# SECOND ANNUAL REPORT

*1 October 2007 to 30 September 2008*

**AQUAFISH COLLABORATIVE RESEARCH SUPPORT PROGRAM**
**MANAGEMENT ENTITY, OREGON STATE UNIVERSITY**

USAID FROM THE AMERICAN PEOPLE

Oregon State UNIVERSITY OSU

AQUAFISH COLLABORATIVE RESEARCH SUPPORT PROGRAM

# AQUAFISH CRSP SECOND ANNUAL REPORT

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**Cover Photo**
Small-sized fish (<25 cm) representing 19 species caught by a stationary trawl net (bagnet; "Dai" in the Khmer language) in the Tonle Sap River, Cambodia. Photo by So Nam (IFReDI), Host Country Principal Investigator for the AquaFish CRSP project with the University of Connecticut–Avery Point. For a species listing, see *Core Research Project Reports,* page 43.

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# I. INTRODUCTION

The mission of the Aquaculture & Fisheries Collaborative Research Support Program – AquaFish CRSP – is to enrich livelihoods and promote health by cultivating international mutidisciplinary partnerships that advance science, research, education, and outreach in aquatic resources. USAID looks at the AquaFish CRSP to "develop more comprehensive, sustainable, ecological and socially compatible, and economically viable aquaculture systems and innovative fisheries management systems in developing countries that contribute to poverty alleviation and food security."

This report describes the activities and accomplishments of the AquaFish CRSP from 1 October 2007 to 30 September 2008. The United States Agency for International Development (USAID) funds the AquaFish CRSP under authority of the Foreign Assistance Act of 1961 (PL 87-195), as amended. Significant funding is also provided by the participating US and Host Country institutions. The AquaFish CRSP is a partner of USAID's Economic Growth, Agriculture, and Trade (EGAT) Bureau's Office of Agriculture.

AquaFish CRSP 's cohesive program of research is carried out in selected developing countries and the United States by teams of US and Host Country researchers, faculty, and students. Now operating under its first USAID award, which was received on 29 September 2006, the CRSP is guided by the concepts and direction set down in the *Program Description*, which is funded under USAID Grant No. EPP-A-00-06-00012-00. This award authorizes program activities from 29 September 2006 to 30 September 2011.

The activities of this multinational, multi-institutional, and multidisciplinary program are administered by Oregon State University (OSU), which functions as the Management Entity (ME) and has technical, programmatic, and fiscal responsibility for the performance of grant provisions. ME technical and programmatic activities at OSU are carried out by a Management Team (Director and staff), which is supported in the task of program administration by advisory bodies. Management team personnel and advisory group membership during the reporting period appear in Appendix 1.

The AquaFish CRSP diverges from the previous Aquaculture CRSP in both organization and theme. Organizationally, this new CRSP is a Cooperative Agreement, with a Leader with Associates (LWA) term of reference. The LWA is a mechanism for allowing additional USAID funding to complement core activities. Core activities are funded by EGAT's Office of Agriculture at $8.9 million over five years. Associate Award activities under the Lead are estimated at an additional $3 million, although there is no obligation by USAID to fund these Associate Awards. Thematically, the new AquaFish CRSP focuses on aquaculture with its core funds, and on both aquaculture and fisheries with its Associate Awards. The themes echo much of the sustainable aquaculture emphasis of the Aquaculture CRSP, since that earlier CRSP incorporated a farsighted and mindful approach.

The AquaFish CRSP Management Team produced a number of publications and sponsored a number of conferences during this reporting year. Publications and reports included: *Implementation Plan 2007-2009*; *AquaFish CRSP Site Descriptions*; *Monitoring and Evaluation Plan* (final draft in September 2008); Brochure; Program Poster; USAID impacts matrices; Request for Proposals 2009-2011 and RFP website (draft text completed by September 2008); and CRSP Council reports. *AquaNews* and *EdOPNet* were continued under the concurrent ACRSP (which ended 30 September 2008) and covered items of interest to both CRSPs. Under AquaFish CRSP,

layout, design, and production of reports is unfunded in the Management budget; thus, program participants are asked to share in the burden. AquaFish CRSP is able to leverage existing talent and resources to produce some publications on-line, but editing, design and layout will, by necessity, be less formal than in ACRSP. This can be seen in the present publication where reports are printed as submitted.

Meetings sponsored and/or organized by management included: CRSP Council Meeting in Washington DC July 2008; CRSP Annual Meeting in Korea May 2008; CRSP Session at the World Aquaculture Society conference in Korea May 2008; IIFET Vietnam July 2008; ISTA Egypt October 2008 (planning occurred in this reporting period); PondSchool Oregon September 2008; and the Tilapia and Cichlid Session at the EEEF (Ecological and Evolutionary Ethology of Fishes) conference in Boston June 2008. Both CRSPs sponsored workshops and conferences – attribution to one or the other CRSP is difficult, and it is safe to say both CRSPs deserve credit. For the most part, ACRSP provided funding and direction for these conferences, and AquaFish CRSP provided some staff and researcher time, plus continuity. Many other workshops and conferences were organized and taught by CRSP researchers and are included in the project reports section of this Annual Report.

AquaFish CRSP researchers had a fruitful year, creating podcasts, writing abstracts for scientific conferences, teaching and presenting in-process results at meetings. Most of these outputs are available of the CRSP website. The AquaFish CRSP website architecture was developed and the website was populated during this reporting year. After several false starts, real progress was made towards the end of the year with a quiet launch in September. The official launch occurred in November 2008, along with the RFP release. The cost of creating and maintaining a new website exceeded the minimal budgeted amount, and reallocations or additional funding will be necessary for this important function. The goal is to eventually have a fully on-line system for management information.

The Host Country Principal Investigator Exchange Project in tilapia and native cichlid technology was completed during this reporting year, with many notable results (see the program-wide activities section of this report). Another HCPI exchange was originally planned for air-breathing fishes, but due to the challenges imposed by USAID of locating a project in Bangladesh, activities were postponed indefinitely. Management will be seeking reallocation of those funds for evaluation and networking activities. In the present budget, there are no funds programmed for evaluative advisory bodies such as the EPAC (External Program Advisory Council) and other central functions.

A new Synthesis Project was discussed and initiated during this reporting year. Implementation will begin in January 2008, in time to survey and network with CRSP researchers at the Annual Meeting in Seattle, Washington in February 2009. The proposed Synthesis research project is presented in this report, along with other synthesis activities conducted by the two internal technical advisory groups: Development Themes Advisory Panel (DTAP) and Regional Centers of Excellence (RCE).

AquaFish CRSP can boast about fully funding in advance each of the six core research projects described in the *Implementation Plan 2007-2009*. Not in recent memory, which extends back 25 years under the former ACRSP, has this happened. The ME has been obligated 76.6% of the awarded funding 60% into the program's timeline. To this end, USAID/EGAT deserves credit, as does the CRSP Council and NASULGC. The typical scenario for the CRSPs in general has been that late or reduced funding from USAID causes delays in project work, and the resulting uncertainty begets tentative performance and slowed spending.

The ME hopes that USAID will not only continue to forward-fund with the FY09 obligation but enhance the program budget. The annual budget of approximately $1.78 million is less than the old ACRSP received on average over 10 years of its funded life ($2.15 million). Accountability

standards have driven up reporting effort and costs. The reduced value of the dollar means it does not have the purchasing power anticipated even as recently as 2006 for international work. Most critically, there are no discretionary funds to handle disruptions at our research sites – just this year we faced challenges of getting back on our feet after floods in Mexico, political strife in Kenya, and an earthquake in China. While some changes can be handled by internal reallocations, it is probable that the AquaFish CRSP will not have the impact of the ACRSP with its lower funding level and increased mandate, unless additional core funds are made available. The CRSP Council has made this request of USAID on numerous occasions over the reporting period and the AquaFish CRSP concurs with the reasonableness of the request.

In retrospect, AquaFish CRSP has gotten off to a strong, promising start, with 6 new core research projects and 3 new program-wide projects operating at 12 US universities, in 18 countries, with over 300 collaborators. Degree-training and capacity building efforts have retained 119 students in undergraduate and graduate degrees primarily at regional universities (see section on Capacity Building). Attention to gender has yielded an equal percentage of women and men in long-term training. Looking back to the ACRSP, AquaFish's 50% inclusion rate is the highest involvement of women, demonstrating a renewed commitment to diversity. One Associate Award in Mali has provided AquaFish CRSP expanded outreach in IEHA countries (President's Initiative to End Hunger in Africa).

# II. FISHELLANEOUS

*Submitted by Hillary Egna, CRSP Director*

## Fostering Respectful Partnerships

The mindful sharing of project decision-making and respect form the core of CRSP. Projects foster linkages with organizations including US minority-serving institutions, non-governmental organizations (NGOs), national agricultural research institutions, other CRSPs, international centers, private businesses, and others. Projects that link Host Country researchers from one CRSP site to another CRSP site are encouraged. US and Host Country PIs share in budgetary decisions and overall priority setting for the project, as well as in other collaborative activities related to the CRSP. At least 50% of funds are required to be expended in or on behalf of the Host Country or region. Most projects, however, expend more than 80% of direct costs in Host Countries. Proposals, work plans, and project budgets are developed collaboratively between HC and US researchers. US PI Leads actively establish an effective working relationship with the ME and other CRSP US and Host Country PIs and program participants.

## Matching Funds

Each project supplies an additional 50% or more of matching funding from participating institutions. That translates to an additional 50 cents for every core research dollar supplied by USAID. Indeed, most researchers report even higher rates of leveraging when accounting for external sources of match not provided by their institutions. For example, two CRSP PhD students received Borlaug LEAP fellowships, which contribute up to $50,000 to the AquaFish CRSP projects in Mexico and the Philippines. CRSP funds are not used to support US expatriate personnel, as the CRSP model is intended to build institutional networks and capacities. In furtherance of the Title XII initiative that authorizes all CRSPs, projects also demonstrate return benefits to the US. Under Title XII, CRSP has responsibility to provide mutual benefits and discoveries that can apply to the HC region and US and that will support future development of sustainable aquaculture and fisheries.

## MOUs and Site Descriptions

During this reporting year, MOUs an
d/or subcontracts were put into place with all HC institutions collaborating in the CRSP. MOUs provide the opportunity for other CRSP projects to function under the authority of the agreement and must provide for joint authorship of reports and site visits at the discretion of the CRSP Management Entity. Draft MOUs are supposed to be submitted to the ME for review prior to execution, but only a few US Lead partners remembered this and MOUs were signed without Director's review. PIs have pledged to bring the next round of MOUs to the Director's attention for review prior to execution. Site Descriptions were completed for each country site, and are available from the website.

Table II-1. MOUs or Subcontracts between US Lead and other US or Host Country Institutions

| US Lead Institution | US or Host Country Institution | Country |
|---|---|---|
| **North Carolina State University** | | |
| | University of Arizona | US |
| | Bureau of Fisheries & Aquatic Resources* | Philippines |
| | Central Luzon State University | Philippines |
| | SEAFDEC AQD | Philippines |
| | Ujung Batee Aquaclture Center, Banda Aceh | Indonesia |
| **Purdue University** | | |
| | University of Arkansas at Pine Bluff (UAPB) | US |
| | UAPB with SUA | US-Tanzania |
| | Virginia Polytechnic Institute & State University | US |
| | Kwame Nkrumah University of Science & Technology | Ghana |
| | Moi University | Kenya |
| | Ministry of Natural Resources & Tourism, Aquaculture Development Division* | Tanzania |
| | Sokoine University of Agriculture (SUA) | Tanzania |
| **University of Arizona** | | |
| | Texas Tech University | US |
| | Department of Fisheries | Guyana |
| | Universidad Juárez Autónoma de Tabasco | Mexico |
| | Universidad Autónoma de Tamaulipas | Mexico |
| **University of Connecticut–Avery Point** | | |
| | University of Rhode Island | US |
| | IFReDI | Cambodia |
| | Can Tho University | Vietnam |
| **University of Hawai'i at Hilo** | | |
| | Louisiana State University | US |
| | CIAD | Mexico |
| | Universidad Autónoma de Sinaloa-Culiacán | Mexico |
| | Universidad Autónoma de Sinaloa-Mazatlán | Mexico |
| | CIDEA | Nicaragua |
| **University of Michigan** | | |
| | Shanghai Ocean University | China |
| | Hainan University | China |
| | Huazhong Agricultural University | China |
| | Wuhan University | China |
| | Institute of Agriculture & Animal Science | Nepal |
| | University of Agriculture & Forestry | Vietnam |
| | World Wildlife Fund in Asia* | Asia |

*These organizations participate under other agreements than MOUs or subcontracts. Other agreements include Personal Services Contracts and Travel Reimbursements.

## OSU Program Brings Fish Farming to Impoverished Communities around the World

*Megan McKenzie, News & Communications Services, OSU*

Oregon State University researchers are internationalizing aquaculture through a program that enriches livelihoods and promotes health on the ground in regions as far flung as Kenya and the Philippines.

Access to aquacultural techniques is important because, in many developing countries, fish farming is the single most important source of dietary animal protein and local supplies are diminishing as demand is increasing.

The OSU-based AquaFish Collaborative Research Support Program cultivates multidisciplinary partnerships that make aquaculture accessible to impoverished communities worldwide.

Support for the AquaFish program comes primarily from a five-year, 8.9 million dollar grant that was awarded to OSU by the US Agency for International Development in 2006. These funds were augmented this year by a three-year, $750,000 grant awarded to OSU by USAID's field Mission in Mali, earmarked for sustainable fisheries and aquaculture development in West Africa.

"It would be a recipe for failure to train foreign students in the US and then send them back to their own country with no support, no local network and no funding prospects," said AquaFish director Hillary Egna, an international aquaculture specialist in OSU's College of Agricultural Sciences.

Instead, the idea is to research and develop aquacultural solutions within a host country that are appropriate to that country – environmentally, socially and politically. Students from host countries and the US become part of a larger network of supportive researchers and practitioners.

Since its launch, the primary focus of AquaFish has been to establish feasible, enduring partnerships with people in host country institutions.

One challenge has been to make it clear to partners that AquaFish is presenting the best, most appropriate technology for their situation. "Sometimes partners expect silver bullets," said Egna, "but sustainable solutions for these poorer communities usually involve low energy inputs." Well-managed ponds can easily increase yields ten-fold without costing a lot or negatively affecting the environment.

It all begins with digging a good quality pond that will hold water and not interfere with its watershed.

In Sagana, Kenya (East Africa), local aquaculture students dig ponds as class projects; these students then go on to become government extension agents, fish farmers and teachers.

According to Nancy Gitonga, the former director of the Kenyan Department of Fisheries, "Before AquaFish came to Kenya, ponds were not dug well, or managed well. No records were kept."

Now local extension agents who were trained by AquaFish as students guide local farmers, who in turn participate in field day events and share their knowledge – including business plans – with other farmers. "Once farmers see examples of how aquaculture works, and see that it makes money, they become very interested," said Gitonga. "Marginal lands are becoming more productive."

Another challenge has been to bring partners into a collaborative mindset. Funds are meted out with a 50/50 match requirement (each partner contributing equally). The authority to decide what a project will look like goes both ways, but Egna has often found that "At first, people expect things to be laid out for them, rather than figuring things out together."

Collaboration builds trust among partners and creates projects that are more likely to become self-sustaining.

AquaFish creates avenues for the direct exchange of ideas among host country researchers; it's proven to be a great way to get information to the people who need it.

For example, people in Mali eat a lot of rice, and could benefit from a rice-fish aquaculture intercrop. Farmers in Thailand already do that really well and, through AquaFish, are mentoring farmers in Mali. There are AquaFish colleagues from Thailand now working in China. Chinese colleagues are actively supporting students in Mali.

"The beauty of AquaFish is that it promotes a community larger than itself," said Egna. "It gets to be an intricate web, with people playing off of each other." Connections are forged among students, faculty, and local stakeholders like farmers and teachers.

The successful training of even one student can have a huge impact. For instance, the principal investigator at Juárez Autonomous University of Tabasco Mexico did his master's and PhD in aquaculture at OSU. More than 30 Mexican students have since become involved in AquaFish.

Connections go beyond exchanging students and attending workshops; they seed self-sustaining programs that address issues underlying poverty, even in politically unstable regions.

"The AquaFish program supports change for people's livelihoods," said Gitonga.

# III. OVERVIEW OF RESEARCH PROGRAM STRUCTURE

*Submitted by Hillary Egna, CRSP Director*

AquaFish CRSP is managed in a manner to achieve maximum program impacts, particularly for small-scale farmers and fishers, in Host Countries and more broadly. CRSP program objectives address the need for world-class research, capacity building, and information dissemination. Specifically, the AquaFish CRSP strives to:

- Develop sustainable end-user level aquaculture and fisheries systems to increase productivity, enhance international trade opportunities, and contribute to responsible aquatic resource management;
- Enhance local capacity in aquaculture and aquatic resource management to ensure long-term program impacts at the community and national levels;
- Foster wide dissemination of research results and technologies to local stakeholders at all levels, including end-users, researchers, and government officials; and
- Increase Host Country capacity and productivity to contribute to national food security, income generation, and market access.

The overall research context for the projects described in this *Annual Report* is poverty alleviation and food security improvement through sustainable aquaculture development and aquatic resources management. Discovery of new information forms the core of projects. Projects also include institutional strengthening, outreach, and capacity building activities such as training, formal education, workshops, extension, and conference organizing to support the scientific research being conducted.

Projects focus on one USAID-eligible country within a region, but have activities in nearby countries within the same region. All projects received USAID country-level concurrence prior to award. Non-concurrence meant that a project or investigation was not approved for funding, as was the case with an investigation that included Bangladesh. The USAID Mission in Bangladesh did not concur due to perceived management overload; the AMA CRSP was also denied the privilege of working in Bangladesh.

## GLOBAL AQUAFISH CRSP PROJECT THEMES (GOALS)

A. Improved Health and Nutrition, Food Quality, and Food Safety
B. Income Generation for Small-Scale Fish Farmers and Fishers
C. Environmental Management for Sustainable Aquatic Resources Use
D. Enhanced Trade Opportunities for Global Fishery Markets

Each project has one AquaFish CRSP theme as its primary focus, but addresses all four themes in an integrated systems approach. The global themes of the CRSP are cross-cutting and address several specific USAID policy documents and guidelines.

## AQUAFISH CORE RESEARCH PROJECTS STATS

Under the *Implementation Plan 2007-2009*, 38 investigations have been undertaken with a distribution by Systems Approach of 16 for *Integrated Production Systems* and 22 for *People, Livelihoods, & Ecosystem Interrelationships* (Table III-1).

Table III-1. AquaFish Core Research Projects by Systems Approach and Topic Areas

| SYSTEMS APPROACH | TOPIC AREA | NO. |
|---|---|---|
| **Integrated Production Systems** | | |
| | Indigenous Species Development | 4 |
| | Quality Seedstock Development | 2 |
| | Sustainable Feed Technology | 6 |
| | Production System Design & Best Management Alternatives | 4 |
| **People, Livelihoods, & Ecosystem Interrelationships** | | |
| | Human Health Impact of Aquaculture | 5 |
| | Technology Adoption & Policy Development | 3 |
| | Marketing, Economic Risk Assessment, & Trade | 4 |
| | Mitigating Negative Environmental Impacts | 7 |
| | Watershed & Integrated Coastal Zone Management | 2 |
| | Food Safety & Value-Added Product Development | 1 |
| **Total** | | 38 |

## AQUAFISH CRSP TOPIC AREAS

Six core projects have work plans (investigations) organized around a number of specific areas of inquiry called Topic Areas. Current projects contain between five and eight investigations. Projects focus on more than one topic area in describing aquaculture research that will improve diets, generate income for smallholders, manage environments for future generations, and enhance trade opportunities.

A systems approach requires that each CRSP project integrate topic areas from both *Integrated Production Systems* and *People, Livelihoods and Ecosystem Interrelationships.* USAID also encourages the CRSP to address biodiversity conservation and non-GMO biotechnology solutions to critical issues in aquaculture. Each overall project describes a comprehensive development approach to a problem.

Projects were formed around *core program components*, as identified by USAID:

- a systems approach
- social, economic, and environmental sustainability
- capacity building and institution strengthening
- outreach, dissemination, and adoption
- gender integration

Topic Areas pertain to aquaculture and the nexus between aquaculture and fisheries. Some of the following topic areas overlap and are interconnected. Investigations in this *Implementation Plan* identify a single topic area that best describes each individual investigation. The text under each topic area is provided for illustrative purposes and is not prescriptive. Fisheries-only issues were not funded with core EGAT funds per guidance from USAID.

## Topic Areas: Integrated Production Systems

- **Production System Design & Best Management Alternatives (BMA)**
  Aquaculture is an agricultural activity with specific input demands. Systems should be designed to improve efficiency and/or integrate aquaculture inputs and outputs with other agricultural and non-agricultural production systems. Systems should be designed so as to limit negative environmental impacts. CRSP research should benefit smallholder or low- to semi-intensive producers, and focus on low-trophic species for aquaculture development. Research on soil-water dynamics and natural productivity to lessen feed needs were fundamental to the Aquaculture CRSP; critical new areas of research may be continued. Interventions for disease and predation prevention must adopt an integrated pest management (IPM) approach and be careful to consider consumer acceptance and environmental risk of selected treatments.

- **Sustainable Feed Technology (SFT)**
  Methods of increasing the range of available ingredients and improving the technology available to manufacture and deliver feeds are an important research theme. Better information about fish nutrition can lead to the development of less expensive and more efficient feeds. Investigations on successful adoption, extension, and best practices for efficient feed strategies that reduce the "ecological footprint" of a species under cultivation are encouraged. Feed research that lessens reliance on fish meals/proteins/oils and lowers feed conversion ratios is desired, as is research on feeds (ingredients, sources, regimes, formulations) that result in high quality and safe aquaculture products with healthy nutrition profiles.

- **Indigenous Species Development (IND)**
  Domestication of indigenous species may contribute positively to the development of local communities as well as protect ecosystems. At the same time, the development of new native species for aquaculture must be approached in a responsible manner that diminishes the chance for negative environmental, technical, and social impacts. Research that investigates relevant policies and practices is encouraged while exotic species development and transfer of non-native fishes are not encouraged. A focus on biodiversity conservation, and biodiversity hotspots, as related to the development of new native species for aquaculture is of great interest. Aquaculture can be a means to enhance and restock small-scale capture and wild fisheries resources (Aquaculture-Fisheries Nexus Topic Area). Augmentation of bait fisheries through aquaculture to support capture fisheries is an area of interest, provided there are no net negative environmental effects.

- **Quality Seedstock Development (QSD)**
  Procuring reliable supplies of high quality seed for stocking local and remote sites is critical to continued development of the industry, and especially of smallholder private farms. A better understanding of the factors that contribute to stable seedstock quality, availability, and quantity for aquaculture enterprises is essential. Genetic improvement (e.g., selective breeding) that does not involve GMOs may be needed for certain species that are internationally traded. All genetic improvement strategies need to be cognizant of marketplace pressures and trends, including consumer acceptance and environmental impacts.

## Topic Areas: People, Livelihoods, & Ecosystem Interrelationships

- **Human Health Impacts of Aquaculture (HHI)**
  Aquaculture can be a crucial source of protein and micronutrients for improved human health, growth, and development. Research on the intrinsic food quality of various farmed fish for human consumption is needed—this might include science-based studies of positive and negative effects of consuming certain farmed fishes. Patterns of fish consumption are not well understood for many subpopulations. Human health can be negatively impacted by aquaculture if it serves as a direct or indirect vector for human diseases. There is interest in better understanding the interconnectedness of aquaculture production and water/vector-borne illnesses such as malaria, schistosomiasis, and Buruli ulcer and human health crises such as HIV/AIDS and avian flu.

- **Food Safety & Value-Added Product Development (FSV)**
  Ensuring high quality, safe, and nutritious fish products for local consumers and the competitive international marketplace is a primary research goal. Efforts that focus on reducing microbial contamination, HACCP controls and hazards associated with seafood processing, value-added processing, post-processing, and byproduct/waste development are of interest. Consumers and producers alike will benefit from research that contributes to the development of standards and practices that protect fish products from spoilage, adulteration, mishandling, and off-flavors. Certification, traceability, product integrity and other efforts to improve fish products for consumer acceptance and international markets are desired. Gender integration is important to consider as women are strongly represented in the processing and marketing sectors. **(**Aquaculture-Fisheries Nexus Topic Area)

- **Technology Adoption & Policy Development (TAP)**
  Developing appropriate technology and providing technology-related information to end-users is a high priority. The program encourages research that results in a better understanding of factors and practices that set the stage for near-term technology implementation and that contribute to the development of successful extension tools and methods. Areas of inquiry can include institutional efforts to improve extension related to aquaculture and aquatic resources management; science-based policy recommendations targeting poor subpopulations within a project area, or more broadly (for example, national aquaculture strategies); methods of improving access to fish of vulnerable populations including children (e.g., school-based aquaculture programs); science-based strategies for integrating aquaculture with other water uses to improve wellbeing, such as linkages with clean drinking water and improved sanitation. Policy initiatives that link aquaculture to various water uses to improve human health are needed. Additionally, social and cultural analyses regarding the impacts of fish farming may yield critical information for informing policy development.

- **Marketing, Economic Risk Assessment & Trade (MER)**
  Aquaculture is a rapidly growing industry and its risks and impacts on livelihoods need to be assessed. Significant researchable issues in this arena include cost, price, and risk relationships; domestic market and distribution needs and trends; the relationships between aquaculture and women/underrepresented groups; the availability of financial resources for small farms; and the effects of subsidies, taxes, and other regulations. Understanding constraints across value chains in local, regional, and international markets is of interest, especially as constraints affect competitiveness, market demand, and how to link producers to specific markets. **(**Aquaculture-Fisheries Nexus Topic Area)

- **Watershed & Integrated Coastal Zone Management (WIZ)**
  Aquaculture development that makes wise use of natural resources is at the core of the CRSP. Research that yields a better understanding of aquaculture as one competing part of an integrated water use system is of great interest. The range of research possibilities is broad—from investigations that quantify water availability and quality to those that look

into the social context of water and aquaculture, including land and water rights, national and regional policies (or the lack thereof), traditional versus industrial uses, and the like. Water quality issues are of increasing concern as multiple resource use conflicts increase under trends toward scarcity or uneven supply and access, especially for freshwater. Ecoregional analysis is also of interest to explore spatial differences in the capacities and potentials of ecosystems in response to disturbances. Innovative research on maximizing water and soil quality and productivity of overall watersheds is of interest. Pollution is a huge concern, as over 50% of people in developing countries are exposed to polluted water sources. Additionally, aquatic organisms cannot adequately grow and reproduce in polluted waters, and aquaculture may not only be receiving polluted waters, but adding to the burden. Rapid urbanization has further harmed coastal ecosystems, and with small-scale fisheries and aquaculture operations in the nearshore, integrated management strategies for coastal areas are also important. (Aquaculture-Fisheries Nexus Topic Area)

- **Mitigating Negative Environmental Impacts (MNE)**
  With the rapid growth in aquaculture production, environmental externalities are of increasing concern. Determining the scope and mitigating or eliminating negative environmental impacts of aquaculture—such as poor management practices and the effects of industrial aquaculture—is a primary research goal of this program. A focus on biodiversity conservation, especially in biodiversity "hotspot" areas, as related to emerging or existing fish farms is of great interest. Therefore, research on the impacts of farmed fish on wild fish populations, and research on other potential negative impacts of farmed fish or aquaculture operations is needed, along with scenarios and options for mitigation. **(**Aquaculture-Fisheries Nexus Topic Area)

## ENVIRONMENTAL COMPLIANCE

The following **USAID environmental restrictions** apply to the projects and the overall program:

- Biotechnical investigations will be conducted primarily on research stations in Host Countries.
- Research protocols, policies, and practices will be established prior to implementation to ensure that potential environmental impacts are strictly controlled.
- All training programs and outreach materials intended to promote the adoption of CRSP-generated research findings will incorporate the appropriate environmental recommendations.
- All sub-awards must comply with environmental standards.
- CRSP Projects will not procure, use, or recommend the use of pesticides of any kind. This includes but is not limited to algaecides, herbicides, fungicides, piscicides, parasiticides, and protozoacides.
- CRSP Projects will not use or procure genetically modified organisms (GMO).
- CRSP Projects will not use, or recommend for use, any species that are non-endemic to a country or not already well established in its local waters, or that are non-endemic and well established but are the subject of an invasive species control effort.

## TERMINOLOGY FOR INVESTIGATIONS

Investigations that generate new information form the core of projects. Each investigation is clearly identified as an experiment, study, or activity, based on the following definitions:

**Experiment** A scientifically sound investigation that addresses a testable hypothesis. An experiment implies collection of new data by controlled manipulation and observation.

**Study** A study may or may not be less technical or rigorous than an experiment and maystate a hypothesis if appropriate. Studies include surveys, focus groups, database examinations, most modeling work, and collection of technical data that do not involve controlled manipulation (e.g., collection and analysis of soil samples from sites without having experiments of hypothesized effect before collection).

**Activity** An activity requires staff time and possibly materials but does not generate new information like an experiment or a study. Conference organization, training sessions, workshops, outreach, and transformation and dissemination of information are examples of activities.

Investigations provide a transparent means for evaluating different types of work under the CRSP, be they quantitative, empirical, biologically-based, qualitative, policy-based, or informal. Each project was required to include at least one *experiment* or *study*. Projects were also required to include outreach *activities* such as training, formal education, extension, and conference organizing to supplement the scientific research being proposed.

## General Research Priorities

All six projects address the following general research priorities:

- **Priority Ecosystems**
  Freshwater and brackish water ecosystems for aquaculture and aquaculture-fishery nexus topic areas. Marine ecosystems are also included in the aquaculture-fishery nexus topic areas.

- **Priority Species**
  Low-trophic level fishes; domesticated freshwater fishes; non-finfishes (e.g., bivalves, seaweeds); aquatic organisms used in polycultures and integrated systems; native species. Food fishes are a priority but species used for non-food purposes (e.g., ornamental, pharmaceutical) may also be included as a priority if they are a vital part of an integrated approach towards food security and poverty alleviation.

- **Target Groups**
  Aquaculture farms (small- to medium-scale, subsistence and commercial) and aquaculture intermediaries, policy makers, and others in host countries.

- **Key Partners**
  University, government, non-government, and private sector.

# IV. CORE RESEARCH PROJECT REPORTS

Annual reports cover the period 1 October 2007 – 30 September 2008. Reports are printed as submitted by the Lead US PI.

