma, sociologist at the University of Rwanda-Butare, interviews a fish farmer for the study. Women comprised a significant number of fish farmers, primarily operating ponds in cooperative groups.*

training sessions that research stations have sponsored over the years. The production recipes conveyed directly to farmers in these programs often have had dramatic impact in the operations of receptive individuals with the ingenuity and motivation to realize the promise of the enterprise. The effect of personal relationships between farmers and PDA/CRSP scientists should not be underestimated. In turn these individuals influence their neighbors by example and interaction over the proper practice of fish culture.

Another communication channel for PDA/CRSP findings is through written publi-

formation on two levels: accumulation and reconstitution to become user-robust recommendations; and translation to the spoken language of the user.

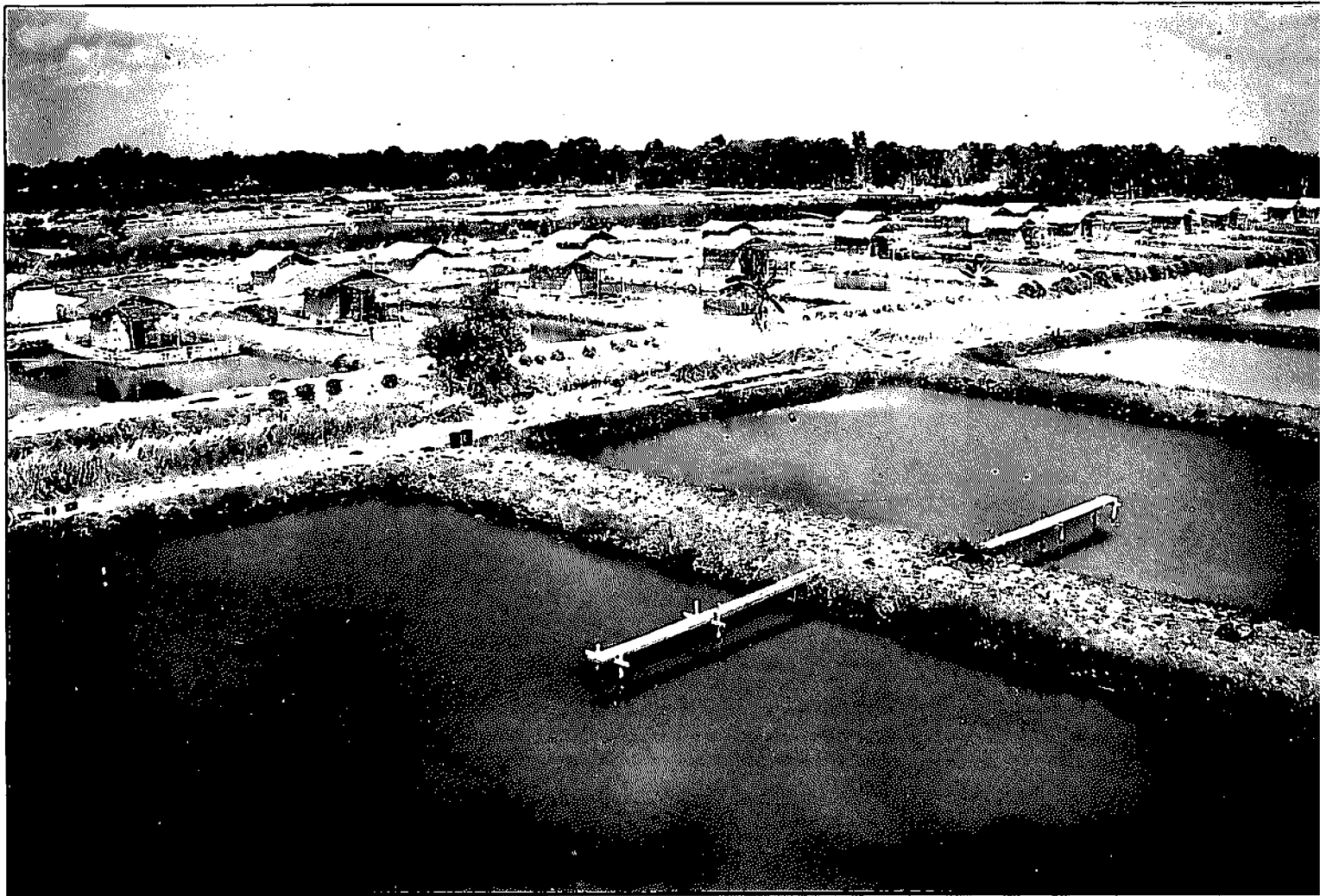
Applied research reports translated into the local language are not extensively found in the Program corpus. Most research reports have been issued solely in English, most often without national language executive summaries or abstracts. These translated preambles are important for non-native English speakers because the translation provides context and meaning for the more detailed findings presented in the document it precedes.

Video cassette recorders are becoming a pervasive part of life in each Program country. Unlike some international projects, the PDA/CRSP has yet to develop video presentations of its findings and research program that could be used in presentations to technical staff and progressive farmers in each of the countries. These videos could be prepared in English with separate voice and music tracks for ready re-recording of narrative into local languages and possible use in other countries.

extensive direct participation in staff or farmer training. However, these are the fundamental mechanisms for extending PDA/CRSP results to the farm level and realizing the socioeconomic benefits of fish culture to individuals, families, rural communities and the national economy.

Where Program activities have the opportunity to influence host-country governmental assistance to aquaculture, efforts should emphasize infrastructure development. Poorly

In all four countries, the purchase of fingerlings is a significant nexus of contact with producers. When government stations are the main source of seed stock for fish farmers, fingerling sales approximate field days or organized events that offer opportunities to communicate with assembled groups of fish farmers. In Thailand, however, the private sector infrastructure for fingerling production has matured to the point that many dispersed fingerling suppliers have regular contacts with local sets of farmers.