## LEAD US INSTITUTION: NORTH CAROLINA STATE UNIVERSITY

**Improved Cost Effectiveness and Sustainability of Aquaculture in The Philippines and Indonesia**

*Printed as submitted by Russell Borski, US Lead PI*

### Investigation Progress Reports

***Investigation 1 - 07QSD01NC - Broodstock seed quality and fingerling production systems rearing for Nile tilapia in the Philippines***

The increase in the demand for tilapia fingerlings is a constraint in the expansion of tilapia growout production. Tilapia hatcheries in the Philippines use various techniques in seed production namely ponds, hapas and artificial incubation units (incubation jars). However, it is unclear if fry rearing or fingerling growout is altered in Nile tilapia seed produced from the three different hatchery systems. We have completed studies aimed at assessing the size distribution, growth and survival of fry and fingerling growout performance of tilapia seed produced from artificial incubation units, hapas, and ponds. We used GIFT strain of Nile tilapia, a genetically improved strain of tilapia commonly used in the Philippines and Southeast Asia. Evidence shows no significant difference on growth and survival among fry hatched in the three different systems and raised in hapas. However, fingerlings from the artificial incubation units were found to be of two sizes only (size 22: mean wt. = 0.2-0.25 g and size 20: mean wt. = 0.3-0.35 g) while tilapia fingerlings from hapas and ponds were more variable in sizes (size 24, 22, 20 and 17).

We then assessed growth, sex conversion rate and percent survival of Nile tilapia fingerlings of the GIFT strain reared in earthen ponds for four months. Trials were replicated three times. Each pond was stocked with similar sized sex-reversed tilapia fingerlings that were initially hatched in incubation jars, hapas, ponds and a combination of the three. There were no significant differences on the mean gain in length, gain in weight, specific growth rate, sex conversion rate and survival of tilapia fingerlings among treatments ($P > 0.05$). Artificial incubation-hatched fry had the highest extrapolated yield (kg/ha) with 3890.67 kg/ha followed by hapa-hatched fry with 3797.49 kg/ha, combination of hatched fry with 3488.96 kg/ha and pond-hatched fry with 2995.15 kg/ha. However, these differences were not statistically significant. We conclude that incubation jars produce the most uniform sized tilapia fry with little impact on growth or survival compared with other hatching systems. However, growout of sized-matched fingerlings hatched under the different systems is similar, although the theoretical total yield of fish appears highest in fry hatched in incubation jars. Collectively these results show that incubation jars might be the most effective hatching method for producing GIFT strain of Nile tilapia.

***Investigation 2 - 07SFT02NC - Feeding Reduction Strategies and Alternative Feeds to Reduce Production Costs of Tilapia Culture***

The feeding reduction study is in progress and will be terminated on January 2009. We have established seven (7) tilapia farmers within the province of Nueva Ecija who will cooperate with the on-farm studies looking at feed reductions strategies to reduce production costs of Nile tilapia . Two earthen ponds of similar dimensions are being utilized per co-operator for the two treatments, a control (full feeding at 100% amount of feed based on the fish biomass) and a reduced feeding strategy that incorporates a series of 60 days delayed feeding; 30 days alternate day feeding; 30 days full feeding on daily basis but at a 67% sub-satiation level). The ponds with size ranges of 568-1280 m-2 were stocked with sex-reversed Nile tilapia fingerlings of the GIFT strain at a density of 4 fish m-2 using fingerling size # 20 (ABW: 0.31-0.37 g). All ponds are fertilized weekly with inorganic fertilizers (urea and ammonium phosphate) at a rate of 28 kg N ha-1 week-1 and 5.6 kg P ha-1 week-1. Weekly monitoring of water quality parameters is done. Fish sampling and feed adjustment is being done every two weeks.

Fish are being sampled for determinations of insulin-like growth factor-I (IGF-1) from each group at three farms to evaluate IGF's utility as a biomarker of growth in the field. We are testing the hypothesis that the feed requirements for tilapia growout on the mixed feeding schedule will be substantially less than that for fish on continuous full daily feeding without affecting overall growth performance or other production parameters.

We have recruited a graduate student and developed feed formulations to test lower cost feed alternatives for tilapia growout. Testing of feeds in growout studies will begin in November.

***Investigation 3 - 07TAP02NC - Internet-based Extension Podcasts for Tilapia Farmers in the Philippines***

Initial efforts have focused on the podcast production to address issues of interest to tilapia farmers in Luzon, Phillipines. A podcast was made using multimedia computer software (Garage Band, Apple Inc.). The podcast has an 18-minute vocal track evaluating two popular tilapia culture reference texts, Lim and Webster (eds., 2006) and El Sayed (ed., 2006). Recorded vocal analysis of the utility of these reference materials is accompanied with a series of ~ 60 photographs of tilapia farming and cultivation centers in the Philippines, along with a musical soundtrack. The compliance of the podcast with copyright law has been a challenge. Draft editions were set to commercially copyrighted music, and holders of those copyrights were contacted for permission to use of their music for an educational podcast. Some did not respond while one responded negatively. For this reason, a non-copyrighted music track (by Dr. Gary Wikfors, US Department of Commerce) was substituted. The podcast was circulated internally and subjected to formal review and approved by the US Department of Commerce. See http://web.mac.com/poptard/Site/Podcast/Podcast.html

Progress continues toward three objectives: 1) upload the podcast and quantify uses or "hits", 2) produce additional podcasts on related themes of interest and 3) hold a workshop for interested parties. Each is addressed below.

1) The podcast will be published on iTunes, where it will be revealed to anyone searching with the keywords aquaculture, tilapia, or Philippines. The iTunes upload will enable us to use a counter to quantify downloads, or "hits" on our podcast.

2) A second podcast addresses the nutritional value of tilapia; it is about 80% complete. A third podcast is on the drawing board, to summarize feeding strategies that enable farmers to reduce in the cost of growing tilapia without compromising production.

3)A workshop or farmers day is scheduled for the second week of January, 2009. The workshop will launch the tilapia podcast series and provide extension activities for promoting alternative feeding strategies for tilapia growout. An estimated 50 participants will gather at Central

Luzon State University Freshwater Aquaculture Center. Drs. Brown, Bolivar, and Borski will address the group with a short overview of podcasting, a demonstration to introduce the podcast, and presentations on alternative feeding strategies for tilapia farming. Questions and discussion will follow.

***Investigation 4 - 07SFT03NC - Alternative Feeding Strategies to Improve Milkfish Production Efficiency in the Philippines***

Milkfish is the largest finfish aquaculture industry in the Philippines. Milkfish are grown in brackish water ponds and seawater cages with seawater culture. Feed represents around 60% of the costs for milkfish culture. A series of experiments were therefore conducted to test the effects of different feeding regimes on growth of milkfish. In tank studies using flow-through brackish water, milkfish fed the usual ration of 10% ABW on alternate days did not grow as well as milkfish fed the same ration daily. On the other hand, ABW of milkfish subjected to 2-week alternate starvation and refeeding cycle was comparable to the control group that was fed daily, suggesting that compensatory growth mechanisms are at work. Milkfish subjected to a 4-week starvation and refeeding cycle attained final ABW that was significantly lower than the control. An experiment was also conducted to compare growth of milkfish fed a ration of 10% or 7.5% of body weight. Results show that growth of milkfish was not affected by reduction of ration to 7.5% of the body weight. Thus, a lower feeding ration can be given to milkfish without compromising yield.

Another experiment was conducted to assess the effects of different feeding regimes on growth of milkfish in a simulated marine cage environment. Results generally reflect the result of the tank experiment. Milkfish fed on alternate days did not grow as well as milkfish fad daily. However, milkfish subjected to a 2-week alternate starvation and refeeding cycle did not exhibit compensatory growth of comparable magnitude as was observed in tanks. This could be due to the presence of algae growing on the nets and of plankton in the water that the fish can feed on. A second run is ongoing to test whether prolonging the starvation period will enhance the compensatory growth response. The experiment will run for another 2 months.

Preparations are underway to set up the experiments in ponds and in marine cages. Meanwhile, SEAFDEC AQD has improved the milkfish grow-out feed formulation to better suit marine cage culture conditions. The SEAFDEC milkfish grow out feed has been tested in marine cage production systems and has shown better FCR than commercially available feeds. The feed will be used in the cage experiments and with better feeding management, it is envisioned that FCR will be improved further.

***Investigation 5 - 07MNE02NC - Training in Sustainable Coastal Aquaculture Technologies in Indonesia and the Philippines***

Shrimp monoculture in Indonesia and the Philippines has led to a decline in mangroves, degradation of water quality, diseases in shrimp, and low prices due to over-production. We have completed 3 workshops demonstrating alternatives to monoculture of shrimp in affected communities of Aceh Province of Indonesia and Visayas (Panay/Guimaras Island) regions of the Philippines. The workshops provide training and techniques for more sustainable shrimp farming that incorporates culture of seaweed and tilapia-shrimp polyculture. The first workshop was held in Kabupaten Pidie, Banda Aceh (Sumatra), Indonesia on April 29-30, 2008. Thirty-one shrimp growers including 5 women participated. The second workshop held at Ujung Batee Aquaculture Center (BBAP, Banda Aceh, Indonesia) on May 1-2, 2008 included 34 participants from BBPA, NGOs and the private sector. The AquaFish CRSP USAID workshops were led by Anne Hurtado, Nelson Golez, Hasanuddin and staff at Ujung Batee and were co-sponsored by Aquaculture without Frontiers, who provided cost match on this project, as well as AUAID. Lectures included fundamentals on sustainable shrimp farming; culture system, management and nutrition; and seaweed (Gracilaria) farming and polyculture. Hands on practical on feed preparation and native agar extraction of seaweed was provided. Participants showed much interest on closed-water recirculating shrimp culture to include Gracilaria as one

of the biofilters, preparation of shrimp feed and native agar extraction. Farmers showed willingness to incorporate new technologies into shrimp farming. Participants also wanted to know more on the biology and ecology of seaweed, including the seasonality of their local Gracilaria to determine the availability of 'seedlings'for possible culture. It is recommended that a closed-water recirculating shrimp culture system (shrimp-oyters-tilapia-Gracilaria) be developed to demonstrate sustainable and environment-friendly shrimp aquaculture. Development of a village-level agar extraction to include product applications is also suggested.

A third workshop was held at the Igang Marine Station, Southeast Asian Fisheries Development Center (SEAFDEC), Aquaculture Department in Igang, Nueva Valencia on the island of Guimaras, Philippines on August 29-30, 2008. The workshop was attended by 29 people, 16 females and 13 males, from the Local Government Unit, Bureau of Fisheries staff, and private sector in nearby towns and barangays of Nueva Valencia. AquaFish CRSP USAID workshops were led by Anne Hurtado and Nelson Golez of SEAFDEC with assistance from Reginor Argueza of Central Luzon State University. Lectures were provided on pond preparation and fertilization, feed formulation, shrimp culture with emphasis on biosecurity and disease control. An integrated shrimp-mollusc-seaweed culture in a recirculating water system were highlighted to prevent disease outbreak. Lectures were also provided on Gracilaria biology-ecology, culture and post harvest management.. A hands-on preparation of feeds, and native agar extraction using a village-level extractor, was conducted. Additional lectures on disease and crop management of seaweeds, particularly a cultured red seaweed, Kappaphycus "cottoni", was provided as Guimaras coastal seaweed farming was recently adversely affected by an oil spill. A more in-depth workshop is requested on Kappaphycus farming, including the biology-physiology-ecology, farming techniques and seasonality of cultivars, post harvest management and marketing. We are trying to add an additional workshop on Kappaphycus "cottoni" farming.

An additional workshop under this project workplan is to be conducted in the Batangas Province of Luzon, Philippines in January 2009.

***Investigation 6 - 07MER04NC - Implications of Export Market Opportunities for Tilapia Farming Practices in the Philippines***

Literature reviews and collection of secondary data have been initiated by Wilfred Jamandre and Upton Hatch in anticipation of HC country travel of Russell Borski and Hatch in January 2009. The literature search is proceeding with the goal of gaining understanding of the challenges of expanding local tilapia production into export markets. Secondary data and accepted economic methods are being used to develop a prototype that will allow better use of in country time, particularly to focus on what aspects of the aquaculture operations are most likely to affect economic viability. Wilfred Jamandre developed a report that analyzes freshwater aquaculture technologies and policies in freshwater aquaculture that is aiding in this effort. A list of industry experts with whom interviews will be conducted in the Philippines is being assembled.

## Participants

***North Carolina State University, Raleigh, North Carolina (Lead US Institution)***

Russell Borski, U.S. Lead Principal Investigator
Peter Ferket, U.S. Co-Principal Investigator
Charles Stark, U.S. Co-Principal Investigator
Upton Hatch, U.S. Co-Principal Investigator
Christina Strom, Graduate Assistant
Kiana Monavi, Graduate Assistant
3 Undergraduate Students

***Central Luzon State University (CLSU), Science City of Muñoz, Nueva Ecija, Philippines (Lead HC Institution)***
Remedios Bolivar, Lead HC Principal Investigator
Emmanuel Vera Cruz, HC Co-Principal Investigator
Wilfred Jamandre, HC Co-Principal Investigator
Eddie Boy Jimenez, Graduate Assistant
Jun Rey Sugue, Graduate Assistant
Reginor Lyzza Argueza, Graduate Assistant
Sherwin Celestino, Graduate Assistant
Hernaiz Malanon, Graduate Assistant
Lourdes Dadag, Graduate Assistant
Laarni Germino, Graduate Assistant
Veronica Grande, Graduate Assistant
Marietta Hechanova, Graduate Assistant
Michelle Zamora, Graduate Assistant
Ravelina Velasco, Graduate Assistant, Winner of a LEAP Bourlag Fellowship
10 Undergraduate Students

***Southeast Asian Fisheries Development Center, Aquaculture Department, Iloilo, Philippines (HC Institution)***
Evelyn Grace T. de Jesus-Ayson, HC Principal Investigator
Felix G. Ayson, HC Co-Principal Investigator
Anicia Hurtado, HC Co-Principal Investigator
Nelson Golez, HC Co-Principal Investigator
Abigail Tauro, Undergraduate Student (West Visayas State Univ)
Joy MaeLedesma, Undergraduate Student (West Visayas State Univ)
Heysale Casalem, Undergraduate Student (West Visayas State Univ)
Mary June Cabarles, Undergraduate Student (West Visayas State Univ)

***Ujung Batee Aquaculture Center, Banda Aceh, Indonesia (HC Institution)***
Hasanuddin, HC Co-Principal Investigator

***University of Arizona, Tucson, AZ (U.S. Institution)***
Kevin Fitzsimmons, U.S. Co-Principal Investigator
Mario Hernandez, Graduate Assistant
Kyle Vanderlugt, Graduate Assistant
Cesar Hernandez, Graduate Assistant

***Bureau of Fisheries and Aquatic Resources, Department of Agriculture, Manila, Philippines***
Nelson Lopez, HC Collaborating Investigator

***United Status Department of Commerce, Milford, Connecticut (Collaborating Partner)***
Christopher Brown, Collaborating Investigator
Sydney Williams, High School Student (Aquaculture High School, Bridgeport CT)

***GIFT (Genetically Improved Farmed Tilapia) Foundation International, Inc., Science City of Muñoz, Nueva Ecija, Philippines (Collaborating Partner)***
Hernando Bolivar, HC Collaborating Partner

***Aquaculture without Frontiers***
Michael New, Cooperating Partner

## Students:

***Students:***
See student data entry sheet below

## Presentations:

Russell J. Borski. 2007. Catch-up Growth: Hormones and Mechanisms. Southeast Asian Fisheries Development Center, Iloilo Philippines

Russell J. Borski. 2007. Catch-up Growth: Hormones and Mechanisms. Fisheries and Aquaculture Center, Central Luzon State University, Science City of Munoz, Philippines

Jamandre, W.E. (2007). Economic Evaluation of Freshwater Aquaculture Technologies and Policies in Selected Production Systems. Philippine Department of Agriculture-Bureau of Agricultural Research, Diliman Quezon City, Philippines. August

Bolivar, R.B. 2007. Overview of tilapia culture in the Philippines. 8th Conference of the Aquaculture Association of Southern Africa (AASA). Cape Town International Convention Center, Cape Town, South Africa. October 22-24.

Bolivar, R.B. 2007. Feeding strategies for cost containment in the pond culture of Nile tilapia, *Oreochromis niloticus* in the Philippines. Aquaculture CRSP-sponsored aquaculture workshop. Phase II-CRSP HCPI Project "Training and Information Exchange on Cichlid Culture and the Adoption of A CRSP Technologies in A CRSP Host Countries". Stellenbosch, South Africa. October 25-28.

Bolivar, R.B. 2007. Feeding strategies for cost containment in the pond culture of Nile tilapia, *Oreochromis niloticus* in the Philippines. Aquaculture CRSP-sponsored aquaculture workshop. Phase II-CRSP HCPI Project "Training and Information Exchange on Cichlid Culture and the Adoption of A CRSP Technologies in A CRSP Host Countries". Kumasi, Ghana. October 29-November 2.

Bolivar, R.B. 2008. Feeding strategies for cost containment in the pond culture of Nile tilapia, *Oreochromis niloticus* in the Philippines. Aquaculture CRSP-sponsored aquaculture workshop. Phase II-CRSP HCPI Project "Training and Information Exchange on Cichlid Culture and the Adoption of A CRSP Technologies in A CRSP Host Countries". Universidade Estadual Paulista, Jaboticabal, São Paulo, Brazil. February 18-23.

Bolivar, R. B., H. L. Bolivar, R.M. V. Sayco, E.B. T. Jimenez, R.L. B. Argueza, L. B. Dadag, A. G. Taduan and R. Borski. 2008. Assessment of size distribution, growth and survival of Nile tilapia, *Oreochromis niloticus* L. fry collected from different hatching systems. Meeting of the World Aquaculture Society, Busan, Korea. May 19-23.

Russell J. Borski. Matt E. Picha. 2008. Enhancing production characteristics of hybrid striped bass through induction of compensatory growth by a combination of feeding and seasonally based temperature manipulations. Meeting of the World Aquaculture Society, Busan, Korea. May 19-23.

Christopher L. Brown, Emmanuel Vera Cruz, Remedios B. Bolivar, Russell J. Borski. 2008. Evaluation of the use of insulin like growth factor-I expression as an instantaneous growth indicator in the tilapia *Oreochromis niloticus*. Meeting of the World Aquaculture Society, Busan, Korea. May 19-23.

Emmanuel M. Vera Cruz, Christopher L. Brown. 2008. Dynamics of increase in insulin-like growth factor-I mRNA expression in Nile tilapia *Oreochromis niloticus* in response to elevated temperature. Meeting of the World Aquaculture Society, Busan, Korea. May 19-23.

Kevin Fitzsimmons. 2008. Restoration of aquaculture in Ache, Indonesia – Seaweed in shrimp ponds. Meeting of the World Aquaculture, Busan, Korea. May 19-23.

Bolivar, R.B., H.L. Bolivar, R.M.V. Sayco, E.B.T. Jimenez, R.L.B. Argueza, L.B. Dadag, A.G. Taduan and R. Borski. 2008. Growth evaluation, sex conversion rate and percent survival of Nile tilapia (*Oreochromis niloticus* L.) fingerlings in earthen ponds. Agency In-house Review of Completed and On-going Researches. FAC, CLSU, Science City of Muñoz, Nueva Ecija, Philippines. May 30.

Bolivar, R.B., H.L. Bolivar, R.M.V. Sayco, E.B.T. Jimenez, R.L.B. Argueza, L.B. Dadag, A.G. Taduan and R. Borski. 2008. Performance of Nile tilapia (*Oreochromis niloticus* L.) during hormonal sex reversal treatment of fry collected from different hatching systems. Agency In-house Review of Completed and On-going Researches. FAC, CLSU, Science City of Muñoz, Nueva Ecija, Philippines. May 30.

Russell J. Borski, Mathew E. Picha, Christina N. Strom, Larry G. Riley. 2008. Somatotroph regulation by metabolic state, temperature, and growth and appetite regulatory hormones. Sixth International Symposium on Fish Endocrinology, Calgary, Canada. June 22-27

Mathew E. Picha, Christina N. Strom, Andy McGinty, Russell J. Borski. 2008. Insulin-like growth factor-I: A robust growth biomarker of complete catch-up growth induced through feeding and temperature in hybrid striped bass. Sixth International Symposium on Fish Endocrinology, Calgary, Canada. June 22-27.

Bolivar, R. B. 2008. Breeding techniques for the genetic improvement of quantitative traits. Seminar-Workshop on Applied Genetics in Aquaculture. BFAR-NIFTDC Cmpd., Dagupan City, Philippines. June 25-27.

Borski, R.J., Picha, M.E., Strom, C.N., Won, E.T., Baltzegar, D.A., Johnstone, W.M. 2008. Endocrinology of catch-up growth following seasonal cold-banking in hybrid striped bass (*Morone chrysops* X *M. Saxatilis*). 8th International Congress on the Biology of Fishes. Portland, Oregon. July 28 – August 1.

De Jesus-Ayson, EG. 2008. Impacts of Climate Change on Aquaculture in Southeast Asia, ASEAN-SEAFDEC Regional Consultation on Emerging Regional Fisheries Policy Issues, Bangkok, Thailand, 15-16 July.

## Conferences Attended:

Bi-Annual Conference of the Aquaculture Association of Southern Africa (AASA). Cape Town International Convention Center, Cape Town, South Africa. October 21-24, 2007. Attendee: Remedios Bolivar

Phase II of the Aquaculture and Fisheries CRSP HCPI Exchange Workshop. Stellenbosch, South Africa. October 25-29, 2007.
Attendee: Remedios Bolivar

Phase II of the Aquaculture and Fisheries CRSP HCPI Exchange Workshop and Site Visit. Kumasi, Ghana. October 29-November 2, 2007.
Attendee: Remedios Bolivar

8th Asian Fisheries Forum. Cochin, India. November 20-23, 2007.
Attendees: Remedios Bolivar, Hernando Bolivar, Sherwin Celestino, Lourdes Dadag, Laarni Germino, Roberto Miguel Sayco

On-the-Job Training on Freshwater Aquaculture. FAC-CLSU, Science City of Muñoz, Nueva Ecija, Philippines. December 13, 2007.
Attendee: Remedios Bolivar

Phase II of the Aquaculture and Fisheries CRSP HCPI Exchange Workshop and Site Visit. São Paulo, Brazil. February 18-23, 2008.
Attendee: Remedios Bolivar

International Workshop on Tilapia and Other Cichlids Culture. UNESP, Jaboticabal, São Paulo, Brazil. February 19-20, 2008
Attendee: Remedios Bolivar

Seminar –Workshop on Thesis Advising, Institute of Graduate Studies Mini-Theater, CLSU, Science City of Muñoz, Nueva Ecija, Philippines. April 28-29, 2008.
Attendee: Remedios Bolivar

Meeting of the World Aquaculture Society, Busan, Korea, May 19-23, 2008
Attendees: Russell Borski, Remedios Bolivar, Emmanuel Vera Cruz, Hasnuddan, Tereso Abella, Hernando Bolivar, Christopher Brown, Kevin Fitzsimmons

Sixth International Symposium on Fish Endocrinology, Calgary, Canada. June 22-27
Attendee: Russell Borski

8th International Congress on the Biology of Fishes, Portland, Oregon July 28-August 1
Attendee: Russell Borski

HIPON (Peneaus vannamei) Summit 2008, Leisure Coast Resort, Bonuan-Binloc, Dagupan City, Philippines. August 21-22, 2008.
Attendee: Remedios Bolivar

## Workshops Held:

***Title: Shrimp and Gracillaria Culture, New Trends for a Changing World***
Location: Kabupaten Pidie, Banda Aceh (Sumatra), Indonesia
Date: April 29-30, 2008
Participants: 31 shrimp growers including 5 women.
Coordinators/Presenters: Anne Hurtado, Nelson Golez, Hasanuddin

***Title: Shrimp and Gracillaria Culture, New Trends for a Changing World***
Location: Ujung Batee Aquaculture Center (BBAP), Banda Aceh (Sumatra), Indonesia
Date: May 1-2, 2008
Participants: 34 mostly from the staff of BBPA, NGOs and private sector.
Coordinators/Presenters: Anne Hurtado, Nelson Golez, Hasanuddin

***Title: Shrimp and Gracilaria Culture: New Trends for a Changing World***
Location: Igang Marine Station, Southeast Asian Fisheries Development Center, Aquaculture Department, Igang, Nueva Valencia Guimaras, Philippines
Date: August 29-30, 2008
Participants: 29 people (16 females, 13 males) from Local Government Unit, Bureau of Fisheries staff, and private sector in nearby touwns and barangays of Nueva Valencia.
Coordinators/Presenters: Anne Hurtado, Nelson Golez, Redj Argueza

## Publications:

Brown, C.L, Borski, R., and Bolivar, R.B. (2008). Tilapia Podcast: Book Reviews. http://web.mac.com/poptard/Site/Podcast/Podcast.html (U.S. Dept Commerce approved)

Picha, M.E., Turano, M.J. Beckman, B.R., Borski, R.J. (2008) Hormonal biomarkers of growth and applications to aquaculture: A mini-review of growth hormone, insulin-like growth factor-I and IGF binding proteins as growth indicators in fish. North American Journal of Aquaculture 70:196–211.

Bowman, J., A. Bart, R. Bolivar, W. Contreras-Sanchez, N. Gitonga, D. Meyer and H. Egna. 2008. A comparison of tilapia culture technologies: linking research and outreach results across geographic regions. World Aquaculture Magazine, 39(2):39-44.

Bart, A., Bolivar, R.B. Contreras-Sachez, W., Gitonga, N., Ngugi, C., Meyer, D., Yang, Y., and Bowman, J. 2007. Advances in aquaculture: the role of aquaculture CRSP-supported research, training and information exchange on the culture of cichlids in CRSP Host Country institutions (ACRSP website publication)

Jamandre, W.E., Marzan, E.G. Jr., and Velasco, C.V. (2007) Economic Evaluation of Freshwater Aquaculture Technologies and Policies in Selected Production Systems. Philippine Department of Agriculture-Bureau of Agricultural Research Report. 61pp. A Central Luzon State University Abstract under In-depth study at the Socio-economic Research Portal by the Philippine Institute for Development Studies.

## DTAP Indicators:

**DTAP A**: **Improved Health and Nutrition, Food Quality, and Food Safety of Fishery Products**

- *Number of aquaculture products developed that meet food safety standards*

**DTAP B**: **Income Generation for Small-Scale Fishers and Farmers**

- *Number of new biotechnologies developed*
  Use of insulin-like growth factor-I as a biomarker of growth in tilapia and other aquacultured species is near full development

- *Number of institutions with access to technological practices*
  Numerous institutes are testing and using insulin-like growth factor-I as a biomarker of growth of aquacultured fish – 4 relevant to this project: North Carolina State University, Central Luzon State Univeristy, Southeast Asian Fisheries Development Center, GIFT Foundation International

- *Number of (people) trained in use of technological practices*
  15 individuals, mainly university and institutional personnel, have been trained in biomarker measurements

**DTAP C: Environmental Management for Sustainable Aquatic Resources Use**

- *Number of hectares under improved natural resource management*
  Based on conservative estimate, approximately 40% or 5,812 ha of the existing freshwater fishponds (14,531 ha) used in tilapia farming are practicing reduced feeding strategies including alternate feed to improve tilapia production efficiency.

- *Number of management practices developed to support biodiversity*
  1 management practice: polyculture implementing seaweed in shrimp culture practices to reduce effluent water quality problems

- *Number of management practices developed that reduce consumptive water use*

- *Number of people trained in practices that promote soil conservation and/or improved water quality*
  95 trained in polyculture practices to improve water quality in shrimp farming

- *Number of management systems developed that increase production by reusing aquaculture effluents & byproducts*

- *Number of IPM practices developed*

**DTAP D: Enhanced Trade Opportunities for Global Fishery Markets**

- *Number of new markets for aquatic products*

- *Number of aquatic products available for human food consumption*
  1 - Agar production as a byproduct of culturing seaweed

# LEAD US INSTITUTION: PURDUE UNIVERSITY

**Improving Competitiveness of African Aquaculture Through Capacity Building, Improved Technology, and Management of Supply Chain and Natural Resources**

*Printed as Submitted by Kwamena Quagrainie, Lead US PI*

## Investigation Progress Reports

***07MER02PU: Developing Supply Chain and Group Marketing Systems for Fish Farmers in Ghana and Kenya***

The study seeks to develop and establish supply chain mechanisms in Kenya and Ghana that enhance the management and skills of fish farmers to access and become integrated into urban fish markets. This is essential to support the emerging small-scale commercial aquaculture sector in these countries, and also enable fish farmers to realize significant profitability and potential credit. Background literature and information relating to spatial organization of fish marketing in the two countries is being compiled. This includes information on transportation infrastructure, telecommunication technology, spatial location of farmers, cold storage facilities and transport mechanisms. Fish farmers in Kenya and Ghana are concentrated in certain regions of the country where suitable conditions for aquaculture prevail, so the study will also explore opportunities for determining the number and location of assembly centers to take advantage of geographical concentration of production and economies of scale in various aspects of infrastructure (e.g., cold storage) for developing market chains for fish. Bio-physical, demographic, marketing and socio-economic factors are being considered in the data collection process to analyze any optimal spatial organization of marketing facilities in these countries. A series of conference calls between the US PI, and the project student and host country PIs have been made to assess these data needs and approaches to obtaining the required data and information. A list of study subjects, which includes fish farmers, fish retailers, and middlemen is being compiled. A draft questionnaire for this study has been developed and is being pre-tested in Kenya and Ghana with a sample of the subjects. The pre-test will provide feedback from the subjects to develop a final survey instrument that will be administered later in the fall and early next year. This study will construct a spatial equilibrium model to analyze alternative platforms for marketing farmed fish in Kenya and Ghana, including transactions costs, optimal spatial organization of fish assembly centers (group marketing), optimal location and number, and their impact on aquaculture growth and fish farmers' welfare. Results will be used to train small- and medium-scale fish farmers in supply chain management, risk analyses, costs analyses, pricing strategies, quality and cost effectiveness in post-harvest value chain. Farmers will also be equipped with skills for group marketing, developing new markets, developing distribution and market structures and networks, and identify value-added opportunities for tilapia and catfish.

***07QSD02PU: Development of Small-scale Clarias Fingerlings as Bait for Lake Victoria Commercial Fisheries in Western Kenya***

The overall objective of this study is to increase catfish fingerling production as bait to supply commercial fishermen in Lake Victoria to reduce overexploitation of indigenous species and conserve the diversity of Lake Victoria Fisheries. Previous work by Aquaculture CRSP has resulted in an emerging small-scale commercial farming of catfish and Nile tilapia in the Western Province. The purpose of the study is to support farmers to transform their current operations into high-yield production clusters for the production of catfish fingerlings as bait for the commercial fisheries associated with Lake Victoria. The turnover for fingerling production is far higher than raising catfish from fingerling to food size therefore opportunities exist for farmers to operate these clusters as profitable business ventures. Clusters of farmers have been identified based on previous work done under the Kenya Business Development

Program. Subsequent technical assistance has been provided to these clusters in the form of fish propagation, production, and general pond husbandry. Commercial small-scale fish farmers have learned that improved management leads to increased production. Fish farmers have realized the benefits from economies of scale through joint purchasing of inputs such as nets and fee, and collective marketing. Host country personnel have visited prospective baitfish dealers along Lake Victoria beaches, and arrangements are underway for a visit of selected baitfish dealers to visit selected cluster fish farms to improve their perceptions of farmed catfish for bait. It was observed that because the traditional supply of baitfish is wild-caught catfish from Lake Victoria, some bait dealers and fishermen are unsure about the use of farmed fish as bait. Some fish farmers are used to producing catfish to food size and are a bit apprehensive about selling small fish as bait. These are some challenges that will be addressed as the project progresses.

***07WIZ01PU: Characterization of Pond Effluents and Biological and Physiochemical Assessment of Receiving Waters in Ghana***

Aquaculture is considered a potential polluter of natural water bodies with effluents, and a user of polluted water because of its tight linkage with natural ecosystems. Aquaculture has the potential to have some impact on aquatic environmental quality therefore the overall objective of the study is to characterize fish farm effluent or potential effluent quality, and quality of receiving waters in terms of nutrients, suspended solids, and pathogens. The study will also assess the biological effects of ponds on receiving waters. A student from Kwame Nkrumah University of Science and Technology, Ghana has been tapped for the study, and is now enrolled at Virginia Tech in an MS program. Possible field sites including fish farms and receiving waters locations have been identified. The schedule for sample collection has been revised because of delays in funding. Field seasons and methods have been outlined and clarified and field work is expected to start in the spring of 2009.

***07SFT06PU: Development of Locally Available Feed Resource Base in Tanzania***

The overall objective of the study is to assess the suitability of local plant species - *Moringa oleifera*, *Leucaena leucocephala*, *Jatropha curcas* and *Sesbania sesban* as protein sources for fish feed. Protein sources of feed constitutes a major cost component of fish feed, and it is scarce. The situation is made worse for resource-poor fish farmers in Tanzania where most of the protein feed sources are also food for humans, and hence their use in fish feed conflicts with food security interests. Consequently, most fish farmers tend to use nutritionally low quality feeds such as maize bran, wheat bran, rice polishing, and brewery residues, which supply energy and not protein. Samples of Moringa oleifera, Leucaena leucocephala, have been collected and are undergoing laboratory analysis of chemical and mineral composition as feed ingredients. Soybean meal and maize bran samples have also been collected and are being analyzed. The next steps are to develop fish diets with protein sources from the local plant species, and compare them to feed developed from other protein sources. The suitability and economic costs of different feed formulations will be examined. Different formulations that will be evaluated include feed in the form of mash, crumbs and pellets. Sokoine University of Agriculture, Tanzania had ponds that had not been used for several years. The ponds have been renovated and prepared for the nutritional studies. Arrangements have been made for the supply of all the inputs needed for the study.

***07MER03PU: On Farm Verification of Tilapia-catfish Predation Culture***

This study involves verification trials to demonstration research-based extension recommendations in small-scale commercial fish farming environments. A set of research-based extension recommendations on yields, feed conversions ratios, survival, and costs will be assessed regarding consistency with results from on-station research trials. A masters student has been enrolled in the Animal Sciences and Production Department at the Sokoine University Agriculture, Tanzania to be involved in this research. Project personnel have visited and selected small-scale farmers in Mikindu Village, which is within the Morogoro Region for the on-farm trials. Several farms were visited but the select ion was based on farmers' willingness

and nature of the ponds. Selected farmers have participated in past fish farming training programs organized by Aquaculture CRSP and Tanzania Ministry of Natural Resources, Fisheries Division. Details of the arrangements are being worked out by Sokoine University of Agriculture and the Ministry of Natural Resources and Tourism - Aquaculture Development Division and the farmers.

## List of Participants involved in the project

| Last Name | First Name | Institution | Role |
|---|---|---|---|
| Quagrainie | Kwamena | Purdue University, US | US Lead PI |
| Dennis | Jennifer | Purdue University, US | US Co-PI |
| Frimpong | Emmanuel | Virginia Polytechnic Institute & State University, US | US Co-PI |
| Engle | Carole | University of Arkansas at Pine Bluff, US | US Co-PI |
| Lochmann | Rebecca | University of Arkansas at Pine Bluff, US | US Co-PI |
| Ngugi | Charles | Moi University, Kenya | HC PI |
| Makambo | John | Moi University, Kenya | HC Co-PI |
| Amisah | Stephen | Kwame Nkrumah University of Science and Technology, Ghana | HC PI |
| Sarfo-Mensah | Paul | Kwame Nkrumah University of Science and Technology, Ghana | HC Co-PI |
| Chenyambuga | Sebastian | Sokoine University of Agriculture, Tanzania | HC PI |
| Osewe | Kajitanus | Ministry of Natural Resources & Tourism – Aquaculture Development Division, Tanzania | HC Co-PI |
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## Conferences Attended:

| | | | |
|---|---|---|---|
| Kwamena Quagrainie | AQUACULTURE AMERICA 2008 | Lake Buena Vista, FL | Feb 9-12, 2008 |
| Kwamena Quagrainie | AQUACULTURE 2008 | Busan, Korea | May 17-24, 2008 |
| Charles Ngugi | AQUACULTURE 2008 | Busan, Korea | May 17-24, 2008 |
| Steve Amisah | AQUACULTURE 2008 | Busan, Korea | May 17-24, 2008 |
| Charles Ngugi | FAO's Aquaculture Network for Africa (ANAF) | Jinja, Uganda | August 25, 2008 |
| Charles Ngugi | Common Market for Eastern and Southern Africa (COMESA) | Nairobi, Kenya | September 2, 2008 |

## Presentations Made

Kwamena Quagrainie: "Study of Fish Farmers Source of Aquaculture Information in Ghana" Paper presented at World Aquaculture 2008, May 20 - 23, 2008, Busan, South Korea.

Kwamena Quagrainie: "The Use of Credit in Fish Production in Kenya" Paper presented at World Aquaculture 2008, May 20 - 23, 2008, Busan, South Korea.

Charles Ngugi: "Contributions of the Aquaculture Collaborative Research Support Program to the Development of Fish Farming in Kenya." Paper presented at World Aquaculture 2008, May 20 - 23, 2008, Busan, South Korea.

# LEAD US INSTITUTION: UNIVERSITY OF ARIZONA

**Developing Sustainable Aquaculture for Coastal and Tilapia Systems in the Americas**

*Printed as Submitted by Kevin Fitzsimmons, Lead US PI*

## Investigation Progress Reports

***1. 07BMA03UA: Co-sponsorship of "Second International Workshop on the Cultivation and Biotechnology of Marine Algae: An Alternative for Sustainable Development in Latin America and the Caribbean"***

The initial timing of the workshop was abandoned as the funding did not arrive in time for the original schedule. The workshop was rescheduled to coincide with the World Aquaculture Meetings to be held in Veracruz Mexico in May of 2009. We met with Dr.Junda Lin and Lorenzo Juarez to begin planning the session in Veracruz. The special session has been approved and abstracts are being submitted to the WAS for inclusion. We will invite a keynote speaker. Also need to have AquaFish CRSP recognized as the sponsor.

***2. 07SFT04UA: Utilization of Local Feed Ingredients for Tilapia and Pacu Production***

The initial workshop was delayed due to a change in host country PI but was eventually held in August 2008. In addition to the workshop, meetings were organized with the Minister of Agriculture, the Permanent Secretary of Agriculture, the Dean of the Agriculture College at Guyana University, the Director of the National Agricultural Research Center, and the Director of Foreign Investment. We also visited the largest poultry feed mill and processor, a fish meal plant, the major fish processor, and a number of tilapia and shrimp farms. We held a full day workshop that included a morning session at the Mon Repos Aquaculture Center and an afternoon session at the Maharaja Feed Mill. We also spent time reviewing the use of YY male tilapia as the primary source of broodstock for tilapia. In October, the Guyana PI, Pamila Ramotar, participated in the ISTA 8 conference in Egypt. The local AID mission supported the participation of two other people from Guyana to the ISTA 8.

***3. 07IND01UA: Development of Snook (Centropomus spp) Seed Production Technology for Application in Aquaculture and Restocking of Over-fished Populations***

Fitzsimmons and Patino traveled to Villahermosa to meet with Contreras and other participants from Tabasco in December 2007. Construction of the snook hatchery was well underway and the broodstock had been collected and was stocked into tanks. In May 2008 the PI's and students met in Busan Korea. Dr. Contreras presented project goals and some of the activities underway including additional construction of the hatchery for snook and collection of additional broodstocks. Induction of reproduction of common snook was initiated in August using injections of GnRH. Eggs were obtained from two females; however, embryonic development was incomplete in all cases. Reproductive induction of fat snooks will be initiated in November, when reproductive runs start. Matching funds ($9,500 USD) for building the snook facility were obtained from UJAT.

***4. 07MNE06UA: Elimination of MT from Aquaculture Masculinization Systems: Use of Catalysis with Titanium Dioxide and Bacterial Degradation***

The experiment for testing the elimination of MT using titanium dioxide has been conducted. Samples were collected and will be analysed using the ELISA method. Two students from UJAT are receiving training to implement this technique at UJAT. Results are expected by March 2009. 110 bacteria isolates were obtained from MT elimination tanks at UJAT. From these isolates, seven Graham negative species have been identified. More species are expected to be identified, including Graham negative strains. Experiments with enriched media will be conducted in January to determine if isolated species can degrade MT.

***5. 07IND02UA: Incorporation of the Native Cichlids, tenhuayaca, Petenia splendida and Castarrica, Cichlasoma urophthalmus into Sustainable Aquaculture in Central America: Improvement of Seedstock and Substitution of Fish Meal Use in Diets***
Fitzimmons met with Contreras and other participants from Tabasco in December 2007. Construction of a new facility for native species was underway. This facility was built with primary support funding from the National Commission for Fisheries (CONAPESCA: $70,000 USD). CRSP funding is currently used to finish-up detailing recirculating systems for Tenhuayaca and Casta Rica reproduction. Spawnings will be used for selection of the F1 group.

***6. 07HHI02UA: Food Safety Study of Leafy Greens Irrigated with Tilapia Farm Effluents***
Dr. Pablo Gonzalez has completed the 70% of the reconstruction of the fish facilities on CUATLI using Tamaulipas government matching funds. Students from the Universidad were trained in the basic techniques to be tested. Tilapia stocks and lettuce seeds were selected and brought on site.

***7. 07SFT05UA: Local Ingredients Substituting for Fishmeal in Tilapia and Pacu Diets in Guyana***
Meetings with feedmill operator and other local experts helped us to develop a suite of local ingredients to test as substitutes for fishmeal. The list includes, palm oil meal, spent grains from a brewery and a rum distillery, and locally available poultry wastes. Experimental diets will be developed and tested at the Mon Repos aquaculture center.

***8. 07TAP03UA: AquaFish CRSP Sponsorship of the Eighth International Symposium on Tilapia in Aquaculture to be Held in Egypt***
The ISTA 8 was successfully held in mid-October 2008. Almost 450 people attended the conference and tradeshow. The Proceedings, co-published by the AquaFish CRSP, included over 100 papers filling two volumes and 1500 pages. Matching funds were solicited and $10,000 was obtained from Intervet/Schering-Plough and $45,000 from the Science and Technology fund from Egypt.

## Request to change implementation Plan:

What aspects of your work are different from those described in the Implementation plan?

The schedule was shifted on the Algae workshop and the Guyana workshop.
The schedule was shifted for the Snook workshop due to flooding conditions in Tabasco.

## Personnel

***List new colleagues***
Ramotar, Pamila, Female, 07SFT04UA new PI for Guyana

***Personnel who left the project.***
Geer, Tejnarine Male, 07SFT04UA, promoted to head of department

## Graduating or leaving students.

Holstein, Traci, Female, USA, end date 5/5/08, no funding, working at commercial shrimp hatchery in Florida.

## Outreach and collaborative activities

Workshop, CRSP Meeting, Busan. Korea, 5/17/08 CRSP PI's and others

## Conferences attended

Fitzsimmons US Aquaculture Meetings Feb 2008, Orlando FL, Presented
Contreras US Aquaculture Meetings Feb 2008, Orlando FL, Presented

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|---|---|---|---|---|
| VanderLugt | US Aquaculture Meetings | Feb 2008, | Orlando FL, | Presented |
| Hernandez | US Aquaculture Meetings | Feb 2008, | Orlando FL, | Presented |
| Gonzalez | US Aquaculture Meetings | Feb 2008, | Orlando FL, | Presented |
| Geer | US Aquaculture Meetings | Feb 2008, | Orlando FL, | Did not Present |

WAS -

| | | | | |
|---|---|---|---|---|
| Fitzsimmons | WAS Aquaculture Meetings | May 2008, | Busan, Korea, | Presented |
| Gonzalez | WAS Aquaculture Meetings | May 2008, | Busan, Korea, | Presented |
| Hernandez | WAS Aquaculture Meetings | May 2008, | Busan, Korea, | Presented |
| VanderLugt | WAS Aquaculture Meetings | May 2008, | Busan, Korea, | Presented |
| Contreras | WAS Aquaculture Meetings | May 2008, | Busan, Korea, | Presented |

## Publications – None

## Miscellaneous

May – July 2008 University of Arizona undergrad student (Patrick Fitzsimmons) spent two months in Egypt working at tilapia research and production facilities and assisted with planning for ISTA 8.

June 2008 Kevin Fitzsimmons traveled to Mexico City and Monterey to present results of research.

July 2008 Fitzsimmons traveled to Swansea Wales to collaborate with FishGen on transfer of broodstocks to Guyana project. Also met with Goldman Sachs in London to discuss aquaculture opportunities in Guyana and Mexico.

August 2008, Goldman Sachs representative accompanied Fitzsimmons to Guyana to examine potential for large-scale integrated aquaculture – agriculture project.

# LEAD US INSTITUTION: UNIVERSITY OF CONNECTICUT–AVERY POINT

## Development of Alternatives to the Use of Freshwater Low Value Fish for Aquaculture in the Lower Mekong Basin of Cambodia and Vietnam: Implications for Livelihoods, Production and Markets

*Printed as Submitted by Robert Pomeroy, US Lead PI*

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- Hap Navy, Inland Fisheries Research and Development Institute, Phnom Penh, Cambodia
- Tran Thi Thanh Hien, College of Aquaculture and Fisheries, Cantho University, Cantho, Vietnam
- Le Xuan Sinh, College of Aquaculture and Fisheries, Cantho University, Cantho, Vietnam


## Investigation Progress Reports

***Investigation 1: 07MER01UC: Competition and impacts between use of low value/trash fish for aquaculture feed versus use for human food***

Reviewed related literature: Review all relevant literature regarding the inland wetland aquatic resources in the Lower Mekong Basin. Priority was given to the common fishing activities, marketing and use of fish products. The review was aimed to summarize the knowledge on existing wild fish capture technology and how the captured fish is distributed and used.

**Orientation of team members:** A team of six members has been established in CTU – Vietnam, while another team of five members has been mobilized at IFReDI – Cambodia. Orientation within the investigation team members was conducted to educate team members to be knowledgeable about the project document and to be responsible to do the assigned work in the process of project implementation.

**Consultation meeting between investigations:** This investigation 1 is being implemented along with investigation 3 in CTU and investigation 4 in both IFReDI and CTU. The consultation was made with different team members from two investigations in CTU (1 & 3) and with those in IFReDI (1 & 4) for synchronization of the preparation & implementation of related activities. The consultation was also to establish a link of each investigation in terms of its activities, planning, and implementation. The consultation was conducted to inform the team members the rule, policies, and procedure of the AquaFish.

**Site selection for the investigation:** A total of eight days for two different field trips were organized to contact local officials, to collect the secondary data, to conduct a preliminary assessment, and to select the sites for investigation 1 in Vietnam. Initial provinces have been selected: An Giang, Dong Thap, Can Tho and Hau Giang. Long An and Tien Giang provinces are also considered due to their location (located in the far north west of MKD). Two districts will be surveyed in each province of An Giang, Dong Thap, and Can Tho while one district will

be surveyed in each province of Hau Giang, Long An and/or Tien Giang. The same activities were conducted in Cambodia. A total of eight days for field visit, site selection, and collect some general information of the study site. This occurred in four provinces: Kandal, Kampong Cham, Kampong Chhnang and Siem Reap. Two districts and two communes were selected for the study in each province.

**Site visit:** One field visit was organized for PI (Dr Robert Pomeroy) and Dr Bengston to visit the snake head and Pangasius catfish farms in An Giang province on 26 July 2008.
Developed Questionnaire and Pre-tested: Two set of designed forms for data collection have been prepared by the team of investigation 1 in CAF and discussed for improvement with Dr Robert Pomeroy. These forms will be pretest before being used for formal surveys from the end of October 2008. These include the forms for key informant interviews; group discussions of low value fish; group discussions of snakehead fish; fisher interviews; fish trader interviews; fish user interviews; and snakehead fish farmer interviews. Conducted training for project staff and participating students on how the forms were developed and the basis of data collection, encoding and analysis.

**Staffing:** Five staff of CAF have been assigned to help design and pretest the set of questionnaires, as well as to participate in the field trip for secondary data collection and individual surveys. They are: (1) Mr. Nguyen Thanh Toan; (2) Mr. Vo Thanh Toan; (3) Mr. Huynh Van Hien; (4) Mr. Do Minh Chung; (5) Ms. Dang Thi Phuong. Two of them have master degree, two are following master programs at Cantho University, and the last one is a young agricultural economist. In total, there are 6 staffs of CAF working under the investigation I included HC PI. Four staff of IFReDI have been assigned to be involved with this project: (1) Ms. Sung Sokunthea, (2) Ms. Hing Sopheavy, (3) Mr. Meas Vichet, and (4) Mr. Soeun Nong. This team in Cambodia is led by Hap Navy.

**Problems Encountered:** The study of low value fish is dependent on the peak of fish harvesting season which will be from October to December 2008 in Vietnam and up to January of 2009 in Cambodia. Therefore, we need to arrange the time to conduct the field surveys of capture and marketing of low value fish during that time period. On the other hand, the harvest of cultured snakehead fish is from the end of December 2008 to February 2009 and this demands that the team to conduct the surveys of snakehead farming should be done later. The farming of snakehead fish is banned in Cambodia, thus the survey of farming this species will be conducted in Vietnam only.

**Summary:** The project implementation was delayed for one year. A number of related documents have been reviewed. The site selection for field surveys has been made. Research instruments were developed and tested. Actual interviews will be conducted from this October of 2008 to the coming February of 2009. All of the activities of this investigation are in good process and we need to receive the funds in time for conducting the planned activities in time.

***Investigation 2: 07MNE01UC: Assessment of diversity and bio-ecological characteristics of low value/trash fish species***

**Literature review:** Literature was extensively reviewed, and a list of more than 60 references was prepared including:

(1) Catch and production, utilization and importance, and management and conservation of fish and fisheries resources in Cambodia, and other Mekong riparian countries;
(2) Bio-ecology of fish species in Cambodia and other Mekong riparian countries, and Asia;
(3) Processing (fermented fish) technologies, marketing, distribution channels and trade patterns of fish and fish products in Cambodia as well as in the other countries of the Mekong River basin (i.e. Laos, Thailand and Vietnam);
(4) Trash fish and fish meal in Mekong countries and other countries in Asia;

(5) Role and use of low value fish as direct feed for aquaculture development in Cambodia as well as in the other Mekong riparian countries
(6) Aquaculture development and its trends in Cambodia and other Mekong riparian countries, Asia and in the world; and
1. Fisheries statistics of Cambodia (1990-2007), Mekong Fish Database (2003), and FishBase

**IFReDI Orientation Meeting:** This meeting was organized on 25-27 February at Inland Fisheries Research and Development Institute (IFReDI), Phnom Penh, Cambodia, and participated by all IFReDI colleagues who are involving in the investigation. The specific objectives of the meeting were:

(1) To understand of AquaFish CRSP;
(2) To enhance knowledge of understanding project details (Investigation 2, 4 and 5);
(3) To give a general consensus on project schedule and activities;
(4) To identify and assign roles and responsibilities of team members;
(5) To finalize budget allocations; and
(6) To finalize Project proposal and workplan for implementation.

**Site and interviewee selection in the field:** Pre-surveys and consultations with provincial fisheries administrations in seven target provinces (Kampong Cham, Prey Veng, Kandal, Phnom Penh, Kampong Chhnang, Battambang and Siem Reap) and their local authorities, and NGOs (e.g. JICA-FAIEX, MRC-Aquaculture/Fisheries Projects, OXFAM America- Fisheries Project, USAID- Aquaculture Enterprise Development Project) who are working on aquaculture and fisheries development in those provinces were conducted. Approximately 2.5 days were spent in each province, including travel (in total 18 days). The major objectives of these pre-surveys and consultations are to:
To inform those relevant stakeholders about the AquaFish CRSP Project;
To identify specific sampling locations, key informants (provincial fisheries officers, fisheries communities, and village and commune chiefs), and interviewees (including experienced fishers, fish farmers, fish and fish products exporters, wholesalers, traders, retailers, and fish fermented processors) at each sampling location to be interviewed.

**AquaFish CRSP inception workshop:** A one-day inception workshop was organized on 13 June 2008 at IFReDI, Phnom Penh and participated by senior fisheries officers/official and policy decision markers from the Central Fisheries Administration (FiA) in Phnom Penh (i.e. all FiA divisions and R & D centers/institutes) and from Provincial Fisheries Administration (the seven project target provinces: Kampong Cham, Prey Veng, Kandal, Phnom Penh, Kampong Chhnang, Battambang and Siem Reap province) where the Project will be implemented in, universities (i.e. Royal University of Agriculture and Prek Leap National School of Agriculture) where undergraduate and graduate thesis students come from, and NGOs (WorldFish Center, FAO, JICA-FAIEX, MRC-Aquaculture/Fisheries Projects, OXFAM America- Fisheries Project, USAID- Aquaculture Enterprise Development Project- DAI, Spanish Aquaculture Project) who are working on aquaculture and fisheries development in Cambodia. In total 30 people were invited for this workshop. The objectives of this workshop were:

(1) To inform these senior fisheries officers and those from relevant NGOs about the AquaFish CSRP/USIAD programs and projects;
(2) To provide knowledge of understanding Project details;
(3) To inform some progress as a result of the late start of the Project;
(4) To inform adjustments of schedules and activities to produce outputs in the remaining months; and
(5) To kick-off the Project officially.

**Questionnaires development:** The field data and information will be collected by using questionnaire forms. Several questionnaire forms were developed as follows:

(1) Questionnaire form I, II and III to obtain data and information of species diversity, catch and abundance, importance, and management of low value or small-sized fish resources respectively from small-scale and medium scale fishers, large-scale bag-net fishers, and large-scale fishing lot operators/owners in the Cambodia and Vietnam Mekong River basin in order to achieve objectives # 1, 2, 3, 4, 5, 7 and 8 (See Statement of Work in PSA);
(2) Questionnaire form IV to obtain data and information on ecological, technological and socioeconomic impacts of the use of low value or small-sized fish in Cambodia and Vietnam in order to achieve objectives # 3, 4, 6, 7 and 8 (See Statement of Work in PSA).

**Pre test and revision of the developed questionnaires:** The above questionnaire forms were tested by four IFReDI data collectors (3 biologists and 1 socio-economist), 1 project research assistant, 1 HC Lead PI, and 6 thesis students with small- and medium- scale fishers (Questionnaire form I), large-scale bag-net fishers (Questionnaire form II), large-scale fishing lot operators (Questionnaire form III), commercial-scale cage and pond aquaculture farmers (Questionnaire form IV). The IFReDI spent three days to conduct the pre-tests. Afterward the questionnaire forms were revised for full individual interviews.

**Services and supplies:** Jointly with Investigation # 4 (coordinated by Dr. Prum Somany) to organize an inception workshop on 13 June 2008; purchased a laptop and a digital camera; and provided trainings to project staff and students on how to review relevant literature and to write project concept note or short proposal and how to develop questionnaires to obtain field data and information according Project set objectives.

**Slight change in the implementation plan:** It was suggested by the participants of the AquaFish CRSP orientation meeting on 26 – 27 May 2008 at IFReDI, Phnom Penh, Cambodia that two more issues should be added to the existing Methodology, i.e. (1) the ground truthing to check quality of data and information of fish species and diversity jointly by IFReDI fish biologists (researchers) and fishers; and (2) catch analysis of low value or small-sized fish species caught dai or bag net gear along Tonle Sap River. This will be done in the dai fishing season December-January to estimate the total catch of low value fish and species catch composition in dai fishery along Tonle Sap River.

***Investigation 3: 07SFT01UC: Alternative feeds for freshwater aquaculture species***

**Reviewed related literature:** Review all relevant literature regarding the situation of using feed for snakehead culture in the Lower Mekong Basin and snakehead requirements. The review was aimed to use the knowledge on existing aquaculture technology to transform into the printed media for dissemination to the project sites.

**Orientation of team members:** A team of three members has been established in CTU – Vietnam. Orientation within the investigation team members was conducted to educate team members to be knowledgeable about the project document and to understand the requirements need to be accomplished by the members in the process of project implementation.

**Consultation meeting between investigations:** This investigation is being implemented along with investigation 3 in CTU and investigation 4 in both IFReDI and CTU. The consultation meeting was held with different team members from the two investigations in CTU (1 & 3) and with those in IFReDI (1 & 4) for a synchronization of the preparation and implementation of related activities. The consultation was also to establish a link of each investigation in terms of its activities, planning, and implementation. The consultation was conducted to inform the team members the rule, policies, and procedure of the AquaFish.

**Site selection for the investigation:** A total of 15 days on five different field trips were organized to contact local officials, to collect the secondary data, to undertake preliminary

assessment, and to select the sites for investigation 3 in Vietnam. Initial provinces have been selected: An Giang, Dong Thap.

**Visited the sites:** One field visit was organized for PI (Dr Robert Pomeroy) and Dr Bengston to visit the snake head and Pangasius catfish farms in An Giang province on 26 July 2008.

**Research activity:** Protocol completion for all of experiments of the investigation. Formulation of diets was done at Cantho University based on information about chemical composition of locally available plant products in the Mekong Delta of Vietnam. Breeding and nursing of snake head (Chana striatus) from fry to fingerling stage at AnGiang province. Collecting of low value freshwater fish samples every month (August to Dec, 2008) at three locations: Chaudoc, Chauphu and Longxuyen district of AnGiang province. The first three feeding trials were finished on 15 October 2008.

**Services and supplies:** The wet lab at Cantho University used for feeding trials was upgraded with 45 new fiberglass tanks and water and aeration equipment. Fish and ingredients for feeding trial were purchased.

**Staffing:** Three staff of CAF have been assigned to the field trip and feeding trial management. They are: (1) Ms: Tran Le Cam Tu; (2) Mr. Tran Minh Phu and Mr. Nguyen Hoang Duc Trung. Two of them are following master program and the last one is a young aquaculture scientist.

**Problems Encountered:** No problems have been encountered to date.

**Summary:** The project implementation was delayed for one year. A number of related documents have been reviewed. The site selection for field surveys has been made. Research instruments were developed and tested. All of the activities of this investigation are in good process and we need to receive the funds in time for conducting the planned activities in time.

***Investigation 4: 07TAP01UC: Feed technology adoption and policy development for fisheries and aquaculture management***

**Reviewed related literature:** Review all relevant literature regarding the fish process technologies and existing practical aquaculture technologies which have been successfully implemented by AIT Aquaculture Outreach Program and JICA Aquaculture Development Program in Cambodia. The review was aimed to use the knowledge on existing aquaculture technology to transform into the printed media for dissemination to the project sites.

**Orientation of team members:** Orientation of the investigation team members was conducted to internalize team members to be aware of the project document and to understand the requirements needed to be accomplished by the members in the process of project implementation.

**Consultation meeting between investigations in IFReDI:** A consultation meeting with different team members from three investigations in IFReDI was held to provide an opportunity to all members implementing the AquaFish CRSP projects in IFReDI to be aware of the process and procedure as well as the goals and objectives of the whole project and particularly the three investigations. The consultation was also to establish a link of each investigation in terms of its activities, planning, and implementation. The consultation was conducted to inform the team members the rule, policies, and procedure of the AquaFish.

**Inception Workshop:** The inception workshop was conducted on June 13, 2008 at IFReDI to provide awareness of the project implementation to the other relevant stakeholders whose work related to aquaculture development sector and also to seek suggestions and recommendation from the participants. Thirty (30) participants were invited to participate in this workshop.

Fourteen participants were from seven provinces, seven from NGOs, two from universities, and seven from Fisheries Administration staff.

**Select sites for targeted technology adoption and interventions:** A total of 10 days for three different field trips were organized for a preliminary assessment and selection of investigation sites for targeted technology adoption and intervention for four provinces: Siem Reap, Battambeng, Pursat, and Kompong Chhnang Province. The trips were arranged to make a preliminary assessment of existing aquaculture feeding practices and aquatic resources issues and problems at the sites. One trip was made to assess and understand the fish processing process of private Fish Paste Company and the household fish paste producers in Battambang province. The trip was designed to do a preliminary survey on the best fish processing producers and identified as targeted group to be interviewed in the peak period of small size fish harvesting in December and January to come.

**Visited Local Fish Feed Producers:** One trip was made to visit three local fish feed producers in Kandal province to understand the appropriate technology to produce fish feed by local knowledge to help improve fish feed from direct trash fish and to help protect environment from over-fishing for fish feeding purposes. This local knowledge on appropriate fish feed technology will be produced in printed media such as leaflet and poster in next project period.

**Developed Questionnaire and Pre-tested:** Two set of questionnaires have been developed and pre-tested. The revision of questionnaires will be finished in November prior to actual data collection at the peak season of trash fish in the end of November and in December or until January 2009.

**Services and supplies:** Purchased a laptop, a digital camera, and a Laser Color Printer; conducted trainings to project staff and students on questionnaire formulation, data encoding, basic photography, and data analysis.

**Staffing:** There are two IFReDI's staff recruited to help in questionnaire preparation and pre-testing and will be involved in the investigation as data enumerators: 1) Mr. Meas Vichet and 2) Mrs. Sim Thavary, both of them are pursuing Master degree in integrated agriculture management at Royal University of Agriculture in Cambodia. There is a total of four staff working under the investigation IV included HC PI.