*Pond facilities at the Asian Institute of Technology at Ayutthaya, in the northern suburbs of Bangkok. Nearby are Kasetsart University, the Thai Department of Fisheries Headquarters, and one of its provincial research stations making this location a central place for aquaculture in Thailand and Southeast Asia.*

The primary effects of the Program experimental program have been on national systems through interaction with national scientists, program managers, and extension personnel. It is understandable that one or two scientists responsible for an annual work plan and experimental program have little time or resources to expend on applied publications or

organized fish product markets and input distribution systems often hinder aquaculture development. As markets for tilapia expand, demand for producer services also will expand. Development of private sector marketing services for both production inputs and fish outputs are needed for sustained aquaculture development.

The fingerling suppliers themselves then become an important target group for extension because of their regular, direct interactions with farmers. Private hatchery managers often provide informal advisory and diagnostic services to their customers, if only to maintain the reputation of their seed stock against competing sources.

Finally, aquaculture development will be more sustainable if fish production technologies having low economic risks to the farmer are developed. Baseline experimental and on-farm production data need to be analyzed for risk levels and strategies developed to lower such risks. Economic analysis can help researchers fine-tune technologies to improve the likelihood of farmer acceptance and long-term sustainability.

## Reprise: Technology Transfer and the PDA/CRSP

One common pattern across the four PDA/CRSP sites considered here is the upstream nature of its contribution to aquaculture development. Although farmer trials have been conducted at one time or another in each site, these efforts largely have been singular or specialized events and not part of a systematic program.

Farmers rely heavily on word-of-mouth and a melange of information sources and experiences most of which have little connection to the PDA/CRSP. Most of the farm-level impact of the effort's activities is second order; that is, research information is absorbed, integrated with other messages, and retransmitted by private firms and national institutions. The messages are received by innovator farmers, private managers, hatchery personnel, trainers,

consultants, and others who will use the information to make decisions about growing fish. The messages also affect what these individuals tell others who want to or already are raising tilapia.

The most immediate impacts of PDA/CRSP activities are manifested primarily in the training experiences of degree candidates at institutions of higher learning such as the Asian Institute of Technology, University of Rwanda, Zamorano University, or Central Luzon State University. Program personnel serve as thesis advisors or consultants for faculty and students conducting aquaculture research or have other ties with these institutions. The insights, paradigms, organizing frameworks, and scientific techniques communicated during these activities represent a major technology transfer impact of the Program.

In each country, PDA/CRSP researchers have direct contacts with extension or outreach staff working in fish culture. The collegial relationships, information exchanges, mutual assistance, and other forms of reciprocal influence also are a means for furthering the influence of Program research. Often diffuse and subtle, but occasionally direct and focused, its experimental program and research findings contribute to the information milieu shaping to development of each nation's aquaculture industry.

The many institutional actors working in aquaculture perhaps should be considered the

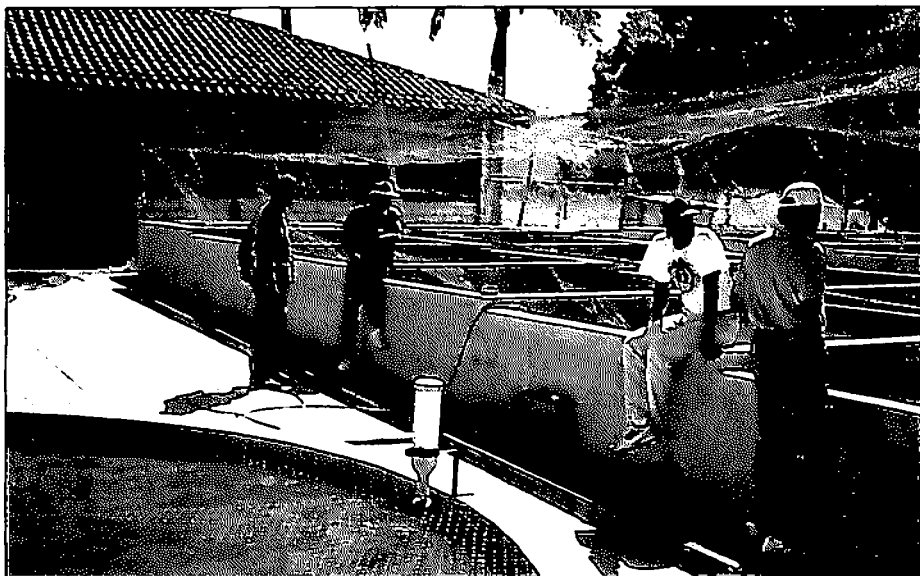
primary audience for a global research project such as our Program. Although some level of direct farmer contact and training is necessary for keeping scientists in touch with the direct experiences and problems of fish farmers, the impacts and influence of the effort may be greater if institutions and industry are understood to be the primary consumers of its outcomes.

Thus, seminars for nongovernmental organizations (NGOs) that maintain extensive and long-term relationships with villages and small-scale farmers may be a more important mechanism for reaching this constituency than direct intervention. As long as small- and medium-scale farmers remain a central target segment for such research impact, the development of a continuing network of contacts with representatives of these groups will be a significant objective for the present PDA/CRSP.

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*The Pan-American Agricultural School, known as El Zamorano, is an important source of fingerlings and technical assistance in central Honduras. Private institutions play an important role in technology transfer through the services and aquaculture training they provide.*