**Problems Encountered:** The study of low valued fish is dependent on the peak of fish harvesting season which will be in this coming November to January, 2009. Therefore, we need to wait until November this year to conduct interview with people on how they use low valued fish.

**Summary:** The project implementation was delayed for one year. A number of related documents have been reviewed. Research instruments were developed and tested. Actual interviews will be conducted in this coming November and December 2008. The investigation will achieve its objectives with best results.

***Investigation 5: 07FSV01UC: Maximizing the utilization of low value or small size fish for human consumption through appropriate value added product development***

**Literature review:** Literature was extensively reviewed, and a list of more than 60 references was prepared including:

(1) Catch and production, utilization and importance, and management and conservation of fish and fisheries resources in Cambodia, and other Mekong riparian countries;
(2) Bioecology of fish species in Cambodia and other Mekong riparian countries, and Asia;
(3) Processing (fermented fish) technologies, marketing, distribution channels and trade patterns of fish and fish products in Cambodia as well as in the other countries of the Mekong River basin (i.e. Laos, Thailand and Vietnam);

(4) Trash fish and fish meal in Mekong countries and other countries in Asia;
(5) Role and use of low value fish as direct feed for aquaculture development in Cambodia as well as in the other Mekong riparian countries
(6) Aquaculture development and its trends in Cambodia and other Mekong riparian countries, Asia and in the world; and
(7) Fisheries statistics of Cambodia (1990-2007), Mekong Fish Database (2003), and FishBase

**IFReDI Orientation Meeting:** This meeting was organized on 25-27 February at Inland Fisheries Research and Development Institute (IFReDI), Phnom Penh, Cambodia, and participated by all IFReDI colleagues who are involving in the investigation. The specific objectives of the meeting were:
(1) To understand of AquaFish CRSP;
(2) To enhance knowledge of understanding project details (Investigation 2, 4 and 5);
(3) To give a general consensus on project schedule and activities;
(4) To identify and assign roles and responsibilities of team members;
(5) To finalize budget allocations; and
(6) To finalize Project proposal and workplan for implementation.

**Site and interviewee selection in the field:** Pre-surveys and consultations with provincial fisheries administrations in seven target provinces (Kampong Cham, Prey Veng, Kandal, Phnom Penh, Kampong Chhnang, Battambang and Siem Reap) and their local authorities, and NGOs (e.g. JICA-FAIEX, MRC-Aquaculture/Fisheries Projects, OXFAM America- Fisheries Project, USAID- Aquaculture Enterprise Development Project) who are working on aquaculture and fisheries development in those provinces were conducted. Approximately 2.5 days were spent in each province, including travel (in total 18 days). The major objectives of these pre-surveys and consultations are to:
To inform those relevant stakeholders about the AquaFish CRSP Project;
To understand and collect background information of aquaculture and fisheries development (including fish processing technologies, marketing and trade of fish and fish products and processed fish) in those target provinces; and
To identify specific sampling locations, key informants (provincial fisheries officers, fisheries communities, and village and commune chiefs), and interviewees (including experienced fishers, fish farmers, fish and fish products exporters, wholesalers, traders, retailers, and fish fermented processors) at each sampling location to be interviewed.

**AquaFish CRSP inception workshop:** A one-day inception workshop was organized on 13 June 2008 at IFReDI, Phnom Penh and participated by senior fisheries officers/official and policy decision markers from the Central Fisheries Administration (FiA) in Phnom Penh (i.e. all FiA divisions and R & D centers/institutes) and from Provincial Fisheries Administration (the seven project target provinces: Kampong Cham, Prey Veng, Kandal, Phnom Penh, Kampong Chhnang, Battambang and Siem Reap province) where the Project will be implemented in, universities (i.e. Royal University of Agriculture and Prek Leap National School of Agriculture) where undergraduate and graduate thesis students come from, and NGOs (WorldFish Center, FAO, JICA-FAIEX, MRC-Aquaculture/Fisheries Projects, OXFAM America- Fisheries Project, USAID- Aquaculture Enterprise Development Project- DAI, Spanish Aquaculture Project) who are working on aquaculture and fisheries development in Cambodia. In total 30 people were invited for this workshop. The objectives of this workshop were:
(1) To inform these senior fisheries officers and those from relevant NGOs about the AquaFish CSRP/USIAD programs and projects;
(2) To provide knowledge of understanding Project details;
(3) To inform some progress as a result of the late start of the Project;
(4) To inform adjustments of schedules and activities to produce outputs in the remaining months; and
(5) To kick-off the Project officially.

**Questionnaires development:** The field data and information will be collected by using questionnaire forms. Several questionnaire forms were developed as follows:

(1) Questionnaire form V, VI, VIII and VIII to obtain data and information of market chain and trade of fermented products of low value fish (i.e. prohoc in Khmer) from exporters/wholesalers, traders, retailers and processors in order to achieve objectives # 10, 11, 12 and 13 (See Statement of Work in PSA); and

(2) Questionnaire form IX to obtain data and information of processing (fermented) technologies of low value or small-sized fish in Cambodia (i.e. prohoc in Khmer), including Best Management Practice (BMP) for increasing in processing products of low value fish from processors in order to achieve objectives # 9, 11, 12 and 13 (See Statement of Work in PSA).

**Pre test and revision of the developed questionnaires:** The above questionnaire forms were tested by four IFReDI data collectors (3 biologists and 1 socio-economist), 1 project research assistant, 1 HC Lead PI, and 6 thesis students with fermented low value fish exporters (Questionnaire form V), fermented LVF traders (Questionnaire form VI), fermented LVF retailers (Questionnaire form VII), fermented LVF processors in the two provinces Kandal and Phnom Penh (Questionnaire VIII and IX). The IFReDI spent three days to conduct the pre-tests. Afterward the questionnaire forms were revised for full individual interviews.

**Slight change in the implementation plan:** As a result from the Project pre-surveys and consultations with local fisheries officers (see above section) and AquaFish CRSP orientation meeting on 26-27 May 2008 (see above section), two locations of field work have been changed from Prey Veng and Kampong Cham to Phnom Penh and Siem Reap because of more availability of and accessibility to low value fish fermenting practices and technologies, and market and trade in these two latter provinces, and the number of sampling locations has been kept the same as in the original Implementation Plan.

## Presentations of Dr. So Nam (lectures and seminars, etc.)

| Category | Topic Title of course, seminar, etc. | Location | Date (dd/mm/yy) | Audience type |
|---|---|---|---|---|
| Lecture | Overview of low value fish resources: trends in catch and abundance, utilization, and management | Royal University of Agriculture, Phnom Penh, Cambodia | - 21/07/07<br>- 25/08/07<br>- 08/09/07<br>- 17/11/07<br>- 26/01/08<br>- 08/03/08<br>- 05/04/08<br>- 10/05/08<br>-12/06/08<br>- 20/08/08 | M.Sc. Graduate students |
| Lecture | Socio-technological assessment of the utilization and importance of low value fish in Cambodia and other Mekong riparian | Royal University of Agriculture | - 21/07/07<br>- 25/08/07<br>- 08/09/07<br>- 17/11/07<br>- 26/01/08<br>- 08/03/08<br>- 05/04/08<br>- 10/05/08<br>- 17/07/08<br>-20/08/08 | M.Sc. Graduate students |

| Category | Topic Title of course, seminar, etc. | Location | Date (dd/mm/yy) | Audience type |
|---|---|---|---|---|
| | countries | | | |
| Lecture | Catch and market chain of low value fish along the Tonle Sap River, Cambodia | Royal University of Agriculture | - 21/07/07<br>- 25/08/07<br>- 08/09/07<br>- 17/11/07<br>- 26/01/08<br>- 08/03/08<br>- 05/04/08<br>- 10/05/08<br>- 22/07/08<br>- 16/09/08 | M.Sc. Graduate students |

## Conferences attended on AquaFish CRSP funds

| Name of attendee | Name of conference | Location | Month/Year (mm/yy) | Presented (y/n) |
|---|---|---|---|---|
| So Nam, Somany, Pomeroy | AquaFish Orientation and Pre-Synthesis Meeting | Washington DC, USA | 21-22 May 2007 | y |
| So Nam, Somany, Hien, Pomeroy, Sinh, Bengston, Lee | AquaFish CRSP Annual Meeting | Busan, S. Korea | 18-19 May 2008 | y |
| So Nam, Somany, Hien, Bengston, Lee | World Aquaculture Society Meeting | Busan, S. Korea | 19-23 May 2008 | y |

***AquaFish CRSP team orientation meeting***

This meeting was organized on 26 - 27 May at Inland Fisheries Research and Development Institute (IFReDI), Phnom Penh, Cambodia, and participated by IFReDI colleagues (Dr. Prum Somany, Mr. Leng Sy Vann, Mrs. Hap Navy, Dr. SoNam), collaborators from Can Tho University, Viet Nam (Dr. Le Xuan Sinh and Dr. Tran Thi Thanh Hien), University of Connecticut, USA (Dr. Robert Pomeroy) and University of Rhode Island, USA (Dr. David Bengtson), and thesis students from Royal University of Agriculture (Miss. Norng Chakrya, Miss. Un Sophea and Mr. Choup Soniwath) and from Prek Leap National School of Agriculture (Miss. Sok Sophean). The orientation was conducted to bring all the US PIs and HC PIs to fully understand the process and procedure of the project implementation. The specific objectives of the meeting were:

(1) To understand of AquaFish CRSP;
(2) To enhance knowledge of understanding project details (Investigation 1, 2, 3, 4 and 5);
(3) To give a general consensus on project objectives, research methods, research locations, and schedules and activities;
(4) To identify and assign roles and responsibilities of team members;

(5) To finalize budget allocations;
(6) To finalize Project proposal and workplan for implementation;
(7) To discuss timing of activities and progress as a result of the late start;
(8) To discuss reporting to AquaFish CRSP and USAID;
(9) To discuss management and leadership, and administration and fund transfer for host country partners to implement their field activities;
(10) To discuss team communication using Skype and Yahoo Messenger; and
(11) To discuss continuation funding (Second Phase).

***Professional and technical contacts with international and US colleagues:***
Contacts about the project were made through phone, emails or in person with the following international/regional institutions:

- WorldFish Center
- Network of Aquaculture Centers in Asia Pacific, Bangkok
- Mekong River Commission, Vientiane
- Kasetsart University, Bangkok
- University of Trupura, India
- University of Sterling, UK
- Virginia Commonwealth University, Virginia

## DTAP Indicators for the Project:

**DTAP A: Improved Health and Nutrition, Food Quality, and Food Safety of Fishery Products**

- *Number of aquaculture products developed that meet food safety standards*
  0

**DTAP B: Income Generation for Small-Scale Fishers and Farmers**

- *Number of new biotechnologies developed*
  0
- *Number of institutions with access to technological practices*
  0
- *Number of (people) trained in use of technological practices*
  0

**DTAP C: Environmental Management for Sustainable Aquatic Resources Use**

- *Number of hectares under improved natural resource management*
  0
- *Number of management practices developed to support biodiversity*
  0
- *Number of management practices developed that reduce consumptive water use*
  0
- *Number of people trained in practices that promote soil conservation and/or improved water quality*
  0
- *Number of management systems developed that increase production by reusing aquaculture effluents & byproducts*
  0
- *Number of IPM practices developed*
  0

**DTAP D: Enhanced Trade Opportunities for Global Fishery Markets**

- *Number of new markets for aquatic products*
  0
- *Number of aquatic products available for human food consumption*
  0

Table IV-1. Listing of 19 small-sized fish species pictured in the cover photo taken by University of Connecticut–Avery Point project HCPI So Nam[1].

| Scientific name | English name | Khmer Name in Roman | Remark[2] |
|---|---|---|---|
| *Amblyrhynchichthys truncates* | NA | Kambot chramos | SSF species |
| *Cirrhinus jullieni* | NA | Phkar char | SSF species |
| *Cirrhinus lobatus* | NA | Riel angkam | SSF species |
| *Cirrhinus siamensis* | Siamese mud carp | Riel top | SSF species |
| *Crossocheilus reticulatus* | NA | Changva chunchuk | SSF species |
| *Gyrinocheilus aymonieri* | Chinese/Siamese algae-eater | Bandol sok or Snok | Juvenile of commercially important fish species (max. TL = 35 cm) |
| *Labeo chrysophekadion* | Black sharkminnow | Ka-ek | Juvenile of commercially important fish species (max. TL = 90cm) |
| *Labiobarbus lineatus* | NA | Khnorng veng | SSF species |
| *Labiobarbus siamensis* | NA | Arch kok | SSF species |
| *Lobocheilos melanotaenia* | NA | Changva ronoung | SSF species |
| *Osteochilus microcephalus* | NA | Kros | SSF species |
| *Paralaubuca typus* | Pelagic river carp | Sleuk russey | SSF species |
| *Parambassis wolffii* | Duskyfin glassy perchlet | Kantrorng preng | SSF species |
| *Pseudolais micronemus* | Shortbarbel pangasius | Pra po | Juvenile of commercially important fish species (max. TL = 107cm) |
| *Syncrossus helodes* | Tiger botia | Kanhchrouk chnot | SSF species |
| *Thynnichthys thynnoides* | NA | Linh | SSF species |
| *Yasuhikotakia lecontei* | Silver loach | Kanhchrouk leung | SSF species |
| *Yasuhikotakia modesta* | Redtail botia | Kanhchrouk krohorm | SSF species |
| *Yasuhikotakia sp.* | NA | Kanhchrouk | SSF species |

[1] For additional information on the project investigation, see the UConn Annual Report entry for 07FSV01UC.
[2] Fish which is defined as small-sized fish has its maximum total ength of < 25 cm

# LEAD US INSTITUTION: UNIVERSITY OF HAWAI'I AT HILO

**Human Health and Aquaculture: Health Benefits Through Improving Aquaculture Sanitation and Best Management Practices**

*Printed as Submitted by Maria Haws, US Lead PI*

## Investigation Progress Reports

***Investigation 1: 07IND03UH: Spat collection, growth rates and survival of the native oyster species, Crassostrea corteziensis at Santa Maria Bay, Mexico***

This work is being initiated late since delayed disbursement of funds prevented work from beginning at the start of the 2007 annual oyster spawning and settlement season (June through October). Preparations have been completed for this work, which will begin in October 2008. Visits have been made by researchers and community members from Santa Maria Bay to the main culture area (Boca de Camichin, Nayarit State) for the native oyster, Crassostrea corteziensis, commonly known as the "Pleasure Oyster". The purpose of the visits was to observe the culture methods used at Boca de Camichin and learn the culture methods so they can be transferred to new culture sites at Santa Maria Bay. Professor Olga Olivia Lopez Sanchez (Autonomous University of Sinaloa, School of Marine Sciences) also attended the bivalve culture and sanitation workshop held at Louisiana State University as she will be supervising the trials. A student (Saul Lopez Sanchez, UAS) was also selected to work on this investigation which will comprise his senior thesis research. Mr. Lopez Sanchez is from the Bahia Santa Maria area and plans to return there to work with aquaculture after his graduation. He also attended the International Workshop on Shellfish Sanitation and Culture held in September 2008. A meeting was held with the women's group from Playa Colorado that is now culturing the Japanese Oyster (Crassostrea gigas) in Santa Maria Bay and a group of male oyster farmers working at another site on the Bay (Costa Azul) to plan out the investigation and select a site for the trials. It was decided that the project site would be located close to the men's farm so that they can provide security. The trials with spat collection and growout will begin in October as that is the principal season for oyster recruitment in the area. This work is slated for completion in July 2009.

***Investigation 2: 07IND04UH: Oyster-relaying and depuration in open-water locations***

This investigation is slightly delayed as engineering difficulties were encountered in establishing a depuration site in the area originally designated. This required the research team to conduct a series of consultations with experts in the area of oyster depuration. Additionally, serous flooding occurred in the oyster culture area which cut off access to the area and killed large numbers of oysters. Another site has since been selected and evaluated with work scheduled to resume in October 2008. This work is projected to be completed in July 2009.

***Investigation 3: 07WIZ02UH: Determination of the carrying capacity of Boca de Camichin Estuary, Mexico, in reference to oyster culture***

The first community meeting was held on November 30, 2007 with the oyster producers of Boca de Camichin, Nayarit State, to present the project and community collaboration with the project. Since that time, sampling has been conducted four times, with water samples totaling 216. Parameters being measured are inorganic and organic materials, temperature, salinity, and dissolved oxygen. At each sampling period, biometric measurements of oysters are being taken at three sites longitudinally distributed along the length of the estuary. Data on mortality is also being taken. Two students are participating in this work, Laura Edith Corona Osuna and Jorge Alberto Domínguez Sandoval, both of whom are in the fifth year of their studies related to Fisheries and Marine Sciences at UAS. Ms. Coruna Osuna will defend her thesis in December

2008 and Mr. Dominguez Sandoval will defend his in January 2009. The carrying capacity study will be finished in March 2009.

***Investigation 4: 07HH103UH: International Workshop for Aquaculture Sanitation***
This work has been completed. The workshop was held in two parts. The first component was held at UAS in Culiacan, Mexico on Sept. 22-24 and included two days of conferences with 19 presentations, and one day of field visit to a pilot site where shellfish polyculture (oyster, pen shell, shrimp) is being demonstrated in conjunction with a Santa Maria Bay community. Thirty-six persons participated in this part of the workshop. This area of the Bay (Altata) is now targeted for shellfish growing water classification by the State of Sinaloa and the Mexican Federal Government. The second component was conducted in Nayarit State in Santiago Ixcuintla. One day of presentations (11) were held the first day. Thirty-nine persons participated in this part of the workshop. Two field visits were made; the first on September 26 to a major oyster growing area, Pozo Chino. This area is one which is now projected for shellfish growing water classification by the State of Nayarit and the Mexican Federal Government. The second field visit on September 27 was to another major oyster growing area, Boca de Camichin.

Workshop organizers included: UAS, Sinaloa Institute of Aquaculture, Sinaloa State Aquaculture Sanitation Committee, CIAD, National Polytechnical Institute (CIIDIR-IPN), Autonomous University of Nayarit and University of the Coast. Dr. John Supan from LSU also participated. An industry volunteer from the U.S., Mr. David Nisbet, owner of Goosepoint Oyster Company, also attended and provided technical input. Erick Sandoval, CRSP Collaborator and Microbiologist at UCA-Nicaragua, attended the workshop and made several presentations. He also visited several microbiology and public health laboratories in Culiacan and Nayarit. The US PI, Maria Haws, also participated in organizing the workshop and made several presentations.

It should be noted that the two efforts currently underway to classify shellfish growing waters at Altata (Sinaloa) and Pozo Chino (Nayarit) are direct outcome from previous ACRSP work. Water quality sampling revealed that E. coliform levels are low enough to justify the expense of classifying these areas which the growers and researchers used to make the request for classification to the government agencies. Classification of growing waters not only helps protect the health of local consumers, but opens the door to export to the U.S. Several buyers in the U.S. have expressed interest in buying shellfish from these areas once acceptable classification is in place.

***Investigation 5: 07HH104UH: Regional workshop on shellfish culture and sanitation***
This workshop is in the planning stages and is expected to take place in early 2009.

***Investigation 6: 07BMA04UH: Training in best management practices for the production of mollusks in the States of Nayarit and Sinaloa***
This series of training events is planning and will take place during the first half of 2009.

***Investigation 7: 07HH105UH: Microbiological quality of bivalve growing waters and tissues***
A work plan change request was approved for this work in July 2008. Preliminary water quality monitoring demonstrated that water quality in two of the three estuaries originally selected for work with relaying and depuration trial was so poor that efforts to depurate bivalves in situ would not be possible. Hence the work focuses on one estuary (Aserradores) where water quality is sufficiently good in some sites that relaying and depuration is potentially feasible. The research will involve selecting potential depuration sites within the estuary and monitoring water quality and tissues of black cockles (Anadara spp.) to determine whether depuration to suitable microbiological levels actually takes place. Laboratory trials will also be conducted to validate the depuration rates in Anadara spp. If successful, the depurated cockles will be test

marketed under the CIDEA seal to determine if consumers are willing to pay a higher price for cleaner and safer products.

Since the work change plan was approved in July, the work is now on schedule. Water quality has been monitored for two periods (August and September). Cockle tissue samples were also taken at the same time and will be analyzed in the laboratory in Managua. Discussions are also underway with the European Union representative in Nicaragua to leverage funding to permit expansion of this effort to include a packaging center for the depurated bivalves in order to increase the value of the product and maintain its safety during post-harvest handling, develop a best management practices manual for depuration and to eventually legally certify the product by government agencies. An engineering student (Andrés Brenes Altamirano) has been involved in this work and will also conduct a related series of studies for his thesis examining the impact of run-off from agricultural and animal husbandry activities on shellfish quality in the area.

***Investigation 8: 07BMA05UH: Intensive training and internship in bivalve culture and shellfish sanitation***

This training event was held in New Orleans and Grand Isle Louisiana June 8-17. Participants included:

-Dr. John Supan, Hatchery Director and Researcher, LSU Sea Grant Program
-Two LSU graduate students
-Dr. Maria Haws, Pacific Aquaculture and Coastal Resources Center, University of Hawaii Hilo and UH Sea Grant College Program
-Nelvia Hernandez, CRSP Co-PI, UCA, Nicaragua
-Olga Zamudio Armenta, UAS, CRSP Collaborator, Mexico

The first two days of the workshop were spent attending the annual meetings of the Shellfish Sanitation Meeting for the Southeastern States. This included visits to Motivatit Seafoods, a company which uses hydrostatic pressure as a post-harvest treatment for oysters, and a second company which uses a pasteurization post-harvest treatment. The remainder of the workshop was spent in training and hatchery work at the LSU oyster hatchery located at Grand Isle, Louisiana. This training included topics in microalgae culture, larviculture, grow-out methods, oyster restoration and emergency preparedness. Ironically, shortly thereafter, the hatchery was destroyed for the second time by Hurricane Gustav but due to the LSU emergency plan, much of the equipment and materials were saved. This plan and strategies are now being used to inform other hatcheries around the world that are vulnerable to natural disasters. Follow-up after the workshop to evaluate the effectiveness of the training demonstrates that the participants have been able to utilize the knowledge and skills gained. For example, Olga Zamudio Armenta has since taken on work related to two of the CRSP investigations in Mexico; Nelvia Hernandez is involved in the planning process for a hatchery to be built in Nicaragua; and Maria Haws and her graduate student Daren Gariques have replicated the LSU microalgae bag culture system at UHH.

## List of Participants in the Human Health Project

US PI: Maria Haws
Pacific Aquaculture and Coastal Resources Center
University of Hawaii Hilo
Hilo, Hawaii

UC Co-PI: William Steiner
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University of Hawaii Hilo
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US Co-PI: Sharon Ziegler-Chong
Associate Director (Interim), Pacific Aquaculture and Coastal Resources Center
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US Co-PI: John Supan
Louisiana State University
Baton Rouge, Louisiana

HC PI: Eladio Gaxiola Camacho
Autonomous University of Sinaloa-Culiacan
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HC Co-PI: Guillermo Rodriguez Domingo
Director, School of Marine Science
Autonomous University of Sinaloa-Mazatlan
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HC Co-PI: Ambrocio Mojardin Heraldez
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Collaborator: Olga Zamudio Armenta
Autonomous University of Sinaloa-Mazatlan
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Collaborator: Gustavo Rodriguez
Autonomous University of Sinaloa-Mazatlan
Mazatlan, Mexico

HC Co-PI: Omar Calvario Martinez
Researcher, Center for Research for Food and Development (CIAD)
Mazatlan, Mexico

HC Co-PI: Carlos Rivas LeClair
Director, Center for Research and Development of Aquatic Ecosystems (CIDEA)
Central American University (UCA)
Managua, Nicaragua

HC Co-PI: Nelvia Hernandez
Center for Research and Development of Aquatic Ecosystems (CIDEA)
Central American University (UCA)
Managua, Nicaragua

HC Co-PI: Erick Sandoval Palacios
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***Presentations***

From the International Workshop on Bivalve Sanitation and Culture (Sept. 21-27, 2008, Culiacan and Santiago Ixcuintla, Mexico)

Haws, M.C. 2008. Goals and objectives of CRSP Human Health Program.

Supan, J. 2008. Bivalve sanitation in the U.S.

Supan, J. 2008. Bivalve depuration methods.

Nisbet, D. 2008. Oyster farming and post harvest treatment at Willapa Bay, Washington.

Sandoval Palacios, E. 2008. Microbiological quality of shellfish growing waters and tissues in three coastal estuaries of Nicaragua and the application of RT-PCR for the identification of VHA in black cockle tissues (Anadara tuberculosa and A. similis).

Sandoval Palacios, E. 2008. Depuration trials for Anadara spp. in Nicaragua.

Calvario, O. 2008. Aquaculture food safety.

***Other presentations***

Haws, M.C., Gaxiola-Camacho, E., G. Rodríguez-Domínguez, O.Calvario-Martinez, M.C. Velásquez, J. Supan, F. Martínez-Cordero and Q.S.W. Fong. 2007. Management strategies for oyster culture, Crassostrea gigas and C. cortesiensis, in Sinaloa and Nayarit, Mexico. World Aquaculture Society Meetings, Busan, South Korea. May 5-10, 2008. Oral presentation.

Haws, M.C., A. Saborio-Coze, N. Hernandez, M.J. Almanza and E. Sandoval. 2008. Water quality monitoring for development of shellfish sanitation plans for three estuaries in Nicaragua. World Aquaculture Society Meetings, Busan, South Korea. May 5-10, 2008. Poster presentation.

Sandoval Palacios, E. 2007. Microbiological water quality from collection areas for black cockles. Second National Congress of Universities, "Water is Life". Holiday Inn Hotel, Managua, Nicaragua.

Sandoval Palacios, E. 2008. Microbiological water quality from collection areas for black cockles. Second Interdisciplinary Research Congress, May 8-9 2008, Managua, Nicaragua.

Sandoval Palacios, E. 2008. Application of RT-PCR for the identification of Hepatitis A virus in black cockle samples. Fourth Nicaraguan Biotechnology Congress, "Biotechnology for Development". April 24, 2008. Managua, Nicaragua.

***Conferences attended or held***

World Aquaculture Society Meetings, Busan, Korea, May 2008.
Attendees:
Maria Haws
Eladio Gaxiola Camacho
Guillermo Rodriguez Dominguez

First International Workshop on Bivalve Sanitation and Culture, Culiacan, Mexico, Sept. 2008
Attendees:
Maria Haws
John Supan
Eladio Gaxiola
Guillermo Rodriguez Dominguez
Erick Sandoval Palacios

***Publications***

Haws, M.C., J. Supan, D. Gariques, N. Hernandez, O. Zamudio Armenta and A. Rojas Umaña. 2008 (in preparation). Microalgae and oyster culture methods. Louisiana Sea Grant College Program. Baton Rouge, Louisiana.

Haws, M.C. and R. Howerton. 2008. (in press). A shellfish in every pot….everywhere. University of Hawaii Sea Grant College Program Newsletter "Ka Pili Kai". Honolulu, HI.

***DTAP Indicators for the Human Health Project***

**DTAP A: Improved Health and Nutrition, Food Quality, and Food Safety of Fishery Products**

- *Number of aquaculture products developed that meet food safety standards*
  4 total- 2 oyster species *Crassostrea gigas* and *C. corteziensis*; 2 cockle species *Anadara tuberculosa* and *A. similis*

**DTAP B: Income Generation for Small-Scale Fishers and Farmers**

- *Number of new biotechnologies developed*
  3 under development (spat collection for *C. corteziensis*, depuration/relay for oysters, depuration dynamics for *Anadara* sp.)

- *Number of institutions with access to technological practices*
  48-UAS, UAN, ISA, University of the Coast, Sinaloa State Committee for Sanitation, Nayarit State Committee for Sanitation, CIDEA/UCA, 39 oyster growing cooperatives, 2 women's groups growing oysters

- *Number of (people) trained in use of technological practices*
  Total to date=170 (134 in international workshops, 6 in LSU training course, 30 in women's oyster growing group)

**DTAP C: Environmental Management for Sustainable Aquatic Resources Use**

- *Number of hectares under improved natural resource management*
  Total=52,000 hectares, under water quality monitoring regimes and management plans (46,000 ha in Bahia Santa Maria, 8,000 ha at Boca de Camichin)

- *Number of management practices developed to support biodiversity*
  5 (promotion of culturing local species, co-management of black cockles, improved water quality at 3 culture sites)

- *Number of people trained in practices that promote soil conservation and/or improved water quality*
  Total 76 (20 people trained in Mexico, 56 trained in Nicaragua)

- *Number of management practices developed or adopted to improve natural resource managment*:
  Possible 1 (improved shellfish culture methods designed to reduce crab predation)

**DTAP D: Enhanced Trade Opportunities for Global Fishery Markets**

- *Number of new markets for aquatic products*: 0

- *Number of aquatic products available for human food consumption*
  4 (2 oyster species, 2 cockle species)

# LEAD US INSTITUTION: UNIVERSITY OF MICHIGAN

**Improving Sustainability and Reducing Environmental Impacts of Aquaculture Systems in China, and South and Southeast Asia**

*Printed as Submitted by James Diana, US Lead PI*

## Staff

The University of Michigan, Ann Arbor, Michigan (Lead US Institution)

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| James Diana | Lead US Principal Investigator |
| Barbara Diana | Research Assistant |
| | Graduate Assistant (China) |

Shanghai Oceans University (Lead HC Institution)

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| Yang Yi | Lead HC Principal Investigator |
| Jiang Min | HC Co-Principal Investigator |
| Liu Liping | HC Co-Principal Investigator |
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| Vu Cam Luong | Research Assistant |
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World Wildlife Fund (US Support Institution)

| | |
|---|---|
| Flavio Corsin | Workshop participant |
| Eric Bernard | Workshop participant |

## Presentations

Yang Yi. 2007. Environmental impact of cage culture in rivers: a case study in Vietnam, presented May 15, 2007 in Cairo, Egypt, to the American Soybean Association sponsored workshop on cage culture in Egypt.

Diana, James. 2007. Use of cages in pond aquaculture to reclaim wastes from intensive feeding of fish, presented May 15, 2007 in Cairo, Egypt, to the American Soybean Association sponsored workshop on cage culture in Egypt.

Yang Yi. 2007. Environmentally-friendly aquaculture, presented October 15, 2007 in Beijing, China, to feed formulation staff of many private companies.

Yang Yi. 2007. Tilapia aquaculture in China and Thailand, presented June 18, 2007 in Cairo, Egypt, to the American Soybean Association sponsored meeting of fish farmers from Egypt.

Yang Yi. 2008. Economic performance of different strategies of tilapia culture in ponds, presented April 27, 2008 in Cairo, Egypt to the American Soybean Association sponsored meeting of fish farmers from Egypt.

Yang Yi. 2008. Tilapia aquaculture in China, presented April 27, 2008 in Cairo, Egypt to the American Soybean Association sponsored meeting of fish farmers from Egypt.

Diana, James. 2008. Ecological aspects of fertilizing and feeding regimes used to improve efficiency of pond culture for Nile tilapia, presented April 27, 2008 in Cairo, Egypt to the American Soybean Association sponsored meeting of fish farmers from Egypt.

Diana, James. 2008. Outreach, acceptance, and success of pond aquaculture in promoting rural economy and social stability, presented April 27, 2008 in Cairo, Egypt to the American Soybean Association sponsored meeting of fish farmers from Egypt.

Yang Yi. 2008. Application of microbial phytase in fish feed, presented May 2008 in Busan, Korea to the WAS participants.

Jiang Min. 2008. Biofilm start-up on different filter media, presented May 2008 in Busan, Korea to the WAS participants.

Liu Liping. 2008. Microcystins in aquaculture systems – their endangerment and research progress in detection and elimination methods, presented May 2008 in Busan, Korea to the WAS participants.

Wang Weimin. 2008. Phylogenetics and population pattern of Elopichthys bambusa (Richardson, 1845) from the middle reaches of Yangtze river as inferred from Cytochrome b sequences, presented May 2008 in Busan, Korea to the WAS participants.

Wang Youji. 2008. Effects on growth and survival of loach Misgurnus anguillicaudatus larvae when co-fed on live and microparticle diets, presented May 2008 in Busan, Korea to the WAS participants.

Lai Qiumin. 2008. Application of water purification technology in intensive shrimp culture, presented May 2008 in Busan, Korea to the WAS participants.

Shrestha, M.K. 2008. Limnological characteristics and cage culture practice in Indrasarobar reservoir of Nepal, presented May 2008 in Busan, Korea to the WAS participants.

Hung, L.T. 2008. Effect of allzyme SSF on growth performance and feed utilization in Tra and Basa catfish fingerlings Pangasius hypophthalmus and Pangasius bocourti, presented May 2008 in Busan, Korea to the WAS participants.

Yang Yi. 2008. Environmental impact of cage culture in rivers, presented September 3, 2008 in International Symposium on Sustaining Fish Biodiversity, Fisheries and Aquacultures in the Mekong held in Ubon Rajathanee, Thailand.

## Meetings Attended

Yang Yi, Cai A. Yuan, Li Yang, Nguyen Phu Hoa, Rai Sunila, and Asaduzzaman all attended the Eighth Asian Fisheries Forum in Kochi, India during November 2007.

Yang Yi, Liu Liping, Wang Weimin, Wang Youji, Lai Quiming, Madhav Shrestha, and Le Thanh Hung attended the World Aquaculture Society meeting in Busan, Korea during May 2008.

## Publications

Cao L., Y. Yang, W.M. Wang, A. Yakupitiyage, D.R. Yuan and J.S. Diana, 2008. Effects of pretreatment with microbial phytase on phosphorous utilization and growth performance of Nile tilapia (*Oreochromis niloticus*). Aquaculture Nutrition, 14:99-109.

Sunila, R.,Y.Yang, Md. A. Wahab, A.N. Bart1 and J. S. Diana, 2008. Comparison of rice straw and bamboo stick substrates in periphyton-based carp polyculture systems. Aquaculture Research, 39: 464-473.

Schwantes, V.S., J.S. Diana, and Yang Yi. 2009. Social, economic, and production characteristics of giant river prawn *Macrobrachium rosenbergii* culture in Thailand. Aquaculture (accepted with revisions).

## Investigation Progress Reports

***Impact of Introduction of Alien Species on the Fisheries and Biodiversity of Indigenous Species in Zhanghe Reservoir of China and Tri An Reservoir of Vietnam - 07MNE03UM***

The Chinese component of this study is being conducted in Hubei province of China to investigate the changes in population structure of indigenous fish species after the introduction of icefish (Neosalanx taihuensis). A comparison of fish catch and species composition between Zhanghe Reservoir with the introduction of icefish and Huiting Reservoir without presence of icefish will be used to detect the effects of icefish on native biodiversity..

Zhanghe Reservoir and Huiting Reservoir are located in Jingmen City, Hubei province of China, about 100 km away from each other. Both reservoirs have similar size and have been subject to similar fisheries management practices under management of the same department of fisheries. In July and September 2008, the fish catch and fish species composition of Zhanghe Reservoir were investigated and the historical data were obtained from the Zhanghe Reservoir Fisheries Management Company. The results showed that Zhanghe Reservoir supported 40 different species. The fish species composition in Zhanghe Reservoir consisted mainly of Cyprinids. In 1992, icefish was introduced into Zhanghe Reservoir from Taihu Lake, and icefish culture was developed to a production scale by 1995. In recent years, the annual icefish yield has been maintained at 150-200 tons. Furthermore, the yield was expected to further increase to 300 tons. Icefish yield in 2008 decreased sharply compared to that in previous years, while the yield of culters (Culter alburnus and C. mongolicus) increased significantly. Most likely this was due to predation by carnivorous culters on icefish. The fish catch and fish species

composition of Zhanghe Reservoir during winter and spring will be investigated soon, and the research in Huiting Reservoir is being conducted.

The Vietnamese component of this study is being conducted in Tri An Reservoir of Vietnam to investigate changes in population structure of indigenous fish species after introduction of tilapia (Oreochromis spp.) through comparing historical data on fish catch and fish species composition.

In the past year, fish catch and fish species composition were collected through seining fish four separate times at 4, 5 and 4 locations in upstream, midstream and downstream areas of the reservoir, respectively. Preliminary results showed that alien species including tilapias (Tilapia sp.), peacock cichlid (Cichla ocellaris), rohu (Labeo rohita), grass carp (Ctenopharyngodon idellus) and bighead carp (Hypophthalmichthys nobilis) were not abundant, and farmed fish species such as walking catfish (*Clarias* sp.) and Tra fish (*Pangasius hypopothalmus*), which were not present before, were found at large in this study. A total of 35-36 fish species were recorded. Alien fish species accounted for 6-7% in the total fish catch when compared to indigenous species. Among all alien species, tilapias accounted for the highest proportion of 5.11%.

A survey on landing sites around the reservoir showed that there were 42 fish species, 35 were indigenous and 7 farmed species, which included tilapias, rohu, grass carp, bighead carp, common carp, hybrid walking catfish, and tra fish. The number of fish species in this study was significantly lower than that from a survey in 1983, which recorded 93 fish species (Pham Van Mien, 1983). The fish collector in the reservoir believed that there has been an apparent disappearance of at least 5-6 important species.

The study also recorded the number of fish stocked in the reservoir annually varied from 500,000-1,000,000 fish per year. Annual fish landings was reported from 1995 to 2007 varied from 1,126 metric tons in 1995 to 2,837 in 2007. The main field surveys will be completed soon, and the collected data is being analyzed.

***Assessing Effectiveness of Current Waste Management Practices for Intensive Freshwater and Marine Pond Aquaculture in China - 07MNE04UM***

This study is being conducted in Hainan, Hubei, and Sichuan provinces, China to determine existing management practices to reduce effluent and solid waste pollution by intensive freshwater farmers in China. Specific goals included quantifying nutrient loading rates, nutrient budgets, sediment accumulation of nutrients, and release of nutrients in effluents from intensive freshwater ponds utilizing different waste management strategies, determining the best current methods for pollution mitigation in intensive freshwater pond aquaculture, and informing small-scale freshwater pond farmers about waste management in order to build a consensus on management and to develop more effective government policies.

One hundred intensive inland farms were selected randomly in each province, and interviewed during March to June 2008 using a set of designed questionnaires including a structured checklist and open-ended questions. Survey data are being analyzed to evaluate socio-economic characteristics of farmers, pond culture practices, water supply management, effluent water and solid waste management, as well as knowledge and awareness of environmental implications of pond waste disposal. Fifty ponds will be randomly selected from the farms in Hubei and Sichuan provinces to assess effluent water quality, sediment quality, and nutrient budgets under different pond management practices during October 2008 to March 2009. Fifty tilapia ponds and fifty shrimp ponds were randomly selected from the selected farms in Hainan province for interview in August 2008, and the samples have been being taken to assess effluent water quality, sediment quality, and nutrient budgets under different pond management practices.

***Determining the Ecological Footprint of Shrimp Aquaculture Through Life Cycle Analysis of Outdoor Pond Systems - 07MNE05UM***

The environmental footprint of outdoor shrimp aquaculture industry is being conducted using a life cycle assessment (LCA) to gain a better understanding of the sustainability issues. The analysis is based on a questionnaire-survey in Hainan Province, China. The survey focused on three phases of production: hatchery, grow-out, and post-farming. To collect information to complete such a survey, on site visits were completed during June 2008 at Hainan Island. The design was for 3 large, medium, and small farms to be surveyed. For hatcheries, three typical hatcheries were selected from different regions in Hainan Province. For the post-farming phase, local markets including wholesalers and retailers, and processing companies were interviewed. Data collection was completed during the summer, and analyses are being finished during Fall 2008.

Farming appears to be the life cycle stage which generates the most significant environmental impacts, particularly marine toxicity, abiotic depletion and global warming. These all are produced mainly from the use of energy and shrimp feed. Eutrophication caused by wastewater discharged from the shrimp ponds could also be a significant problem to ambient water bodies.

In order to identify more sustainable farming systems, we plan to compare the environmental performance of traditional outdoor shrimp farms with indoor recirculating shrimp farms. The comparison would be useful to gain better understanding of the environmental footprint of different food production systems, contributing to more sustainable management of the food production system as a whole.

This project is proceeding on schedule and we anticipate completion of the final report before August 2009.

***Monitoring and Reducing Microcystins in Tilapias and Channel Catfish Cultured in a Variety of Aquaculture Systems - 07HHI01UM***

A study is being conducted to determine the content of microcystins in aquaculture ponds/tanks at different levels of intensification and different culture environments, to evaluate body burdens of microcystins in the flesh of tilapia cultured under different systems, and to test possible depuration strategies to eliminate microcystins from the flesh of cultured tilapias.

ELISA (Enzyme Linked Immunosorbent Assay) and HPLC (High Performance Liquid Chromatography) are two typical methods widely used for detecting microcystins. A preliminary experiment was conducted to determine which method would be selected for the study. It has been found that ELISA was simpler and faster, also giving better recovery rates than HPLC for water samples. However, for trace microcystins from water samples, solid phase extraction and HPLC could detect as low as 0.05μg/L. For fish flesh, both ELISA and HPLC have their own disadvantages, but HPLC is more widely used.

Tilapia and water samples will be taken from different culture systems for the detection of microcystins during December 2008 – June 2009.

Due to the earthquake occurred on 12 May 2008 in Sichuan province, the implementation of experiments on channel catfish has been postponed until December 2008 – August 2009.

***Polyculture of Sahar (Tor putitora) with Mixed-sex Nile Tilapia (Oreochromis niloticus) - 07BMA02UM***

An experiment was conducted to evaluate the effect of sahar (Tor putitora) stocking on recruitment control, growth and production of mixed-sex Nile tilapia pond (Oreochromis niloticus) culture at Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal. Experiments were conducted for 240 days in 12 earthen ponds, each 100 m2 in area with at least 50 cm water depth. There were four treatments with three replicates each: (T1) Tilapia only (control or monoculture); (T2) 1:16 Sahar to tilapia stocking ratio; (T3) 1:8 Sahar to tilapia stocking ratio; and (T4) 1:4 Sahar to tilapia stocking ratio. The stocking density of tilapia was 2 fish/m2 in all treatments. The ponds were fertilized regularly using diammonium phosphate (DAP) and urea at rates of 470 g and 350 g per pond respectively. Tilapia was fed with a locally made pelleted feed (27% crude protein) at a rate of 2% body weight per day on alternate days after individuals averaged 100 g in weight. Daily weight gain and net fish yield of tilapia in the polyculture control were lower (0.33 g/d and 8.0 kg/pond respectively) than those in the polyculture treatments (ranging from 0.38-0.42 g/d and 9.6-13.6 kg/pond respectively), and the highest daily weight gain and net fish yield were obtained in the treatment with 1:16 sahar to tilapia ratio ($P<0.05$). Growth of sahar was significantly higher (0.39 g/d) in the treatment with 1:16 sahar to tilapia ratio, indicating that sahar required more space for better growth. Apparent feed conversion ratio (AFCR) ranging from 0.14-0.24 was not significantly different among treatments. More tilapia recruits were observed in the monoculture control (324 fish/pond) than in the sahar polyculture treatments (69-169 fish/pond). The number of recruits decreased with increasing stocking density of sahar, indicating sahar preyed on tilapia recruits. Thus, the results demonstrated that stocking of sahar reduced tilapia recruitment in a mixed-sex Nile tilapia pond culture system and provided environmental conditions for better tilapia growth and production. The sahar to tilapia ratio of 1:16 resulted in overall best performance.

***Workshop on Aquaculture, Human Health and Environment - 07MNE07UM***

This project has not yet started, but is slated for July, 2009 in China and is proceeding with planning under normal schedule. This workshop will be held in Chengdu of Sichuan Province, China in July 2009. The participants of the workshop will be from China, Nepal and Vietnam, as well as other AquaFish CRSP host countries. The project host country researchers will present research results from AquaFish CRSP experiments, to share the experience in research related to aquaculture, human health and environment, and to establish links between AquaFish CRSP host institutions and other institutions in the region.

# V. PROGRAM-WIDE REPORTS: OUTREACH, CAPACITY BUILDING, ASSOCIATE AWARDS, AND SYNTHESIS

## OUTREACH: HOST COUNTRY PRINCIPAL INVESTIGATOR

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### Host Country Principal Investigator Exchange Project on Tilapia and Native Cichlid Technologies (Phase II)

*Submitted by James Bowman, HCPI Project Coordinator*

***Introduction***

Following over twenty years of tilapia research by the Aquaculture Collaborative Research Support Program (ACRSP), the Program in 2004 launched an innovative exchange project designed to facilitate more direct collaboration among ACRSP Host Country institutions in Honduras, Kenya, Mexico, the Philippines, and Thailand. The objective of the activity was to share successful tilapia production techniques among scientists and institutions in different countries and regions. The project involved visits to each of the participants' home countries, where tilapia culture information was exchanged through seminars, field visits, and informal discussions. Feedback from all participants was overwhelmingly positive.

In 2006 the new Aquaculture & Fisheries CRSP (AquaFish CRSP) was initiated, renewing the CRSP emphasis on poverty eradication and focusing on both aquaculture and fisheries. Because the exchange project conducted under the ACRSP was so successful, the concept was continued under the AquaFish CRSP. A novel mentored-training approach was employed, and greater emphasis was placed on the entire value chain of tilapia production. In 2007 and 2008, CRSP researchers from four new countries—South Africa, Ghana, Vietnam, and Brazil—participated in Phase II of the Project (Table V-1).

Table V-1.HCPI Exchange Project Host Country Participants

| Institutional Representative | Institution | Location |
|---|---|---|
| Steve Amisah | Kwameh Nkrumah University of Science & Technology | Kumasi, Ghana |
| Lourens DeWet<br>Khalid Salie | Stellenbosch University | Stellenbosch, South Africa |
| Nguyen Thanh Phuong | Can Tho University | Can Tho City, Vietnam |
| Maria Célia Portella | Centro de Acüicultura, UNESP | Jaboticabal, Brazil |

Each of the participating countries represents a unique combination of conditions and factors within which the culture of cichlids has been developed. Regional and local differences with respect to climate, species, available inputs, pond management protocols being practiced, and constraints to continued growth have all influenced the development of the tilapia farming industry in each country. One characteristic common to all sites, however, is the important role

of cichlid fish in fish farming at all scales. The CRSP's Host Country Principal Investigator Exchange Project facilitated the sharing of information among these sites so that, where appropriate, the most successful practices could be transferred and applied across sites and regions.

In both phases of the project the participants spent at least four days in each country, beginning with a seminar in which the status of tilapia and native cichlid culture in the home country of each participant was shared with the other CRSP participants, faculty and staff from the host and other institutions, students at the host and other institutions, farmers, and other interested persons. Each of these introductory seminars was followed by a tour of the host institution's research facilities. Two to three days of field visits typically followed, including visits to hatcheries specializing in all-male fingerling production, small-scale farms, larger intensive commercial operations, other collaborating institutions, processing facilities, and markets. Each workshop concluded with a wrap-up session in which lessons learned and possible approaches to technology transfer were discussed.

***PHASE II of the Exchange Project: South Africa, Ghana, Vietnam, and Brazil***

Phase II workshops were held in four countries in 2007 and 2008:
South Africa and Ghana — October 2007
Vietnam — December 2007
Brazil — February 2008

Although similar to Phase I in most respects, the following variations were brought in for Phase II of the project:

- The scope was widened to include value-chain aspects of aquaculture (e.g., harvesting, transportation, processing, and marketing)
- Production technologies, economic factors, and the entire tilapia production value chain were considered
- A mentoring approach was taken, whereby some participants from Phase I of the project participated in the Phase II exchange visits, using their past experience to assist Phase II participants, thus broadening the overall benefits of the project.*
- Greater attention was focused on Africa, and in particular on countries in the US Initiative to End Hunger in Africa (IEHA), by including participants from South Africa, Ghana, and Kenya.

The four introductory seminars of Phase II involved a total of almost 300 participants (21 in South Africa, 40 in Ghana, 12 in Vietnam, and 220 in Brazil. Two of the workshops were scheduled to coincide with or be a part of other major aquaculture conferences or workshops. In South Africa the HCPI workshop followed immediately after the Eighth Conference of the Aquaculture Association of Southern Africa (AASA), held in Cape Town, and in Brazil the HCPI visit was organized to include the two-day "International Workshop on the Production of Tilapias and other Cichlids," at the Aquaculture Center of the State University of Sao Paulo (CAUNESP), in Jaboticabal. Participation in these two "extra" conferences significantly increased the benefits of this project to its participants. This participation also brought additional attention to the efforts of the CRSP and increased the benefits and impacts of CRSP work to many more individuals and institutions than the CRSP Exchange Project participants and their home institutions. In the words of one participant, "The informative presentations during the seminars and, even more interestingly, the opportunity of informal and friendly discussions during the trips made a big difference in my understanding about tilapia aquaculture around the world."

***Observations and Lessons Learned***

The following observations and comments were gleaned from reports and other feedback from the project participants following completion of the Phase II country visits:

- Students at the hosting institutions in all of the countries visited were eager to learn about the work being done by the visiting researchers in their home countries, becoming actively engaged in discussions with the visitors during and after the seminars.
- The government in South Africa is highly interested in the development of aquaculture and has made tremendous efforts to formulate fisheries and related policies that can influence this development.
- The development of tilapia culture in South Africa faces special challenges, in that Oreochromis niloticus, the most popular culture species in other regions, is not native to the area and its importation is prohibited, while at the same time native species such as Oreochromis mossambicus do not exhibit the high growth rates shown by the Nile tilapia. The climate in the southern parts of the country is relatively cool and therefore less suitable for tilapia culture, while parts of the warmer northern regions are limited by the availability of water.
- Although Ghana has enormous fresh water resources, including Lake Volta, and an excellent climate for tilapia production, poor infrastructure and communications will likely impede rapid development of the industry.
- The KNUST aquaculture facility in Kumasi is apparently not being used. If adequate water and management skills are available, this facility could be put to good use for small-scale research, particularly as part of the teaching program at the university.
- Aquaculture development experiences in some of the Asian countries like the Philippines, Thailand, China, Viet Nam would be relevant and helpful for countries just beginning to develop aquaculture, such as South Africa.
- Based on experiences with tilapia culture development in Central America, one participant offered the following formula for success in South Africa and Ghana:

  good quality fry + feed + production technology + markets = success

- The need to make more and better tilapia fry available for stocking was expressed by officials in Ghana, a scenario which is similar to that in Honduras. The large operations visited have their own hatcheries and do allow farmers to purchase fingerlings for stocking, but the price is slightly high.
- Lack of trained personnel and adequate extension services were seen as constraints to the development of aquaculture in Ghana, but it is hoped that the creation in 2005 of a separate Ministry of Fisheries to deal with both fisheries and aquaculture concerns will help in these areas.
- Other constraints understood to be important in Ghana include lack of policies, poor planning and implementation, and limited access to loans and credit facilities.
- There are few tilapia producers in Ghana. The system used by small-scale producers is familiar from other areas: one or two small ponds (10 x 20 x 1 m) per family, with a poor management, based on initial storage and partial harvesting, and with re-stocking not planned. The larger-scale, commercial producers seen by the group in Ghana tended to be cage culture operations backed by heavy investment.
- Vietnam is fortunate in having excellent natural resources in terms of vast water resources in the Mekong Delta and a tropical temperate climate conducive to the farming of warm water aquatic species.
- At all the farm visits in Vietnam, there was a sense of dealing with very industrious people. Aquaculture systems in Viet Nam cover the entire spectrum from low-tech, low-input farming systems to high-tech, high-input systems.
- Viet Nam is a very good example of communities producing aquaculture with very little capital input, but with successful output. This may be a useful example to take back to South Africa, where aquaculture is a newly emerging enterprise.
- Viet Nam produces thousands of tons of aquatic products from waste water which are safely consumed by the local communities, and simultaneously providing cash crops for

means of income generation. This may be another useful example for South Africa, which is considered a dry country, where clean water supplies are limited.

- The number of homes that have small ponds in the periphery of the cities or towns in Vietnam is impressive. In these ponds the Vietnamese people raise Chinese carps, catfish Pangasius, tilapia and silver barb, in polyculture systems using fertilization and by-products to feed the fish (integration of rice crop and fish is also spread in the south of the country). This system of production guarantees food for home consumption as well as some income, by selling the fish in the local market or to the neighbors.
- Tilapia production in the Mekong Delta in general has gradually decreased because of feed requirement, market price, processing and competition from Tra culture. One tilapia cage culture farm the group visited was quite successful, however, and was expanding.
- The group's visit to a snakehead farm in Vietnam indicated that aquaculture is gradually being diversified. Catfishes, tilapia, giant freshwater prawns, snakehead, and climbing perch are among the species being cultured in these areas.
- The use of mixed-sex fish for culture in cages was new for the participant from Brazil, where they do not use this system. This technology avoids the use of hormones and should be tested in Brazil. The Brazilian participant has thus already submitted a proposal to compare the production and economic viability of systems using sex-reversed and not-reversed fingerlings during the nursery phase.
- Can Tho University continues to expand its prominence in the Mekong Delta as a premier institution engaged in teaching, research, and extension of aquaculture.
- One area in Vietnam's marketing strategy for tilapia and catfish that could result in a future challenge for is the percentage of the products that are exported to the USA and EU countries. Trade embargos has already been imposed on catfish exports and has caused a lot of concern to the bigger processing companies in the country. A finer balance should be struck between exports and providing to local markets.
- The trip to Vietnam was very productive and I think that all of us learned a lot observing in practice the tilapia production in a country where aquaculture is a major activity. During the visit the group exchanged experiences and links between people from different countries were created; that was an excellent opportunity to strengthen collaboration.
- In Brazil there is a tremendous market potential for products made from tilapia skin leather, for example, wallets, belts, cell phone cases, pencil cases, eyeglass cases, sandals, slippers, bags and many others.
- The last 3 years has shown a turnaround in import/export with previously 90 % of tilapia being exported and the rest of 10 % was for the local market. Currently it's just the opposite with 10 % for export and about 90 % for the local market. The development of the local market has provided additional opportunities to the industry.
- Several community-run cage culture projects provide less wealthy families in western Sao Paulo State (Brazil) with the opportunity to run successful fish culture businesses. Members at two co-operatives visited displayed a high level of excitement about their projects and a sense of working together to achieve a common goal
- The Brazilian contribution to aquaculture has grown significantly in the last decade and already it features in the top ten producing countries of tilapia.
- In Brazil, cage farming is considered to be one of the most economical farming systems and the Brazilians have proven that tilapia can be very successfully farmed in cages on larger lakes and reservoirs.
- Most of the Brazilian farms practice zero-waste principles and a range of products is produced from fish meat and offal. A lot of trout offal is produced each year in South Africa and some of the processing strategies learned about in Brazil can be investigated for possible adoption.

***Project Outputs***

Following the conclusion of the series of site visits in the participating countries, Phase II participants and some of the Phase I mentors[3] held "Echo-Seminars" in their home countries in which they shared the new knowledge and information gained during the entire project with students, farmers, government officials, faculty at their home institutions, and others. At least four such seminars were conducted in four countries, with at least 114 people participating, including 43 in Kenya, 24 in Brazil, 18 in South Africa, and 29 in the Philippines.

In addition to the echo-seminars, several other outputs should also be noted. Maria Célia Portella, Phase II participant from Brazil, worked with Phase I mentor Charles Ngugi to write an article about aquaculture in Africa, based on the exchange experience, for publication in the Brazilian magazine Panorama da Aqüicultura, as follows:

- **Acüicultura na África O Projeto Interegional de Intercâmbio de Tecnologia sobre Produção de Tilápias e outros Ciclídeos**. Maria Célia Portella e Charles C. Ngugi. In Panorama da Aqüicultura, janeiro/fevreiro, 2008.

Maria also made a presentation about the CRSP tilapia Exchange Project at AquaCiencia 2008 (Congress of the Brazilian Association of Aquaculture and Aquatic Biology), Maringa, PR, Brazil in October, 2008:

- **Atualidades sobre a criação de tilápias na África do Sul, Gana e Vietnã (Current status of tilapia culture in South Africa, Ghana and Viet Nam).** Maria Célia Portella, Lourens De Wet, Khalid Salie, Stephen Amisah, Nguyen Thanh Phuong, James R. Bowman, and Hillary S. Egna. At AquaCiencia 2008, Maringa PR, 27-30 October, 2008.

In addition, three posters describing the Project were organized by the CRSP Management Office and completed with input from the participants, as follows:

- **Inter-regional Exchange of Local and CRSP-Derived Knowledge on Tilapia Culture.** James R. Bowman and Hillary S. Egna. Posted at the Eighth Conference of the Aquaculture Association of Southern Africa, 22-26 October, 2007.
- **Inter-regional Exchange of Local and CRSP-Derived Knowledge on Tilapia Culture.** James R. Bowman and Hillary S. Egna, with contributions from the Exchange Project participants. Posted at World Aquaculture 2008, Busan, South Korea, 19-23 May, 2008.
- **Inter-regional Exchange of Local and CRSP-Derived Knowledge on Tilapia Culture.** James R. Bowman, Hillary S. Egna, and Maria Célia Portella, with contributions from the Exchange Project participants. Posted at AquaCiencia 2008 (Congress of the Brazilian Association of Aquaculture and Aquatic Biology), Maringa PR, 27-30 October, 2008.

***Project Beneficiaries***

Many individuals and institutions benefited from this project, including:

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[3] Phase I participants who served as mentors during Phase II:
Amrit Bart, Asian Institute of Technology, Bangkok, Thailand
Remedios Bolivar, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines
Wilfrido Contreras-Sánchez, Universidad Juárez Autónoma de Tabasco, Villahermosa, Mexico
Nancy Gitonga, FishAfrica, Nairobi, Kenya (formerly Fisheries Department, Nairobi, Kenya)
Dan Meyer, Escuela Agricola Panamericana (Zamorano), Tegucigalpa, Honduras
Charles Ngugi, Moi University, Eldoret, Kenya
Yang Yi, Shanghai Ocean University, Shanghai, China (formerly with the Asian Institute of Technology, Bangkok, Thailand).

- The CRSP Host Country researchers themselves, who gained valuable first-hand knowledge about institutions engaged in aquaculture research, aquaculture extension systems in use, and aquaculture technologies being practiced in other regions of the world, some of which can be transferred back home.
- Professional colleagues and students at participating Host Country institutions, who benefited from interactions with the visiting PIs, from whom they gained new knowledge and insights into cichlid culture in other parts of the world.
- Host Country fish farmers, who learned directly from visiting PIs during field visits and who will benefit indirectly as the recipients of better extension and research services provided by their own countries' research and extension institutions in the future.
- The exchanges have provided opportunities for strengthening existing linkages as well as making new professional contacts, leading to greater networking among researchers in CRSP and other host-country institutions.

Participants in the Host Country Principal Investigator Exchange Project are already applying and disseminating knowledge gained through these visits. In all countries, one of the first steps was to conduct "echo seminars," as described above, to share knowledge gained abroad with fellow aquaculturists back home. New information gained is also being applied through the inclusion of updated material in university courses, new research projects, and extension materials in the various participating countries.

Participants from both phases of this project held a final wrap-up meeting during the week of the CRSP annual meeting and the annual conference of the World Aquaculture Society in Busan, Korea, to reflect on the benefits realized by the project and to think about how to expand upon those benefits and carry them forward following conclusion of the project. The participants agreed to work towards establishing and maintaining a network of their own to stay in contact and build relationships beyond the life of the CRSP.

# CAPACITY BUILDING

*Submitted by James R. Bowman, Capacity Building Coordinator*

The AquaFish CRSP takes pride in the capacity building efforts it undertakes as a part of its overall program. Training supported by the program takes a number of forms, with perhaps the most important being short-term (non-degree) courses and long-term (degree) programs. Short-term training most frequently occurs as seminars, workshops, short-courses, and the like. These typically occur over periods of half a day to two or three weeks, and they usually focus on specific topics that have been deemed to be of particular importance for one or more of the AquaFish core or associate projects. Long-term programs typically last as long as it takes for a student to complete a BS, MS, or PhD program at an accredited university, either in one of the host countries or in the US.

***Short-Term Training***

Since the beginning of the AquaFish program in late 2006, at least 32 short-term training sessions involving at least 903 participants have been run under its seven projects (6 core projects and 1 associate project). Of the 32 short-term training sessions held, 11 were held in the Asian region (4 in Cambodia, 2 in Indonesia, 3 in the Philippines, 1 in Vietnam, and 1 in China), 16 were held in Latin America and the Caribbean (12 in Mexico and 4 in Nicaragua), 4 were held in Africa (2 in South Africa, 1 in Ghana, and 1 in Kenya), and one was held in the US (Figure V-1).

Workshops held in Cambodia focused on project orientation, planning, and training for the UConn-led project on alternative uses of low-value fishes. Those in Mexico revolved around various aspects of the Human Health investigations led by UHH, for example meetings with oyster producers, spat and data collection, field trips to sampling areas, and monitoring of organic material in oyster production areas, but also included two sessions of the "International Workshop on Bivalve Culture and Sanitation," one in Culiacan Rosales, Sinaloa, and the other in Santiago Ixcuintla, Nayarit. Workshops in Nicaragua were also associated with the UHH Human Health studies, including a community meeting to organize for the project and several sessions on monitoring of water and *Anadara* spp. tissues at sites on the Estuary of Aserradores, Chinandega. Workshops in the Philippines and Indonesia were mainly associated with the NCSU project, including workshops about shrimp and Gracilaria culture and a forum on Kappaphycus. The session held in the US ("Intensive training and internship in bivalve culture and shellfish sanitation") was part of the UHH Human Health project, involving participants from Mexico, Nicaragua, and the US, and the course held in China ("Training Course on Rice-Fish Culture") provided training for Malians under the Mali associate award.

Another 3 workshops, involving approximately 144 additional participants were conducted in Brazil, Ghana, and Guyana (33, 40, and 28 participants respectively), but complete data for these three workshops were unavailable at the time of this report.

Several of the workshops were associated with Phase II of the "HCPI Information Exchange Project." Four exchange visits were conducted under this project (South Africa, Ghana, Vietnam, and Brazil), each including a seminar in which participants shared information about the development and status of tilapia or related cichlid culture in their home countries. Following completion of the exchange visit series, the participants also conducted "Echo-Seminars" back at their home institutions to share their experiences and new knowledge with

colleagues, students, farmers, and others. More details about this project are included in a separate section of this annual report.

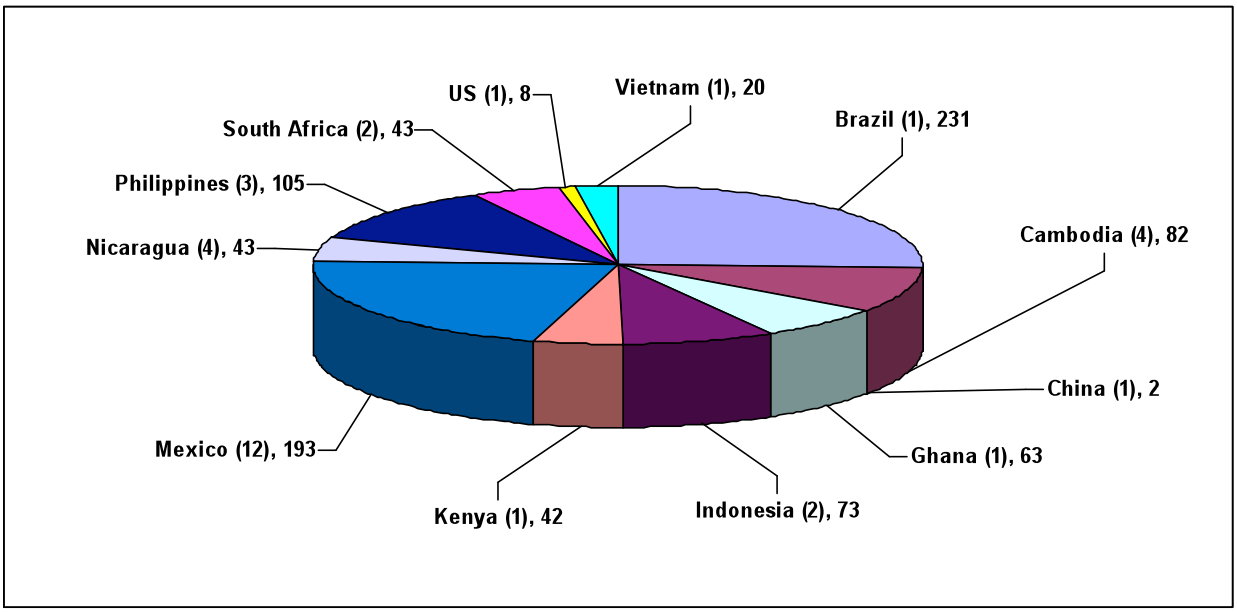


Figure V-1. Number of participants in AquaFish CRSP short-term training events, by country. Numbers in parentheses indicate number of short-term training events held in each country.

**Gender Distribution in Short-Term Training:** The gender of 888 of the 903 participants was clearly indicated in reports received from the field. Of these 888, 301 (33.9%) were women and 587 (66.1%) were men. On a country basis, the gender distribution was as indicated in Table V-2.

**Short-Term Training for Participants from IEHA Countries:** To date most short-term training for participants from IEHA countries has occurred as a part of the HCPI Information Exchange Project referred to above, either in initial seminars held during the country visits or in "Echo-Seminars" conducted after the visits. Under this project there were 102 instances of IEHA-country individuals receiving training, including 58 from Ghana and 44 from Kenya. Training occurred in South Africa, Ghana, Kenya, and Vietnam. In addition to HCPI project seminars, one short-term training session was conducted under the Mali associate award project, in which two Malian participants were trained in rice-fish culture methods in China, bringing the total IEHA short-term training number to 104.

Table V-2. Numbers and percentages of women short-term training participants in selected AquaFish CRSP project countries where short-courses and seminars were held and for workshops from which meaningful gender data are available.

| Country | Total Participants* | Number of Women | % Women |
|---|---|---|---|
| Cambodia | 82 | 20 | 24.4 |
| China | 2 | 0 | 0 |
| Ghana | 63 | 22 | 34.9 |
| Indonesia | 70 | 11 | 15.7 |
| Kenya | 42 | 12 | 28.6 |
| Mexico | 193 | 51 | 26.4 |
| Nicaragua | 43 | 42 | 97.7 |
| Philippines | 103 | 43 | 41.7 |
| South Africa | 43 | 12 | 27.9 |
| USA | 8 | 4 | 50.0 |
| **Total/Overall** | **649** | **217** | **33.4** |

***Long-Term Training***

The AquaFish CRSP is currently involved in the long-term training programs of 119 students. These students come from 15 countries, including Cambodia, China, Côte d'Ivoire, Ecuador, el Salvador, Ghana, Guyana, Kenya, Mexico, Nepal, Nicaragua, the Philippines, Tanzania, Vietnam, and the US. The distribution of these students by nationality is as shown in Figure V-2.

On a regional basis, 69 of the program's long-term students (58%) are from Asia, 31 (26%) are from Latin America and the Caribbean, 8 (6.7%) are from Africa, and 11 (9.2%) are from the US. On a project basis, 35 of our students (29.4%) are engaged under the North Carolina State University project, 8 (6.7%) are with the Purdue project, 23 (19.3%) are sponsored under the University of Arizona project, 21 (17.6%) are sponsored by the project led by the University of Michigan, 23 (19.3%%) are through the University of Connecticut, and 9 (7.6%) are with the project led by the University of Hawaii at Hilo.

**Degrees Sought by AquaFish CRSP Students:** Degree programs currently supported under the AquaFish program are shown in Figure V-3. Included are 50 students seeking bachelor's degrees (42.0%), 48 students working towards master's degrees (40.3%), 18 students seeking doctorates (15.1%), and 3 high school or "certificate" students (2.5%).

**Gender Distribution of Long-Term AquaFish CRSP Students:** Overall the program supports the training of 60 women and 59 men, for an almost 50:50 ratio (50.4 and 49.6%, respectively).

Among students seeking BS degrees, 27 are men (54.0%) and 23 are women (46.0%); among MS candidates, 21 (43.8%) are men and 27 (56.2%) are women; and among those seeking PhD's, 6 (33.3%) are men and 12 (66.7%) are women. Of the three students classified as "other" (high school or "certificate" students), 2 are men (66.7%) and 1 (33.3%) is a woman (Figure V-3).

With respect to students supported through the six core AquaFish projects, 20 of 35 students (57.1%) sponsored through the NCSU project are women, 5 of 8 students (62.5%) supported by the Purdue project are women, 7 of 23 students (30.4%) supported through the University of Arizona are women, 13 of 23 students (56.5%) through the University of Connecticut are women, 2 of 9 (22%) of those supported through the University of Hawaii at Hilo are women, and 13 of 21 (61.9%) of those sponsored through the University of Michigan are women (Table V-3).

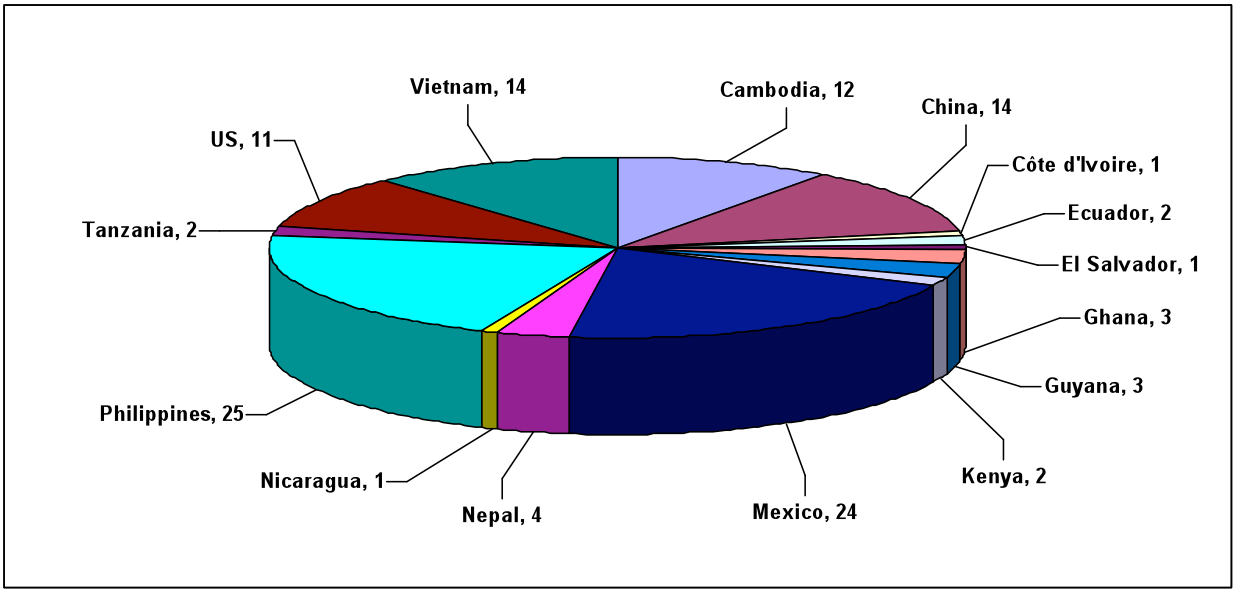


Figure V-2. Number of students currently supported by the AquaFish CRSP, by nationality. The greatest numbers of students are from the Philippines (25), Mexico (24), Vietnam (14), China (14), and Cambodia (12).

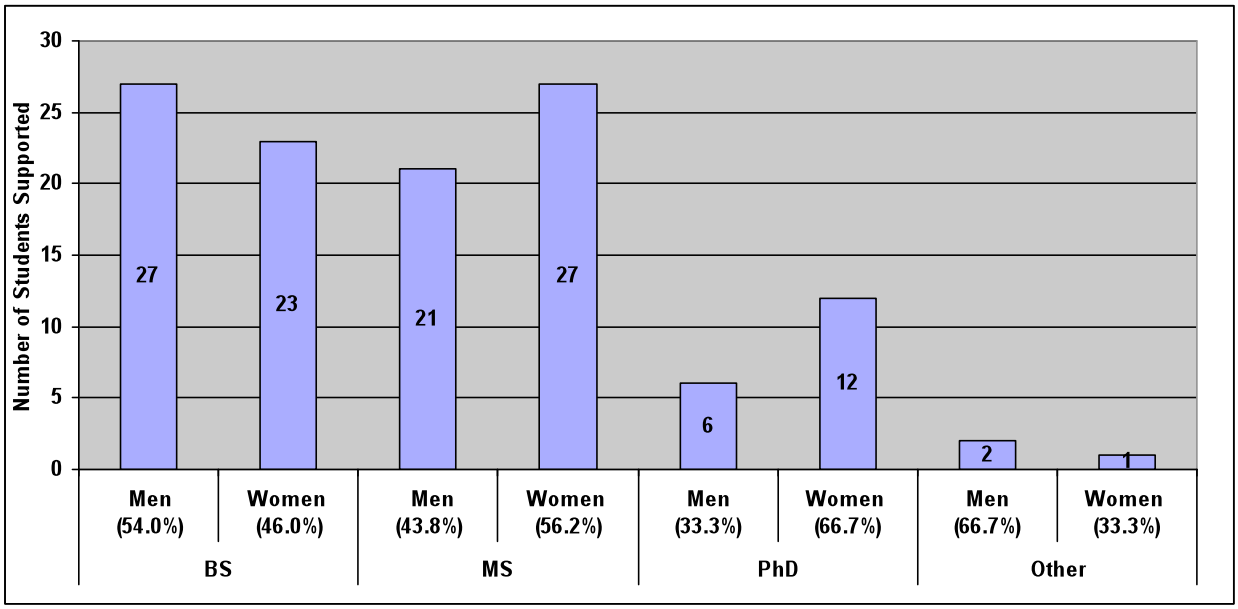


Figure V-3. Numbers of currently supported AquaFish CRSP students seeking BS, MS, PhD, and "other" degrees, disaggregated by gender. Students classified as "other" are high school or "certificate" students.

Table V-3. Number and percentage of long-term training participants who are women in the six core projects of the AquaFish CRSP.

| US Lead Institution | Total Students | Number of Women | % Women |
|---|---|---|---|
| North Carolina State University | 35 | 20 | 57.1 |
| Purdue University | 8 | 5 | 62.0 |
| University of Arizona | 23 | 7 | 30.4 |
| University of Connecticut | 23 | 13 | 56.5 |
| University of Hawaii at Hilo | 9 | 2 | 22.0 |
| University of Michigan | 21 | 13 | 61.9 |
| **Total** | **119** | **60** | **50.4** |

**Long-Term Training in IEHA Countries:** Of the 8 students supported under Purdue University's "Africa Project," 5 (4.2% of all long-term students) are from IEHA countries (Kenya and Ghana). Among these 5 students, 3 (60.0%) are female and 2 (40.0%) are male. All are seeking MS degrees

***Conferences and Symposia***

Another capacity building activity that should not be overlooked is the support provided for PIs, long-term students, and others to attend national and international conferences and symposia. Conference attendance is most frequently associated with the Aquaculture America and World Aquaculture meetings sponsored by the World Aquaculture Association (WAS) and by other organizations, including the CRSP. Other relevant meetings include various regional meetings (e.g., those of the Asian Fisheries Society, the Latin America and Caribbean Chapter of WAS (LACC-WAS), and the Aquaculture Association of Southern Africa) and the International Symposium on Tilapia in Aquaculture (ISTA) series. The CRSP typically plans its annual meetings to coincide with these conferences so that participants can attend both on a single trip. Attendance at these meetings constitutes an extremely valuable capacity building experience for the participants, regardless of which country or institution they are from. It provides them not only with access to a great deal of technical information on aquaculture and fisheries topics, but also with the opportunity to meet professionals from all over the world who are conducting research, training students, or carrying out extension activities. Professional contacts are made, friendships are formed, and networks are strengthened, all of which serve to build capacity for the individuals involved as well as for their home institutions. Students who attend these conferences often do so because they are ready to report on the results of the research they did as part of their graduate programs. Many are able to present their first scientific paper and experience their first professional conference because of this support from the CRSP.

# MALI ASSOCIATE AWARD

## Aquatic Resource Use and Conservation for Sustainable Freshwater Aquaculture and Fisheries in Mali (Associate Award Annual Report )

Cooperative Agreement No. 688-A-00-07-00044-00
Leader with Associates Award under EPP-A-00-06-00012-00

*Submitted by James R. Bowman, Project Coordinator*

***Introduction***

The Mali Project ("Aquatic Resource Use and Conservation for Sustainable Freshwater Aquaculture and Fisheries in Mali") is the first associate award received under the prime "Leader with Associates" (LWA) that established the AquaFish CRSP in 2006. The project, which has a planned span of three years (1 October 2007 through 30 September 2010), has the overall goal of "improving the productivity and income of producers in targeted areas of Mali through facilitation of access to technologies and building the capacity of stakeholders involved in freshwater fish farming and capture fisheries management." Its intent is to work in three major thematic areas to:

- Facilitate access and adoption of improved aquaculture production technologies in targeted areas to increase and diversify the incomes of farmers,
- Develop the capacity of the Government of Mali to help develop and disseminate relevant technologies,
- Identify appropriate strategies for the implementation of integrated rice and fish farming in target areas,
- Help develop an appropriate fisheries management plan to ensure long-term viability and sustainability of capture fisheries in the target area, and
- Help establish linkages useful for further development of aquaculture and fisheries in Mali.

***The Mali Project's Three Theme Areas:***

The Project's three-pronged approach towards encouraging the development of sustainable aquaculture and good fisheries management in Mali is being applied through work in these three theme areas:

- Theme I: Pond Culture—Advancing Sustainable Freshwater Aquaculture Practices and Technologies (Theme Leaders Dr. Héry Coulibaly and Dr. Charles Ngugi)
- Theme II: Rice-Fish—Promoting Sustainable Rice-Fish Aquaculture in Irrigated Systems (Theme Leaders Dr. Héry Coulibaly and Dr. Yang Yi)
- Theme III: Fisheries Planning—Building Community and Consensus towards a Fisheries Management Plan (Theme Leaders Mr. Soumaila Diarra and Mrs. Nancy Gitonga)

Theme I is working to identify, develop, and promote appropriate pond culture systems for implementation in Mali. Theme II is working to introduce appropriate adaptations of proven rice-fish systems, based on experience in China, to irrigated systems of the Niger River delta in Mali, and Theme III is seeking to encourage local involvement (ownership) in the development of sound fisheries management plans, working initially in the Lake Sélingué area.

Theme I is working to identify, develop, and promote appropriate pond culture systems for implementation in Mali. Theme II is working to introduce appropriate adaptations of proven rice-fish systems, based on experience in China, to irrigated systems of the Niger River delta in Mali, and Theme III is seeking to encourage local involvement (ownership) in the development of sound fisheries management agreements, working initially in the Lake Sélingué area.

The Mali Project takes a South-South approach to development, in which scientific expertise and practical experience from two Kenyan institutions (Moi University and FishAfrica) and one Chinese institution (Shanghai Ocean University) are brought to bear on the three areas being addressed.

***Collaborating Institutions and Personnel:***

**AquaFish CRSP, Oregon State University, Corvallis, Oregon, USA**
**(Lead US Institution)**
Hillary Egna, Principal Investigator
James Bowman, Project Coordinator and Co-PI
Dwight Brimley, Business Manager
Lisa Reifke, Graduate Research Student
Stephanie Misola, Undergraduate Student

**Direction Nationale de la Pêche (DNP), Ministère de l'Élevage et de la Pêche, Bamako, Mali**
**(Lead Mali Institution)**
Héry Coulibaly, Principal Investigator and Mali Theme Leader for Themes I & II (Pond Culture and Rice-Fish)
Soumaila Diarra, Mali Theme Coordinator for Theme III (Fisheries Management)
Madi M. Kheita, Collaborator for Theme II
Alhassane Abdou Sidy Toure, Collaborator for Theme II
Boureima Traore, Collaborator, Theme III

**Moi University, Eldoret, Kenya**
**(Theme I Lead Institution)**
Charles Ngugi, PhD, Theme Leader
Mr. Manyala, Collaborator for Theme III

**Shanghai Ocean University, Shanghai, China**
**(Theme II Lead Institution)**
Yang Yi, PhD, Theme Leader
Derun Yuan, Assistant Leader and trainer, Theme II
Liping Liu, Assistant Leader and trainer, Theme II

**FishAfrica, Nairobi, Kenya**
**(Theme III Lead Institution)**
Nancy Gitonga, Theme Leader

**Fisheries Department, Government of Kenya, Nairobi, Kenya**
Peter Nzungi, Frame Survey consultant/trainer for Theme III

**Sichuan Aquacultural Engineering and Technology Research Center, China**
Wu Zongwen, Collaborator, Theme III

***Summary of Activities Undertaken***

Much of the work conducted during this year was planning and start-up related. First on the agenda was to create an outline for a work plan and to visit Mali to gain first-hand knowledge of the status and constraints of both aquaculture and fisheries and identify potential Malian participants for the project, providing information that would be needed to properly develop

the work plan. Work on fleshing out the work plan began soon after that visit and extended into the 2008 calendar year. The Work Plan was further developed through a series of emails in early 2008 and final touches were agreed on during a meeting of the entire team in Busan, Korea, following the CRSP Annual Meeting and WAS World Aquaculture conference there. The final version was submitted to USAID/Mali and approved in early June 2008.

Development of the administrative documents needed to carry out the work—MOUs and Subcontracts—was simultaneously undertaken, leading to signing and execution of two of the needed sets of documents by August. Communication problems and language difficulties slowed the completion of the third set of documents.

***Progress Made and Results Achieved***

**Scoping Visit to Mali, November 25-30, 2007.**

Theme leaders Charles Ngugi and Nancy Gitonga conducted a scoping visit to Mali from 25 to 30 November, 2007. Theme leader Yang Yi (Theme II) was unable to join the mission at that time due to a scheduling conflict. The purposes of this visit were to:

- Assess the coordination and organization of agencies already active in the subsector
- Identify potential organizations and personnel for participation in the Mali Project
- Select suitable sites in Mali for activities to be conducted under the three themes and consider logistic arrangements for those activities
- Collect baseline information on fish production and post-harvest technologies in practice
- Evaluate the potential for rice-fish culture in Mali, with a focus on direct economic impacts, potential impacts on public health, household nutrition, and the environment, and the potential role of rice-fish production in poverty alleviation.

**Some key observations from the Scoping Visit:**

- Fisheries and Aquaculture in Mali have great potential. More than half of the people in West Africa consume fish products on a daily basis. Regionally, the sector employs about 5 million fishers, fish processors, and fish traders, along with other associated jobs.
- There are 700,000 fishermen in a population of 12 million people in Mali.
- The main species presently cultured in Mali are the Nile tilapia (Oreochromis niloticus) and African catfish (Clarias gariepinus).
- Aquaculture development is on the increase although not well practiced; the issues of poor soil quality and low water retention in ponds need to be addressed
- There is private sector interest and a need to strengthen private sector capacity.
- Increased capacities for processing and warehousing of fish and fish products are needed.
- There is a need to work towards access investment, training extension agents, and strengthening of linkages between institutions.
- There is a need for a fisheries policy to strengthen the management of fisheries through the development of management plans and implementation strategies.
- Research is needed to assess fish catches, value addition, and breeding grounds.
- Slot sizes need to be defined and gear sizes need to be regulated for the main species (Nile perch, Nile tilapia, and Synodontis).
- Efforts should be made to ensure smooth transitions from externally funded efforts to independent commercial aquaculture development effort and sustainability for fisheries in Mali.

**Suggestions or recommendations resulting from this visit:**

- The appropriate Malian institution to partner with for the new project would be the Direction National de la Pêche (DNP), under the direction of Dr. Héry Coulibaly.

- The following sites are deemed suitable for the activities of the three themes:
  - Theme I, Pond Culture: Bamako peri-urban area
    (training and pond management and feed trials/demonstrations)
  - Theme II, Rice-Fish Culture: Baguineda (major irrigation area)
    (training and rice-fish management trials/demonstrations)
  - Theme III, Fisheries Management: Lake Sélingué
    (training, frame surveys, and stakeholders workshops)

***Planning: Development of Project Work Plan***
Planning Phase efforts included extensive collaboration between OSU Project leaders Egna and Bowman and the Theme Leaders to draft the initial version of the Work Plan, resulting in a good working draft by the end of the second quarter.

A concurrent effort during the Planning Phase was the development of Indicator Worksheets for and a Project Monitoring Plan (PMP), which entailed a considerable amount of communication between USAID/Mali personnel and OSU PIs Hillary Egna and Jim Bowman. These documents were mostly complete by the end of the second quarter. Some elements of these documents, e.g., the impact indicators and targets that were identified for the project, were worked into the final versions of the Work Plan.

***Team meeting in Busan, Korea***
Much of this planning work was accomplished through e-mail correspondence. However, in addition an important planning meeting was held in Busan, Korea, following the AquaFish CRSP Annual Meeting (18-19 May) and World Aquaculture Society conference (19-22 May) held there. Team members Hery Coulibaly, Charles Ngugi, Yang Yi, and Nancy Gitonga, together with USAID/Mali CTO Gaoussou Traore and OSU PIs Hillary Egna and Jim Bowman, met there on 22 May, 2008. Although several members of the team (Coulibaly, Ngugi, Gitonga, Traore) had met in Mali in late 2007, this was the first good opportunity for the full team to get acquainted and to have a chance to work on the project Work Plan together, including revising the schedule of activities for each theme and adjusting targets for the selected impact indicators, and to discuss issues related to language and the translation of workshop and other materials into French. It was noted at this meeting that MOUs and Subcontracts remained to be developed and that this process is typically somewhat time-consuming.

During the third quarter the team continued with planning, finalizing the Work Plan, and scheduling of activities for the three themes in Mali, Kenya, and China. The Work Plan was revised to include changes agreed on at the Busan meeting, and final approval of the revised Plan was given by USAID/Mali on 9 June 2008.

Specific other activities conducted included additional planning and preparation for initial activities for all three Themes. In Kenya, Theme I and III leaders Ngugi and Gitonga prepared workshop materials, including working on translations into French. For Theme I, translations of posters and at least one fish farming handbook were begun. Theme II leader Yang Yi collected information for the rice-fish training to be held for two Malians in China and contacting local authorities in China to arrange for site visits during the training. For Theme III, several meetings were held between the Theme leader and collaborators who will help with the frame survey. Survey forms were developed and the software for the survey was agreed on, including the procedure to source for its use for the Mali Project. Potential translators were identified and translation work was begun.

***Development of MOUs and Subcontracts***
Considerable effort was spent developing Memoranda of Understanding (MOUs) and subcontracts between the various institutions that are involved in the project. The development of such documents is typically a detailed and lengthy process, and this case has proved to be so as well. Several aspects of this project are different than typical past AquaFish CRSP projects,

and these complicated the development of these important documents. MOUs and Subcontracts between OSU and FishAfrica (including work to be done by Moi University) (for the work of Themes I and III) and between OSU and Shanghai Ocean University (for Theme II work) had been completed and signed and were in place by the end of the year, but language barriers and other problems contributed to delays in the signing of agreements between OSU and the DNP. Work to finalize the MOU and Subcontract between OSU and the DNP continues and is expected to be complete very early in the next quarter.

***Conference Attendance***

Team members from Mali, Kenya, China, Thailand, and the US attended the Annual Meeting of the AquaFish CRSP and World Aquaculture Society's "World Aquaculture 2008" conference in Busan, Korea, from 19-23 May, 2008. Malians Héry Coulibaly (Direction Nationale de la Pêche) and Gaoussou Traore (USAID/AEG/Mali) were joined by Theme Leaders Nancy Gitonga, Charles Ngugi, and Yang Yi and Oregon State University's Hillary Egna and Jim Bowman for these meetings. For our Malian partners this provided excellent opportunities to meet many of the participants in the wider AquaFish Program, both from the US and from participating Host Countries, and to learn how the AquaFish CRSP functions. Participation in the World Aquaculture meetings also brought them into contact with the global aquaculture community, providing examples and models of what aquaculture can and does do in other countries and regions, and giving them many ideas to bring home to Mali.

***Progress toward Benchmarks, Intermediate Results, and Indicators***

**Required Impact Indicators, FY '08:**

| | *Targets* [a] | *FY '08* | *Cumulative* |
|---|---|---|---|
| New technologies under field testing | 0 | 0 | 0 |
| New technologies made available | 0 | 0 | 0 |
| Individuals receiving short-term training | 15 (8/7) | 2 [b] (2/0) | 2 (2/0) |
| Farmers who adopted new practices | 0 | 0 | 0 |
| Fish processors who adopted new practices | 0 | 0 | 0 |

Additional Optional Indicators:

| | *Targets* [c] | *FY '08* | *Cumulative* |
|---|---|---|---|
| Number of Malians who attend international aquaculture meetings | 3 | __ | 2 |
| Number of students trained or mentored in Mali | 3 | __ | __ |
| Number of participants trained outside of Mali | 8 | 2 | 2 |
| Additional aquaculture production area resulting from project efforts (either number of additional ponds or rice paddies or additional area in hectares) | 1.4 ha | __ | __ |
| Estimated increase in fish productivity in ponds or rice-fish systems in targeted areas (kg/ha/yr or percent) | 1500kg/ha/yr | __ | __ |
| Estimated increase in income for fish farmers in targeted areas (CFA/ha/yr or percent) | __ [d] | __ | __ |
| Number of extension publications developed | 10 | __ | __ |
| Number of frame surveys conducted for lake fisheries | 1 | __ | __ |
| Estimated increase in income for fishermen in targeted areas (CFA/ha/yr or percent) | __ [d] | __ | __ |

[a] Numbers shown in parentheses indicate male/female split of total targets.
[b] Two Malians received rice-fish training in China, 16-21 September, 2008.
[c] All themes, through 2010.
[d] Targets were not stated in the Work Plan (DNP to suggest reasonable targets).

***Training***

The Mali Aquaculture and Fisheries Project is largely a training project, utilizing short-term training (workshops and field testing/demonstrations) to reach its targeted audiences in the three Theme areas. One short-term training activity was undertaken during the year, that being the training of two Malians in various aspects of rice-fish culture in China in September. A full report on this training session was included with the 4th quarter report for the project. Other workshops originally scheduled for the third and fourth quarters were postponed pending the finalization of the required MOUs and subcontracts. Drafts of these documents completed earlier underwent considerable review and revision during this time.

***Problems Encountered***

This first year of the Mali Project has truly been a start-up year, in which a number of factors have combined to get the project off to a slower start than anticipated. Progress was severely affected from the outset by the unsettling events in Kenya, home of two of our Theme Leaders, following the national elections there in late 2007. Those events resulted in the total loss of home and personal safety, followed by dislocation to another part of Kenya, for our Theme Leader Charles Ngugi. The repercussions of that series of events have continued to affect working conditions for Dr. Ngugi until the present.

Working under an associate award is a new experience for all of the partners, presenting new sets of problems and requirements and resulting in an unexpectedly steep learning curve. Another factor is the fact that our core partners are spread literally around the world, including leaders in Mali, Kenya, China, and the US. The sheer physical distances between participants has mostly precluded holding face-to-face meetings in which problems and options could be readily discussed and solutions agreed upon. The modern convenience of email—even if it is working efficiently—can not readily substitute for being able to meet together in a single place. Language has clearly been another problem for the project. While Mali is a French-speaking nation, neither the Theme Leaders nor the Project Coordinator speak French. This barrier has contributed to a slowing of email communications, extra time required for the development of MOUs and Subcontracts, difficulties in developing accurate translations of training materials, and so forth.

***Summary***

Given the numerous stumbling blocks encountered by the project, an amazing amount has been accomplished during this first year. Working partners and project sites have been selected, a three-year Work Plan has been developed and approved, MOUs and subcontracts have been put into place, and on-the-ground work has begun. This project has the potential to make great contributions to Mali and the region, and the project team looks forward to building momentum and achieving good results as constraints are overcome and the way smoothes out during the second and third years.

# SYNTHESIS

*Submitted by Hillary Egna, CRSP Director*

Oregon State University's vision for the AquaFish CRSP advisory coordination brings together highly creative and knowledgeable people in functional advisory groups. Advisory groups provide linkages to the broad global community engaged in aquaculture and fisheries development issues. They have evolved from current CRSP structure, as originally envisioned by BIFAD (Board for International Food and Agricultural Development). A flexible structure allows a common organizational framework to emerge across all CRSPs as they are re-competed and re-organized. Commonalities can lead to cost-saving standardization and facilitated management by USAID, as well as amplification of benefits across focal areas and themes.

## Synthesis Reporting Units

Technical advisory groups (RCE and DTAP) have principal responsibility for synthesizing information across regions and themes, including data from leveraged activities (e.g., Associate Awards). A Synthesis Project has responsibility for providing metadata analysis and broad evaluative syntheses.

***Development Themes Advisory Panel (DTAP)***

DTAP provides technical advice on emerging issues and gaps in the portfolio from a thematic perspective. The four panels are aligned with the four themes mentioned in the Technical Approach and subsequent RFP. Lead Coordinators of the thematic panels assist the ME in integrating cross-cutting needs identified by USAID, but adding additional emphases on conserving biodiversity; preventing further degradation of aquatic ecosystem health; reducing poverty among small-scale farmers and fishers; maintaining and restoring capture fisheries productivity; developing IPM strategies; improving soil-and-water quality; and using biotechnology approaches cautiously. The lead coordinators are also responsible for writing annual reports, assisting the ME in evaluating workplan changes, performing assessments, and working together to provide quality information for thematic synthesis and lessons learned reporting. The DTAP can recommend policies for technical hot-topics, e.g., certification for organic standards, biotechnology applications, and toxics standards for fish consumption.

***Regional Centers of Excellence (RCE)***

RCE provides technical advice on emerging issues and gaps in the portfolio from a regional perspective. Centers will develop useful materials for Missions, other regional stakeholders and end-users, and gauge opportunities for collaboration based on regional or national needs. Three centers have been formed and each coordinates activities within a specified region: Asia, Africa, and Latin America/Caribbean. The center for Africa will also coordinate, synthesize, and report on activities related to IEHA goals. Additional RCEs may be added depending on the portfolio of projects funded through Associate Awards. Lead coordinators (one for each center) will take an active role in integrating Associate Award partners into the portfolio and in managing any Associate Awards that fall under its purview. Lead coordinators will also assist the ME in cases where a screening process is required in advance of an Initial Environmental Examination.

***SYNTHESIS PROJECT (SP)***

The overall Synthesis Project at the ME includes a research component undertaken by a PI (Professor Steven Buccola of Agricultural & Resource Economics, OSU) and his graduate student, and a project support coordinator who will assist the Director and Advisory Groups. During this reporting period, a research plan was discussed, and a preliminary research-based

concept note was developed, and is presented below. OSU took on the SP after the Director asked the six Lead PIs of their interest. Over a 15-month period, no interest was registered so the ME proceeded rapidly to undertake this program commitment. During the upcoming 2009 annual meeting, PIs will have the opportunity to interact with the SP researchers in order to refine the concept into an investigation. The SP will assume responsibility for metadata analysis and reporting. It will provide feedback to the program on minimum dataset sizes to reduce duplication and streamline data collection.

## Development Themes Advisory Panel Reports

The following reports cover progress to date on accomplishments that are measured by the Development Themes Advisory Panel (DTAP) thematic impact indicators (for additional details, see *Monitoring and Evaluation*. Table V-4 at the end of this section summarizes the DTAP metrics.

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### *DTAP A: Improved Health and Nutrition, Food Quality, and Food Safety of Fishery Products*

*Printed as Submitted by Maria Haws (University of Hawai'i at Hilo), Lead Coordinator*

It is estimated that physical and economic losses of fisheries and aquaculture products on a global basis totals about 10%, rising as high as 50% in some regions such as Africa. Reduction of post-harvest losses provides direct economic benefits and reduces environmental impacts. Equally important to food security as food production, is the ability to produce foods which are high quality and safe to consume. Food-borne illnesses in fisheries and aquaculture products may derive from bacterial, viruses, biotoxins, parasites and chemicals. Reduction of food borne illness has both economic and human health benefits. One of the goals of CRSP is to foster practices that improve quality and safety and reduces losses in fisheries and aquaculture products.

The indicator used for this outcome is: "*number of aquaculture products developed that meet food safety standards*". Projects which have activities in this area are:

**Project: Improved cost-effectiveness and sustainability of aquaculture in the Philippines and Indonesia.**
US PI: Russel Borski
No activities related to DTAP A.

**Project: Developing sustainable aquaculture for coastal and tilapia systems in the Americas.**
US PI: Kevin Fitzsimmons
No activities related to DTAP A.

**Project: Improving sustainability and reducing environmental impacts of aquaculture systems in China, and South and Southeast Asia.**
US PI: James Diana
07HHI01UM: reduction of microcystins in fish.

07MNE07UM: workshop on aquaculture and human health (note: does not develop a specific product).

**Project: Human health and aquaculture: health benefits through improving aquaculture sanitation and best management practices.**
US PI: Maria Haws
07IND04UH: depuration of two oysters species, Crassostrea corteziensis and C. gigas.

07HHI05UH: depuration and monitoring of cockles and growing waters: Anadara tuberculosa and A. similis.

**Project: Development of alternatives to the use of freshwater low value fish for aquaculture in the lower Mekong Basin of Cambodia and Vietnam: Implications for livelihoods, production and markets.**
US PI: Bob Pomeroy.
07FSV01UC: Food safety and value-added product development for low value/trash fish (note: this is a study and does not promise to immediately develop any products).

**Project: Improving competitiveness of African aquaculture through capacity building, improved technology and management of supply.**
US PI: Kwamena Quagrainie
No activities related to DTAP A.

## ***DTAP B: Income Generation for Small-Scale Fishers and Farmers***

*Printed as Submitted by Kwamena Quagrainie (Purdue University), Lead Coordinator*

A major goal of the AquaFish program is to help alleviate poverty in host countries through the development and transfer of aquaculture technologies. Consequently, the program seeks to empower small-scale fishers and farmers through trainings in production technology to improve production efficiency and generate income.

In a study on improving aquaculture sanitation and best management practices in Mexico, three techniques are under development, i.e., spat collection for the native oyster Crassostrea corteziensis; depuration/relay for oysters in open-water locations; and depuration dynamics for black cockles, Anadara sp. The technologies being developed will be available to 48-UAS, UAN, ISA, University of the Coast, Sinaloa State Committee for Sanitation, Nayarit State Committee for Sanitation, CIDEA/UCA, 39 oyster growing cooperatives, and 2 women's groups growing oysters. One hundred and seventy (170) people have been trained so far to use these technological practices in Mexico, which includes 134 in international workshops, 6 in LSU training course, 30 in women's oyster growing group.

In Tanzania, local plant species of *Moringa oleifera*, *Leucaena leucocephala*, *Jatropha curcas* and *Sesbania sesban* are being examined for use as protein sources for fish feed to reduce the use of fish meal which conflicts with human food sources. Also, a set of research-based recommendations on fish production technologies, yields, feed conversions ratios, survival, and costs are being assessed. When the feeds are developed, the technologies will be available to the Ministry of Natural Resources & Tourism – Aquaculture Development Division, which is the government entity in charge of aquaculture development, Sokoine University of Agriculture, and fish farmers' cooperatives.

An experiment was conducted in Nepal to evaluate the effect of sahar (*Tor putitora*) stocking on recruitment control, growth and production of mixed-sex Nile tilapia pond (*Oreochromis niloticus*). This production technology demonstrated that stocking of sahar reduced tilapia recruitment in a mixed-sex Nile tilapia pond culture system and provided environmental conditions for better tilapia growth and production. A sahar to tilapia ratio of 1:16 is recommended because it resulted in overall best performance. This technology is available to the Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal, and fish farmers in Nepal.

## *DTAP C: Enviromental Management for Sustainable Aquatic Resources Use*

*Printed as Submitted by James S. Diana (University of Michigan), Lead Coordinator*

The impact indicators agreed upon to evaluate environmental management for sustainable aquatic resources are listed below. Progress to date on each project with impacts on these indicators is included.

**Number of hectares under improved natural resource management**
07SFT02NC – in progress, 7 ha of farms are being converted to alternate feeding strategies for Nile tilapia in the Philippines

07MER03PU – in progress, 7 on farm sites are being evaluated for better production systems in Tanzania

07MNE04UM – in progress, 150 ponds are being evaluated for better waste management systems in China

**Number of management practices developed to support biodiversity**
07SFT02NC- in progress, is developing better feeding practices in Philippines, which will reduce waste discharge
07SFT03NC-in progress, is determining better feeding systems to reduce waste production by milkfish in the Philippines
07QSD02PU – in progress, is developing Clarias culture to replace collection of wild baitfish for Nile perch fisheries in Kenya

07IND03UH – in progress, is evaluating new spat collection practices for endemic species in Mexico

07WIZ02UH – in progress, is evaluating carrying capacity for oysters to reduce eutrophication problems with overstocking in Mexico

07MNE03UM – in progress, is evaluating introduction of culture species on biodiversity in reservoirs in China and Vietnam
Number of management practices developed that reduce consumptive water use

07WIZ01PU – planned to begin this winter, will evaluate waste produced and receiving water quality in Ghana

**Number of people trained in practices that promote soil conservation and/or improved water quality**
07TAP02NC-in progress, is producing podcasts and workshops to train farmers oin tilapia farming in the philippines

07MNE02NC – 94 people trained on sustainable coastal technology

07MER03PU – in progress, 7 cooperating farmers will gain training on improved technologies for polyculture in Tanzania

07HH105UH – in progress, is evaluaing microbial quality of water and methods for improvement in Mexico

07MNE07UM – will hold aworkshop on improved health and environmental control of aquaculture systems to 50 participants in China

**Number of management systems developed that increase production by reusing aquaculture effluents & byproducts**
07SFT06PU – in progress, is using locally based feeds to replace more expensive feed in Tanzania

07IND03UH – in progress, is using locally collected spat to filter water and improve water quality in Mexico

07MNE04UM – in progress, is evaluating waste streams in freshwater and marine aquaculture and evaluate alternative uses of waste products in China

07MNE05UM – in progress, is determining sustainability of flow through and reuse systems for shrimp culture

*Number of IPM practices developed*
07BMA02UM – in progress, is evaluating polyculture to reduce pest problems in sahar culture

***DTAP D: Enhanced Trade Opportunities for Global Fishery Markets***

*Printed as Submitted by Robert Pomeroy (University of Connecticum-Avery Point), Lead Coordinator*

The impact indicators agreed upon to evaluate environmental management for sustainable aquatic resources are listed below. Progress to date on each project with impacts on these indicators is included.

**Number of new markets for aquatic products**
0

**Number of aquatic products available for human food consumption**
Human Health and Aquaculture: Health Benefits Through Improving Aquaculture Sanitation and Best Management Practices - 07IND03UH - 4 (2 oyster species, 2 cockle species)

Improved cost effectiveness and sustainability of aquaculture in the Philippines and Indonesia
07MNE02NC - 1 - Agar production as a byproduct of culturing seaweed

Table V-4. FY2008 DTAP Indicator Summary

| DTAP Indicator | Investigation Code | Status |
|---|---|---|
| **DTAP A: Improved Health and Nutrition, Food Quality, and Food Safety of Fishery Products** | | |
| Number of aquaculture products developed to improve food safety or quality | 07HHI01UM | Reduction of microcystins in fish. |
| | 07MNE07UM | Workshop on aquaculture and human health (note: does not develop a specific product) |
| | 07IND04UH | Depuration of two oysters species, *Crassostrea corteziensis* and *C. gigas* |
| | 07HHI05UH | Depuration and monitoring of cockles and growing waters: *Anadara tuberculosa* and *A. similis* |
| | 07FSV01UC | Food safety and value-added product development for low value/trash fish (note: this is a study and does not promise to immediately develop any products.) |
| **DTAP B: Income Generation for Small-Scale Fishers and Farmers** | | |
| Number. of new biotechnologies developed | 07IND03UH | Spat collection for *C. corteziensis* under development |
| | 07IND04UH | Depuration/relay for oysters under development |
| | 07HHI05UH | Depuration dynamics for *Anadara* sp. under development |
| | 07SFT06PU | Local plant species as feed resource and other fish production technologies under development |
| Number of institutions with access to technological practices | 07IND03UH<br>07HHI03UH<br>07HHI04UH<br>07HHI05UH | 48-UAS, UAN, ISA, University of the Coast, Sinaloa State Committee for Sanitation, Nayarit State Committee for Sanitation, CIDEA/UCA, 39 oyster growing cooperatives, 2 women's groups growing oysters |
| | 07SFT06PU | 1: Ministry of Natural Resources & Tourism, Aquaculture Development Division |
| Number of (people) trained in use of technological practices | 07HHI03UH<br>07BMA05UH | Total to date=170 (134 in international workshops, 6 in LSU training course, 30 in women's oyster growing group) |
| | 07BMA02UM | 1:16 sahar stocking ratio in mixed-sex Nile tilapia pond improved recruitment control, growth and production |

Table V-4. FY2008 DTAP Indicator Summary

| DTAP Indicator | Investigation Code | Status |
|---|---|---|
| **DTAP C: Environmental Management for Sustainable Aquatic Resources Use** | | |
| Number of management practices developed or adopted to improve natural resource management (*includes IPM*) | 07SFT06PU | In progress, is using locally based feeds to replace more expensive feed in Tanzania |
| | 07IND03UH | In progress, is using locally collected spat to filter water and improve water quality in Mexico |
| | 07MNE04UM | In progress, is evaluating waste streams in freshwater and marine aquaculture and evaluate alternative uses of waste products in China |
| | 07MNE05UM | In progress, is determining sustainability of flow through and reuse systems for shrimp culture |
| | 07BMA02UM | In progress, is evaluating polyculture to reduce pest problems in sahar culture |
| Number of hectares under improved natural resource management | 07SFT02NC | In progress, 7 ha of farms are being converted to alternate feeding strategies for Nile tilapia in the Philippines |
| | 07MER03PU | In progress, 7 on farm sites are being evaluated for better production systems in Tanzania |
| | 07MNE04UM | In progress, 150 ponds are being evaluated for better waste management systems in China |
| Number of management practices developed to support biodiversity | 07SFT02NC | In progress, is developing better feeding practices in Philippines, which will reduce waste discharge |
| | 07SFT03NC | In progress, is determining better feeding systems to reduce waste production by milkfish in the Philippines |
| | 07QSD02PU | In progress, is developing Clarias culture to replace collection of wild baitfish for Nile perch fisheries in Kenya |
| | 07IND03UH | In progress, is evaluating new spat collection practices for endemic species in Mexico |
| | 07WIZ02UH | In progress, is evaluating carrying capacity for oysters to reduce eutrophication problems with overstocking in Mexico |
| | 07MNE03UM | In progress, is evaluating introduction of culture species on biodiversity in reservoirs in China and Vietnam |

Table V-4. FY2008 DTAP Indicator Summary

| DTAP Indicator | Investigation Code | Status |
|---|---|---|
| Number of management practices developed to support biodiversity (cont) | 07WIZ01PU | Planned to begin this winter, will evaluate waste produced and receiving water quality in Ghana |
| Number of people trained in practices that promoted soil conservation and/or improved water quality | 07TAP02NC | In progress, is producing podcasts and workshops to train farmers on tilapia farming in the philippines |
| | 07MNE02NC | 94 people trained on sustainable coastal technology |
| | 07MER03PU | In progress, 7 cooperating farmers will gain training on improved technologies for polyculture in Tanzania |
| | 07HH105UH | In progress, is evaluaing microbial quality of water and methods for improvement in Mexico |
| | 07MNE07UM | Will hold a workshop on improved health and environmental control of aquaculture systems to 50 participants in China |
| **DTAP D: Enhanced Trade Opportunities for Global Fishery Markets** | | |
| No. of new markets for aquatic products | no report | |
| No. of aquatic products available for human food consumption | 07IND03UH | 4 (2 oyster species, 2 cockle species) |
| | 07MNE02NC | 1 - Agar production as a byproduct of culturing seaweed |

# Regional Centers of Excellence Reports

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## *RCE-Africa*

*Printed as Submitted by Charles Ngugi (Moi University, Kenya), Lead Coordinator*

With nearly three billion people in the world living on less than two dollars a day, it is vital that we understand the policies and institutions that will contribute to the Millennium Challenge Goal of halving poverty by 2015. Addressing these challenges requires multiple approaches—the pathways from rural poverty will not be the same for all people, in all places. Yet whatever the pathway, elimination of chronic poverty requires mechanisms to manage the risk, vulnerability and other constraints that undercut the nutritional, health and educational investments needed to bolster the human capital of the next generation and break the inequitable inter-generational transmission of poverty. Success in these three areas will have to be part of any deep-reaching transformational development.

Africa is far from achieving the MDGs, and less than one-third of the countries in the region are even close to the 7 percent GDP growth rate deemed necessary to halve poverty by 2015. Moreover, the goals of NEPAD's CAADP to increase agricultural growth by 6 percent and public expenditures on the agricultural sector by 10 percent have so far eluded most African countries. Agriculture is the primary source of livelihood for about 65 percent of Africans. It represents 30–40 percent of Africa's GDP and accounts for almost 60 percent of Africa's export income.

Reducing high levels of poverty and hunger will require greater agricultural and rural development. Since small-scale farms account for more than 90 percent of Africa's agricultural production and are dominated by the poor, this growth must be centered on the small farmer. According to the Millennium Project's Task Force on Hunger, small holder farming systems also contain 75 percent of Africa's underweight children. In spite of this recognized need, progress in improving the lot of Africa's smallholder farmers has been elusive over the last decade. Food insecurity remains a major problem, requiring shipments of some three million metric tons of cereal food aid in 2002 and resulting in food emergencies in 24 African countries.

**The Presidential Initiative to End Hunger in Africa (IEHA):** Launched in 2002, the Presidential Initiative to End Hunger in Africa (IEHA) is a multi-year effort designed to help increase agricultural income and fulfill the United Nations' Millennium Development Goal. This initiative focuses on promoting agricultural growth and building an African-led partnership to cut hunger and poverty by investing in agriculture oriented toward small-scale farmers.

Country and regional action plans for IEHA are structured around six themes for maximum impact:

- Scientific and technological applications that harness the power of new technology
- Agricultural trade and market systems that add value to products and processes
- Community and producer-based organizations that contribute to agricultural growth
- Development of human capital and institutions that shape and lead agricultural policy and research
- Integration of vulnerable groups and countries in transition into sustainable development processes

- Environmental management that contributes to agricultural and rural sector growth

The Aquaculture & Fisheries CRSP is committed to directing at least 25% of its total budget to support IEHA objectives. The six countries currently included in IEHA are Kenya, Ghana, Mali, Mozambique, Uganda and Zambia. There are also three regional platforms in West, East and Southern Africa. Additional IEHA countries may be added that are particularly chronically food insecure, "hunger hotspots."

**AquaFish CRSP Strategy for Achieving Development Impact:**
- Research
- Capacity building
- Information dissemination
- IEHA country involvement

**AquaFish CRSP Focal Areas**
- Improving nutrition and health
- Maximizing water, soil quality and productivity
- Advancing IPM practices
- Broadening market access
- Increasing incomes
- Improving food quality, processing, and safety

**Some of our desired outcomes are:**
- Significant, collaborative relationships between institutions
- Building of professional capacity
- Transfer of new technology and practices to stakeholders
- Safer seafood and aquaculture products
- Improved environmental conditions

Expert panel meeting in Nairobi in 2002 funded by ACRSP opened the way for collaboration. During this meeting, various aquaculture scientists discussed and agreed on a set of priorities for aquaculture development in Africa.

Currently Aquafish CRSP is focused on different issues in different countries
- Kenya –Focus now on marketing and conservation of endemic fish species
- Tanzania – Production technology and technology transfer
- Ghana – Fish feed, environmental impact assessment for cage culture on Lake Volta and marketing

**The role of the Regional Centers of Excellence (RCE) is** to build community among all CRSP participants; identify potential additional partnerships with the public and private sector, NGOs, USAID, and others; and bridge the knowledge gap from local-regional perspectives to global development outcomes

**The key interventions are to:**
- provide technical advice on emerging issues and gaps from a regional perspectives
- develop useful materials for missions and other regional stakeholders and end users
- gauge opportunities for collaboration based on regional and national needs
- coordinate synthesize and report on activities related to IEHA goals
- additional responsibilities based on leader with Associate Award

**Technical Advice.** Currently the RCE facilitates networking with US scientists interested in African aquaculture at WAS meetings and regional meetings, Personal contacts/relationships Through HC PI networking, and ACRSP match making.
- Develop useful materials

- Development of posters in English, French and local languages (Kiswahili)
- Developed a fish farmers' manual
- Establishing a Web Site; in progress

**Opportunities for collaboration**
- Facilitate information exchange (RCE established linkages)
    - FAO
    - ANAF (Aquaculture Network for Africa)
    - SARNISSA (Sustainable Aquaculture Research Network In Sub-Saharan Africa)

**Developing Proposal for Research and Leverage funding**
- Kenya, South Africa linked with Brazil and wrote a proposal in August 2008
- Developed an urban and peri-urban proposal with University of Stirling and three NGOs (submitted on September 1st 2008)

**Working with stakeholders in training programs ( Universities and tertiary colleges in Ghana, Kenya, Malawi, Zambia, and Tanzania)**
- Farmers' training
- Extension agents' training
- Student training

**Working with government officials**
Contacts in Ghana, Kenya, Mali, Uganda and Tanzania
Have established contacts with senior government officers in these countries
In Ghana, We are working with the deputy director under FAO/ANAF information exchange. In Kenya CRSP invited the director of fisheries to attend the WAS meeting in Korea. In Tanzania, the Principal fisheries Officer is a member of ANAF and in Uganda we work very closely with the Commissioner for fisheries.

Have held several meetings with Kenya Permanent secretary for fisheries Development to discuss CRSP involvement in development of fisheries and Aquaculture

**USAID Missions**
In Mali USAID working with the mission on the Leader with Associate, award project on "Aquatic Resource use and Conservation for Sustainable Fresh water Aquaculture and Fisheries"

In Kenya, we have worked with USAID Mission though Kenya Business Development Services (KBDS). Discussions on future collaboration were held during the KBDS wrap up meeting held on 17th September 2008 at Holiday inn, Nairobi.

**NGOs and IGOs**
Established contacts with John Moehl, FAO Regional Office, Ghana
Have established communication with NEPAD and Comesa through Dr. Sloans Chimatiro, Senior Fisheries Advisor, NEPAD Secretariat, South Africa
Established contact with Fish Africa, Dr. Koffi and Mrs Nancy Gitonga

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**Additional Text**

**Initiative to End Hunger in Africa (IEHA) Report: The Ghana Perspective**
Available data suggests that fish represents about 60% of the animal protein intake of Ghanaians. Ghana has been making giant strides to try and produce particularly Tilapia and catfishes to supplement animal protein requirements of the country. Main constraints to production include:
- Lack of good quality seed,

- Lack of feed and feed mills
- Restricted technical know-how
- Poor market infrastructure and access
- Lack of access to credit and loans
- Policies that emphasise central planning over private sector initiative
- Sustained importation of outboard motors rather than encouraging artisanal fishermen to go into fish farming

If Ghanaian aquaculture is to be sustained and contribute to the IEHA programme government policy should attempt to facilitate the alleviation of the main constraints outlined above and rely more heavily on commercial investments to enhance future growth of the industry. Demand for fish in Ghana far outstrips the supply and the national government spends about USD 200 million each year to import fish into the country. There is therefore a ready local market that can purchase fish produced. Anecdotal information suggests that some private Tilapia farms in Ghana do not need to export their fish, as their net profits are better when sold in Ghana.

Access to feed has been one of the major constraints to expanded aquaculture production throughout the Africa Region. Experiences from within and outside the Region have demonstrated "traditional" approaches relying on on-farm nutrient inputs (chiefly organic fertilisers) will not lead to profitable harvests to a level that will ensure sustainability and expansion of the enterprise. Furthermore, on-farm or farm-made supplemental feeds have demonstrated poor results for a variety of reasons including unavailability of ingredients and inherent low quality of products.

With efforts now underway to identify an improved strain of tilapia and various strategies for seed production and distribution now being examined, it has become increasingly pressing to identify feed guidelines that correspond to varying and improving seed quality.

The Nigerian catfish industry, in spite of numerous in-country mills of various designs, also depends heavily in imported feeds.

**Initiative to End Hunger in Africa (IEHA) Report: The Kenya Perspective**

Since the mid 1990s, fish farming has been undergoing a major revival in Kenya. After several decades during which many previously constructed ponds fell into disuse, renewed efforts by organizations such as the Kenya Fisheries Department, the FAO, the Belgian Survival Fund, and the Aquaculture CRSP to conduct research and disseminate results about appropriate practices, farmers are now realizing that fish farming can be a profitable enterprise. This has resulted in the revival of some previously abandoned ponds, the construction of numerous new ponds, and a renewed enthusiasm for fish farming among farmers. While some farming of rainbow trout (*Oncorhynchus mykiss*) is practiced in the cool highlands around Mt. Kenya and Mt. Elgon, the primary species cultured in most of the country are the Nile tilapia (*Oreochromis niloticus*) and the African catfish (*Clarias gariepinus*).

Most of the research conducted in the last decade by the Aquaculture CRSP focused on:

- pond construction and culture techniques (appropriate fertilization and feeding regimes) Nile tilapia (*Oreochromis niloticus*)
- improving the survival of catfish fry reared to the fingerling stage.

There are many remaining questions regarding the culture of both tilapia and catfish

One of the standard recommendations for tilapia culture in Kenya has been to stock catfish with the tilapia at a rate of 5-10% of the number of tilapia stocked. This recommendation has been made primarily as a way to control the unwanted reproduction that usually occurs in tilapia

ponds, but farmers do also realize the benefit of a second species being produced for sale or consumption.

This remains a significant problem for tilapia farmers in Kenya because there are as yet no producers of sex-reversed fingerlings in the country, so farmers either rely on hand-sexed all-male populations or must resort to simply stocking mixed-sex fingerlings; in either case reproduction early in the culture period often becomes a problem.

**Other IEHA Countries that the RCE has or will establish linkages**

- Mali: Lead with associate award
- Uganda: through USAID FISH Project
- Mozambique: no action taken
- Zambia: Contacts made

***RCE-Asia***

*Printed as Submitted by Remedios B. Bolivar (Central Luzon State University, Philippines), Lead Coordinator*

The AquaFish CRSP Collaborative Research Support Program's mission is to enrich livelihood and promote health by cultivating international multidisciplinary partnerships that advance science, research, education, and outreach in aquatic resources.

During an orientation meeting in Washington, DC, three AquaFish CRSP Regional Centers of Excellence were created in Asia, Africa and Central/Latin America. The roles of these RCEs are as follows: to provide technical advice on emerging issues and gaps from a regional perspective, to develop useful materials for USAID Missions, other regional stakeholders and end-users and gauge opportunities for collaboration based on regional or national needs and Lead coordinators will also assist the Management Entity in cases where screening process is required in advance of Initial Environment Examination.

The Regional Center of Excellence had served to facilitate information exchange through establishing contact with people (farmers, government officials, scientists, extension agents, etc.) who are working in aquaculture and fisheries.

For the RCE-Asia, this information exchange was in the form of attendance to international and national scientific meetings, symposia and conferences. Examples of important meetings that have been attended during the period were the following:

2. Bi-Annual Conference of the Aquaculture Association of Southern Africa (AASA), Cape Town, South Africa, October 21-24, 2007
3. Eight Asian Fisheries Forum, Cochin, India, November 20-23, 2007
4. Aquafish CRSP Annual Meeting, Busan, South Korea, May 18-19, 2008
5. World Aquaculture Meeting 2008, Busan, South Korea, May 19-21, 2008
6. AquaFish CRSP HCPI Exchange Project Wrap-up Meeting, Busan, South Korea, May 23, 2008
7. Seminar/Workshop on Applied Genetics in Aquaculture, Bonuan-Binloc, Dagupan City, Pangasinan, Philippines, June 25-27, 2008
8. HIPON (Penaeus vannamei) Summit 2008, Bonuan-Binloc, Dagupan City, Pangasinan, Philippines, August 21-22, 2008

Opportunities for research collaboration were also made possible through the following efforts:

1. Joint proposal writing with Dr. Yang Yi of Shanghai Ocean University.
2. Response to call for proposal by CNPq (Brazilian National Council for Science and Technology) by an AquaFish CRSP host country principal investigator in Brazil, Dr. Maria Célia Portella where she asked for possible collaboration with experts on tilapia production. In the end, I think it was Dr. Wilfrido Contreras who was identified to participate in this proposal considering his ability to speak Portuguese.

As a means to strengthen linkages, a planning meeting with Dr. Yang Yi was informally held during the recently concluded ISTA8 in Cairo, Egypt. This planning meeting was focused on the First International Symposium on Aquaculture and Fisheries Education (AFE) to be held on July 26-29, 2009 at Asian Institute of Technology (AIT), Thailand. This symposium will be jointly organized by AIT, Shanghai Ocean University, China and Asian Fisheries Society (AFS). Dr. Yang Yi, being the present president of the AFS hopes to create a session where I will serve as the Chair and also to provide award to best posters or best papers courtesy of AquaFish CRSP. This symposium will bring together reputed speakers from all over the world to discuss issues pertaining to aquaculture and fisheries education. Furthermore, it will deliberate on educational and training needs to support the aquaculture and fisheries industry and related developmental initiatives to sustain its growth through human resource development.

To provide opportunities for colleagues in aquaculture and fisheries to be exposed to international scientific meeting, four participants (2 technical staff and 2 undergraduate students) from the Philippines will attend the Symposium on Catfish Aquaculture in Asia on December 5-7, 2008 in Can Tho City, Vietnam.

To strengthen human capacity building, during the period under review and during the Philippine 2nd Semester (SY 2007-08), 14 undergraduate students in Fisheries at the Central Luzon State University, Philippines and 9 graduate students were financially supported in their respective degree programs. On April 2008, 3 graduated their undergraduate degree and last Summer 2008, one graduated. During the 1st Semester (School Year 2008-09), AquaFish CRSP supported 9 undergraduate and 11 graduate students.

Also, during the 2008 World Aquaculture Society Meeting in Busan, South Korea last May 19-21, 2008, partial support was provided to Mr. Isagani Angeles, a Filipino graduate student of the National Taiwan Ocean University (NTOU) for him to attend the international meeting.

Last August 29-30, 2008, one project staff participated in the workshop on Shrinmp and Gracilaria Culture: New Trends for a Changing World held at the Igang Marine Station, SEAFDEC, Igang, Nueva Valencia, Guimaras.

There were 23 visitors who consulted and accessed information from the AquaFish CRSP Office at the Central Luzon State University, Nueva Ecija, Philippines.

These activities are all worthwhile to mention to have been made possible with the establishment of the Regional Centers of Excellence.

## *RCE-LAC*

*Printed as Submitted by Wilfrido Contreras-Sanchez (Universidad Juárez Autónoma de Tabasco, Mexico), Lead Coordinator*

Different activities have been conducted in regards of meeting the objectives conceived for the RCE. These activities involve:

Researches from different universities in Mexico and Central America have been contacted. The main goal is to look for new partners interested in collaborative research in aquaculture and/or fisheries. Faculty from UJAT was invited by the Secretary of Natural resources and Environmental Protection of Tabasco (SERNAPAM) to participate in a tilapia culture workshop at Universidad Intercultural, located in Oxolotan, Tabasco. This University focuses on indigenous groups that live in the mountains of Tabasco and Chiapas and is looking at aquaculture as an alternative for good-quality food production. We expect that this workshop will create strong bonds between both universities to continue promoting tilapia culture is the region.

Researchers from Guatemala, Nicaragua and Costa Rica have also been contacted and invited to participate in the 2nd Snook Biology and Aquaculture workshop to be held in Villahermosa next year. The idea is to bring together aquaculture and fisheries experts interested in snooks and draw a common research outline to search for international funds. In addition to this, Mauritzio Protti (a researcher from the National University of Costa Rica; UNA) has invited UJAT to help initiating a project to restore tropical gars into the national reserve "Caño Negro". Two actions have been conducted a) Gabriel Marquez gave a workshop on tropical gar culture and trained researchers from UNA. As a result of this, a successful spawning was achieved and juveniles kept at UNA facilities. Adrián Sevilla --a researcher from UNA-- will spend a month at UJAT to be trained on gar and native cichlids culture techniques. An interesting feature of the "Caño Negro" reserve is that shares borders with Nicaragua and comprises very poor communities from both countries. An initiative to develop an international aquaculture station in the area has been proposed by UNA and both the National University of Nicaragua and UJAT have been invited to participate in the project.

Communication with the USAID mission in Mexico has not been successful. USAID considerably reduced its personnel in Mexico and only one person has been in charge of all environmental programs since early 2007. No other missions have been contacted in Central or South America.

Communications is maintained with former members of the CRSP in the region, particularly with Maria Célia Portella. Maria has submitted two projects on tilapia aquaculture and environmental assessment in Brazil involving CRSP researchers; one of the projects is waiting for a response from the Special Secretariat for Aquaculture and Fisheries in Brazil. The project was considered highest priority in a list of projects to be fund (based on money availability). Maria Célia is waiting for official information.

We have continued increasing human resources capacity by promoting workshops, training students in tilapia farms (Arizona) and conferences. UJAT has approved to keep sending two students each semester to Arizona to participate in a tilapia farm and gain experience hands-on. Since the TIES project has ended, UJAT is paying plane tickets and part of the stipend to the students.

A meeting with the tilapia producers association of Tabasco has been schedule to promote UJAT activities and new investigations funded by A&F CRSP in the area. Our interest is to tighten bonds between members of the association and scientists that conduct research with tilapia.

# Synthesis Concept Note

for the research part of the Synthesis Project

***Evaluating AquaFish Accomplishments in a Systems Framework***

*Printed as Submitted by Steven Bucola (Oregon State University), Lead PI*

***Introduction***

The goal of USAID's AquaFish CRSP is to alleviate poverty and improve food security in developing and other countries through sustainable aquaculture development and aquatic resources management. The CRSP began in 2007 to fund US-based Lead Partner Institutions (LPI), each of which provide numerous sub-awards to developing country institutions for investigations to be completed by 30 September 2009.

Each LPI focuses on one of the four CRSP Themes, with attention to the remaining three: (a) improving health and nutrition, (b) generating income for small-scale fish farmers, (c) improving environmental management, and (d) enhancing trade opportunities. Awarded LPIs and the investigations they finance are to adhere to USAID's core program components: a systems approach; social and environmental sustainability; local and national capacity building; outreach and adoption; and gender integration. Investigations are to build as much as possible on previous USAID-funded work and institutions. The overarching requirement is that a funded investigation or sub-award provide, at its conclusion, a comprehensive development approach to a small-scale aquaculture or fisheries problem. The approach must include some attention to outreach and dissemination, even if outreach is not its main emphasis.

The purpose of the present proposal is to evaluate the performance of the AquaFish CRSP LPIs, and their funded investigations, during the 1 April 2007 – 30 September 2009 period. In the following, we discuss alternative ways of conducting such an evaluation, then offer an approach that we think would be most productive.

*Alternative Structural Approaches to this Study*

Each investigation or sub-award concentrates on a particular Research and Outreach Topic. Topics are organized under one of two Areas as follows (titles are abbreviated):

Integrated Production Systems
Production System Design
Feed Technology
Species Development
Seedstock Development

People and Ecosystem Relationships
Human Health
Food Safety and Value-Added
Technology and Policy Adoption
Marketing, Trade, and Risk Assessment
Watershed and Coastal Management
Mitigating Environmental Impacts

The proposed program evaluation might proceed along one of four alternative lines:

1. *Each investigation might be evaluated individually.*

This approach would provide CRSP and LPI administrators and sub-award investigators with the most detailed guidance about individual investigator and project performance. However, comparisons among investigations would be awkward, and evaluation results would be sensitive to random circumstances in particular research/activity countries and locales.

2. *Each LPI might be evaluated individually; that is, each LPI's sub-awards might be evaluated as a group.*

   This approach would enable us to best assess the synergies or interrelationships among a given LPI's sub-awards, because an LPI concentrates on a particular Theme and country set. Such synergies are a key criterion of a successful investigation under the AquaFish CRSP. However, because each LPI finances studies on a variety of Topics, evaluative comparisons among Topics will sometimes be difficult.

3. *Each of the ten Topic areas might be evaluated individually; that is, sub-awards falling under each of the above ten Topics might be evaluated as a group.*

   Because the criteria for evaluating an investigation are largely the same for all investigations under a given Topic, this approach is conceptually and operationally the most feasible, especially if administrators desire measures of relative investigator performance in a given Topic, or are interested in deciding whether to continue funding studies under that Topic. The disadvantage of this approach is that it will poorly reflect the system relationships or synergies among investigations in a particular country or region, that is across Topics in that country or region. For example, it cannot be used well to evaluate a given LPI's success.

4. *Each of the two Topic Areas, or other suitable Topic groupings (see next section), might be evaluated individually; that is, the sub-awards falling under those Topic Areas might be evaluated as a group.*

   This approach is similar to Approach 3 but facilitates greater evaluative comparability than does Approach 3 across Topics in a given Topic Area. As such, both its advantages and disadvantages are weaker than in Approach 3. Taking Approach 4 will involve two (or some other small number of) separate program evaluations, in contrast to the ten evaluations offered under Approach 3.

The systems orientation of the AquaFish CRSP suggest that Approaches 2 and 4 be given special consideration. While every sub-award investigation under this CRSP is expected to take biological, physical, social, and economic relationships into account and thus have a systems perspective, the CRSP's full impact and meaning cannot be understood well unless the inter-relationships among Topics are themselves expressed. Approaches 2 and 4 are best positioned to take a systems perspective in the evaluation of this CRSP.

However, provisions already have been made for LPI-level evaluations along the lines of Approach 2. Thus, the focus of the present proposal naturally lies in the direction of Approach 4 (Topic Area-level evaluation), with attention to Approach 3 (individual Topic-level evaluation) if data permit.

**Study Framework**

The Topics and Topic Areas listed above involve a wide variety of subject matters and disciplinary foci, even after account is taken of the systems approach that all investigators are required to follow. Because subject matter and discipline greatly influence how an investigation is to be understood and valued, the frameworks and procedures employed in the present evaluation study ought to vary according to Topic or Topic Area. That is, an adequate evaluation of a particular research/outreach/activity, and thus of the LPI of which it is a part,

must be cognizant of that investigation's goals, materials, and conceptual framework. This is true regardless of which of the four structural approaches above that we decide to pursue.

Topics grouped under the People and Ecosystem Relationships Topic Area at the top of page 2 probably are too heterogeneous to be included in a single evaluative study. Because we wish primarily to pursue Approach 4 above, it is important, then, to show how the CRSP's Topics might be better be grouped for evaluative purposes. The CRSP RFP's illustrative descriptions of the Topics to be funded suggest, in terms of conceptual or scientific paradigm, that we group the Topics into five categories.

Category I: Production System Design; Feed Technology; Species Development; Seedstock Development
This Category comprises all four Topics in the Integrated Production Systems Topic Area. Its focus is aquaculture and fisheries production. Its main analytic paradigm is physical, and especially biological, science. As such, the CRSP's goal of alleviating poverty and improving food security is best assessed in this Category by asking how and by how much the technical input-output possibilities in the relevant fisheries production sector have been enhanced. That is, how and by how much might fisheries productivity have been improved as a result of the investigation or LPI, taking systems interrelationships into account?

Category II: Human Health; Food Safety and Value-Added
This Category's focus is fish processing and food value. It's main analytic paradigm is, again, the physical and biological sciences. Therefore, the CRSP's goals are best assessed by inquiring into the extent by which, on account of the investigation in question, fish-food quality and quantity have been enhanced per unit of processing cost. In other words by how much has processing productivity grown, taking food quality, human health, and systems interrelationships into account?

Category III: Technology and Policy Adoption
Evaluative paradigms in this Category are greatly different from those in Categories I and II. The evaluator here must ask by how much the investigation has: (i) enhanced communication channels among the important aquaculture-fisheries stakeholders and actors, and (ii) educated or otherwise persuaded them to adopt best-practice methods and policies. That is, while Categories I and II (and IV and V below) are evaluated in terms of how much they expand the technical possibilities, Category III is evaluated in terms of how the investigation has moved producers, processors, marketers, and others toward those expanded possibilities.

Category IV: Marketing, Trade, and Risk Assessment
Investigations in this Category are best assessed in terms of the social sciences. The evaluator can ask how and in what ways the investigator has identified new markets, grown existing ones, improved handling and transportation logistics, and reduced price distortions in the smallholder fish processing/handling/marketing sector. Studies and activities in this Category would especially be expected to take the entire smallholder aquatic system into account, since markets and risk necessarily involve every element of a market or distribution system.

Category V: Watershed and Coastal Management
This Category is best assessed in terms of the biological sciences and management, for example in terms of ecology and ecosystem management. The evaluator can ask how the investigator has helped ameliorate environmental damage, market or other-environmental costs of that amelioration, and likely long-run impacts of these changes on the level and stability of poor families' incomes. Systems considerations, that is the inter-relatedness of physical, biological, and social relationships, should again be accorded an especially heavy weight in this Category.

**Study Procedure**

1. After consulting with the OSU CRSP administration, make final decisions about study approach and framework.
2. Examine supporting documents relevant to this study.
3. Systematically examine LPI (award) and sub-award documents, including research/outreach/activity plans, outputs, and results.
4. Communicate directly with LPI and investigator personnel to obtain further information about the investigations and their outputs.
5. Conduct our analysis following the principles discussed above, and in consultation with the OSU CRSP administration.
6. Report results in the form of analytical papers and, if appropriate, case studies.

Data for our evaluation will be drawn primarily from the LPI's quarterly and annual reports, along with discussions with LPI and sub-award investigators and with supplementary information those investigators provide.

# MONITORING AND EVALUATION

♦

## Development of an Aquafish CRSP Monitoring and Evaluation System

*Submitted by Hillary Egna, CRSP Director*

In the initial year of the AquaFish CRSP, the ME organized a pre-synthesis workshop during which an internal framework, indicators, and benchmarks were established (May 2007). The indicators developed in May 2007 were re-evaluated and updated during the May 2008 Annual Meeting, and are reported in this section. A monitoring and evaluation plan — containing CRSP indicators and benchmarks — has been formalized, and pegged against the Agricultural Program 5.1 and 5.2 indicators in the USAID matrix (also in this section). The CTO received and approved the Monitoring and Evaluation (M&E) Plan shortly after the close of this reporting period. CRSP indicators relevant to each project are correlated with each USAID EGAT and IEHA indicator[4]. Several partners will typically be reporting on results, and citation by investigation code has proved useful.

### *Monitoring & Evaluation Plan: 2006 to 2011*

The CRSP works towards achieving its development impacts by meeting key targets, measured as indicators and benchmarks of progress. In addition to the benchmarks and indicators for USAID's key targets (research, capacity building, information dissemination, and IEHA), thematically-driven indicators were developed internally for the four themes adhered to under the AquaFish CRSP. These internal indicators were developed by the four DTAPs and approved in May 2007 prior to project implementation. The DTAP updated the indicators in May 2008; see Part I below.

Following project selection, in May 2007, Lead Principal Investigators attended a CRSP orientation meeting and pre-synthesis workshop organized by the Management Team. This meeting provided a timely opportunity for researchers, the USAID CTO, and the CRSP Management Team to refine project specific impact indicators and benchmarks to measure program progress on development impacts. Gender plans were reviewed at that time along with anticipated environmental impacts. The notes from that meeting are available at: aquafishcrsp.oregonstate.edu/pre_synthesis_meet.php

The benchmarks (see Part 2) provide a means to explore different measures of performance than either the more quantitative thematic impact indicators, or the metrics designed by USAID for reporting under 5.1 Enabling Environment, 5.2 Sector Productivity, and IR indicators. Tables V-5 to V-9 (see Part 3) cross reference the CRSP M&E indicators with the applicable USAID indicators.

### *Part 1. Impact Indicators by Development Theme – Approved 2007 DTAP metrics, updated in May 2008*

**DTAP A: Improved Health and Nutrition, Food Quality, and Food Safety of Fishery Products**

- *Number of aquaculture products developed to improve food safety or quality*

[4] Indicators for the USAID Economic Growth & Trade program form the EGAT 5.1 (Enabling Environment) and 5.2 (Sector Productivity) series. Indicators for the IEHA (Presidential Initiative to End Hunger in Africa) program comprise two categories: Output Indicators (EGAT 5.1 and 5.2 indicators) and Intermediate Results (IRs).

**DTAP B: Income Generation for Small-Scale Fishers and Farmers**
- *Number of new biotechnologies developed*
- *Number of institutions with access to technological practices*
- *Number of (people) trained in use of technological practices*

**DTAP C: Environmental Management for Sustainable Aquatic Resources Use**
- *Number of management practices developed or adopted to improve natural resource management*
- *Number of hectares under improved natural resource management*
- *Number of management practices developed to support biodiversity*
- *Number of people trained in practices that promote soil conservation and/or improved water quality*

**DTAP D: Enhanced Trade Opportunities for Global Fishery Markets**
- *Number of new markets for aquatic products*
- *Number of aquatic products available for human food consumption*

## *Part 2. Development Targets, Impacts and Benchmarks for the AquaFish CRSP*

This conceptual framework helps ensure that targets and benchmarks are adequately addressed across its global portfolio, for facilitating feedback and continuous learning in order to improve processes and outcomes. A gender strategy shows plans for ensuring strong programmatic commitment toward gender inclusion. Gender is both integrated into the four targets and also highlighted independently.

**A. Research Target**

Produce sustainable end-user aquaculture and fisheries research results that increase productivity, enhance international trade opportunities, and contribute to responsible aquatic resource management.

**Program-wide Research Indicators:**

(1) Developed and adopted innovative technologies that increase profitability and environmental stewardship in aquaculture and fisheries.
(2) Addressed biodiversity conservation issues to ameliorate threats to biodiversity and developed technologies and strategies to protect biodiversity habitat and populations.
(3) Continuously funded research projects that meet the expectations of external peer-review panels.
(4) Conducted appropriate biotechnology research to develop technologies that increase farm productivity.
(5) Engaged local stakeholders in research design, implementation, and results reporting through active participation in stakeholder meetings.
(6) Published AquaFish CRSP research published in regional, national, and international peer-reviewed journals.

**Research Benchmarks:**

Year 1:

a. Request for Proposals approved by USAID and widely advertised, and submitted proposals externally peer-reviewed; and
b. Favorably reviewed proposals have activities initiated.

Years 2-5:

a. 1 innovative aquaculture and fisheries technology or strategy developed and disseminated throughout each region;
b. AquaFish CRSP activities remain locally appropriate by receiving regular input through the Regional Centers of Excellence and Development Theme Advisory Panels;

c. measured increases in farm productivity, farmer incomes, market access, and export value achieved following adoption of AquaFish CRSP recommendations and technologies;
d. threats to biodiversity resulting from aquaculture activities ameliorated and biologically significant areas positively impacted;
e. cost-effective biotechnology appropriate for use in developing countries developed; and
f. continuous academic output of AquaFish CRSP data as publications within recognized journals and presentations provided at regional, national, and international forums.

**B. Capacity Building Target**
Focus AquaFish CRSP investments on building local capacity in aquaculture and aquatic resource management and ensuring long-term program impacts at local and national levels through strategic informal and formal training opportunities. Integrate items related to gender.

**Capacity Building Indicators (Regional):**
(1) Forged professional and managerial relationships between US and Host Country researchers and institutions.
(2) Established track record of successful formal long-term training of Host Country and US students and researchers.
(3) Delivered relevant short-term training opportunities that provide positive Host Country societal benefits beyond the life of the AquaFish CRSP.
(4) Identified gender issues in aquaculture and fisheries and adopted gender program-wide integration policies.

**Capacity Building Benchmarks**:
Year 1:
a. An additional year of the highly successful Host Country Principal Investigator Exchange Project continued to exchange information on cichlid aquaculture to additional countries including two IEHA countries.
b. The jointly funded NOAA Sea Grant Technical Assistance program continued.
c. Gender integration strategies adopted within all sub-awards.
d. Regional Centers of Excellence established to reflect the AquaFish CRSP regions for research activities (i.e., Asia, Africa, and Latin America and the Caribbean.
e. Formal Memoranda of Understanding adopted between all US and Host Country partners.

Years 2-5:
a. Partnerships strengthened among US and Host Country universities, NGOs, NARS, and USAID Missions through Associate Awards;
b. At least 100 degree students enrolled through formal long-term training opportunities in US, Host Country, and Regional universities;
c. Equal numbers of women and men trained through short- and long-term training opportunities;
d. Numerous train-the-trainer workshops convened to provide Host Countries with highly skilled extension specialists; and
e. Biotechnology and biodiversity training activities conducted as identified.

**C. Information Dissemination Target:**
Disseminate AquaFish CRSP research results to foster broad application of results among local stakeholders within governmental and non-governmental organizations, as well as for end-users.

**Information Dissemination Indicators (Regional)**:

(1) Successful diffusion of AquaFish CRSP research results and technologies between countries within a region having comparable social and environmental conditions;
(2) Increased awareness of local stakeholder constraints and opportunities related to responsible aquaculture and fisheries management;
(3) Applicable extension activities associated with each research project conducted to ensure wide dissemination of research results;
(4) AquaFish CRSP results and technologies for farm operations adopted and policies for responsible aquatic resource management created;
(5) Applicable technologies developed and adopted by the US and other countries' aquaculture and fisheries sectors.

**Information Dissemination Benchmarks:**

Year 1:

a. Dissemination efforts have continued through Aquanews, EdopNet, and a new searchable online publication database.
b. The importance of extension evident through integration of at least one outreach activity within each funded project.
c. Research adoption encouraged by prioritizing the use of on- and off-farm trials to conduct research.

Years 2-5:

a. Intra- and inter-regional diffusion of AquaFish CRSP results and technologies accomplished;
b. Training manuals with local and regional scopes published following completion of AquaFish CRSP research projects; and
c. At least 30 workshops convened over the course of the 5-year AquaFish CRSP.

**D. IEHA Country Involvement Target:**

Expand AquaFish CRSP science and technology efforts in IEHA Host Countries to increase local capacity and productivity thereby contributing to national food security, income generation, and market access.

**IEHA Indicators (Within each participating IEHA Host Country):**

(1) Development and adoption of innovative technologies that increase profitability and environmental stewardship in the context of aquaculture and fisheries;
(2) Students enrolled in formal long-term training programs within Host Country, Regional, and US universities;
(3) Increased awareness of stakeholder constraints and opportunities related to responsible aquaculture and fisheries management;
(4) Applicable extension activities associated with each research project conducted to ensure wide dissemination of research results;
(5) AquaFish CRSP results and technologies adopted for farm operations and policies for responsible aquatic resource management created; and
(6) Increased farm income and local economic growth through enhanced market access in project areas.

**IEHA Benchmarks:**

Year 1:

a. Formal strategy initiated to maximize locally appropriate results in participating IHEA Host Countries.
b. Sites selected and formal connections established with suitable research institutions and government departments within each IHEA Host Country.
c. The Africa Regional Center of Excellence has representation from IEHA countries to design research and outreach activities.

Years 2-5:

a. Formal linkages, collaborative research, and outreach activities fostered between US universities and IEHA site institutions;
b. Long-term research projects addressed specific needs of each IEHA Host Country;
c. Diffusion of knowledge facilitated between separate research projects ongoing within each IEHA Host Country; and
d. A measured increase in farm productivity, farmer incomes, market access, and export value has followed adoption of AquaFish CRSP recommendations and technologies in project areas.

**E. Gender Integration Strategy**

The AquaFish CRSP is dedicated to improving gender inclusiveness in the Aquaculture and Fisheries sectors, and in the CRSP arena. Gender Integration is implicit and interwoven into in the above "target" benchmarks and indicators requested by USAID in its RFA. Additional explicit guidance, in the form of an improvement plan, was established for CRSP operations.

**Gender Integration Initiatives:**

Year 1:

- Require that all funded projects address gender inclusiveness within their planned scope-of-work.
- Seek out USAID review of projects' gender inclusiveness plans and respond by improving plans prior to project implementation.
- Promote the participation of women in formal and informal education and training opportunities provided through the CRSP. The CRSP has set a 50% benchmark for training women in formal and informal education. In addition, the 50% benchmark applies to attracting and retaining women scientists and administrators in all CRSP activities, as project researchers, advisory group members, and managers. (continue all years)

Years 2-5:

- Collect disaggregated gender data from individual research and outreach projects funded by the CRSP.
- Analyze disaggregated data on an annual basis to gauge gender inclusiveness success and take appropriate action as indicated through data analysis.
- Involve field projects in monitoring and evaluating gender integration as the program progresses with time. Evaluate the effects of specific projects on gender and ensure that any possible negative effects due to gender bias are mitigated.
- Focus one component of a lessons learned and synthesis assessment specifically on the social context and impact of CRSP research and outreach activities on the lives of women.
- Tailor specific extension and technical services related to sustainable aquaculture and aquatic resource management to women producers.
- Engage extension specialists sensitive to diversity issues and access to resources of underrepresented groups and women will be included as an integral part of their delivery team to ensure women farmers and fishers feel welcome in CRSP training opportunities.

## *Part 3. PMP-USAID Indicators Cross-Referencing*

The AquaFish CRSP Program Indicators (PMP Indicators) are specifically tailored for assessing program-specific achievements, impacts, targets, and benchmarks. Tables V-5 to V-9 cross-reference these PMP Indicators with the broader, more general USAID-EGAT Indicators:

**Agriculture Program Element Indicators**

- EG 5.1 (Enabling Environment): 5 indicators numbered 5.1-9 to 5.1-13 and three Custom Indicators
- EG 5.2 (Sector Productivity): 15 indicators numbered 5.2-14 to 5.2-28 and one Custom Indicators.

**IEHA Performance (Outcome) Indicators**[5]

- IR 1.1 (Adoption of Targeted Technologies)
- IR 1.2 (Enhanced Human and Institutional Capacity for Technology Development…)
- IR 2 (Improved Policy Environment for Smallholder-Based Agriculture)

CRSP and USAID-EGAT indicators do not have a one-to-one correspondence. In most cases, the USAID-EGAT indicators apply only in part and usually form a mixed combination for a given CRSP PMP indicator. In other cases, there is no correspondence between the two indicator sets, which is noted as "NA" (Not Applicable) in the USAID-EGAT indicator column.

Tables V-5 to V-9 illustrate (1) how the CRSP indicators are an extension of the USAID-EGAT and IR indicator sets and (2) how general features of the USAID set can be encompassed within a specific AquaFish CRSP indicator.

**Table Notes**

The EG 5.1[6] and 5.2 indicator series has two components: **FACT** (numbered) and **Custom** (not numbered). For purposes of cross referencing, the USAID-EGAT system is clarified or modified as follows:

**FACT Indicators**:

- EG 5.1-11 (short-term enabling training) is expanded to encompass both short- and long-term training for both genders
- EG 5.2-26 and 5.2-27 are tallied by the numbers of males or females attending a training.

**Custom Indicators**: AquaFish CRSP created a numerical coding system to differentiate among the custom indicators:

***Enabling Environment Custom Indicators***

- 5.1-C1: Policy Studies Undertaken
- 5.1-C2 Policy Studies Disseminated
- 5.1-C3 Partner Organizations Benefiting

***Sector Productivity Custom Indicators***

- 5.2-C1: Partner Organizations Benefiting

[5] IEHA Output Indicators are not included here given their direct correspondence with the EGAT 5.1 indicators.
[6] EG 5.1 Indicators only apply through 30 September 2008 and are not applicable after 1 October 2008..

Table V-5 AquaFish CRSP Development Themes

| USAID-EGAT Indicators[7] | AquaFish CRSP Impact Indicators |
|---|---|
| 5.1-12<br>5.2-14<br>5.2-15<br>5.2-16 | **DTAP A**: **Improved Health and Nutrition, Food Quality, and Food Safety of Fishery Products**<br>• *Number of aquaculture products developed to improve food safety or quality* |
| 5.1-11<br>5.1-C1<br>5.2-14<br>5.2-15<br>5.2-16<br>5.2-19<br>5.2-20<br>5.2-21<br>5.2-22<br>5.2-26<br>5.2-27<br>5.2-28<br>5.2-C1 | **DTAP B: Income Generation for Small-Scale Fishers and Farmers**<br>• *Number of new biotechnologies developed*<br>• *Number of institutions with access to technological practices*<br>• *Number of (people) trained in use of technological practices* |
| 5.1-11<br>5.1-12<br>5.1-C1<br>5.2-14<br>5.2-15<br>5.2-16<br>5.2-17<br>5.2-18<br>5.2-21<br>5.2-26<br>5.2-27 | **DTAP C: Environmental Management for Sustainable Aquatic Resources Use**<br>• *Number of management practices developed or adopted to improve natural resource management*<br>• *Number of hectares under improved natural resource management*<br>• *Number of management practices developed to support biodiversity*<br>• *Number of people trained in practices that promote soil conservation and/or improved water quality* |
| 5.1-12<br>5.2-16<br>5.2-21 | **DTAP D: Enhanced Trade Opportunities for Global Fishery Markets**<br>• *Number of new markets for aquatic products*<br>• *Number of aquatic products available for human food consumption* |

[7] Cross referencing for the CRSP DTAP indicators is at the thematic level.

Table V-6. AquaFish CRSP Development Targets, Impacts and Benchmarks

| USAID-EGAT Indicators | AquaFish CRSP Research Indicators |
|---|---|
| 5.1-11<br>5.1-12<br>5.1-C1<br>5.2-14<br>5.2-15<br>5.2-16<br>5.2-19<br>5.2-21<br>5.2-26<br>5.2-27 | (1) Developed and adopted innovative technologies that increase profitability and environmental stewardship in aquaculture and fisheries. |
| NA | (2) Addressed biodiversity conservation issues to ameliorate threats to biodiversity and developed technologies and strategies to protect biodiversity habitat and populations. |
| NA | (3) Continuously funded research projects that meet the expectations of external peer-review panels. |
| 5.1-14 | (4) Conducted appropriate biotechnology research to develop technologies tha increase farm productivity. |
| 5.2-18<br>5.2-19<br>5.2-20<br>5.2-21<br>5.2-22<br>5.2-28<br>5.2-C1 | (5) Engaged local stakeholders in research design, implementation, and results reporting through their active participation in stakeholder meetings. |
| NA | (6) Published AquaFish CRSP research in regional, national, and international peer-reviewed journals. |

Table V-7. AquaFish Capacity Building Target

| USAID-EGAT Indicators | AquaFish CRSP Indicators |
|---|---|
| 5.2-14<br>5.2-15<br>5.2-C1 | (1) Forged professional and managerial relationships between US and Host Country researchers and institutions |

Table V-7. AquaFish Capacity Building Target

| USAID-EGAT Indicators | AquaFish CRSP Indicators |
|---|---|
| 5.1-11<br>5.2-27 | (2) Established track record of successful formal long-term training of Host Country and US students and researchers. |
| 5.1-11<br>5.2-19<br>5.2-21<br>5.2-26 | (3) Delivered relevant short-term training opportunities that provide positive Host Country societal benefits beyond the life of the AquaFish CRSP. |
| 5.1-12<br>5.1-C1<br>5.2-28 | (4) Identified gender issues in aquaculture and fisheries and adopted program-wide, gender-integration policies. |

Table V-8. AquaFish CRSP Information Dissemination Target

| USAID-EGAT Indicators | AquaFish CRSP Indicators |
|---|---|
| NA | (1) Successful diffusion of AquaFish CRSP research results and technologies between countries within a region having comparable social and environmental conditions. |
| NA | (2) Icreased awareness of local stakeholder constraints and opportunities related to responsible aquaculture and fisheries management. |
| 5.1-11<br>5.2-16<br>5.2-26 | (3) Applicable extension activities within each research project conducted to ensure wide dissemination of research results. |
| 5.1-12<br>5.1-C1<br>5.2-16 | (4) Adoption of AquaFish CRSP results and technologies for farm operations and policies created for responsible aquatic resource management. |
| 5.1-11<br>5.2-14<br>5.2-15<br>5.2-16<br>5.2-19<br>5.2-21<br>5.2-26<br>5.2-28 | (5) Applicable technologies developed and adopted by the US and other countries' aquaculture and fisheries sectors. |

Table V-9. IEHA Country Involvement Target

| USAID-EGAT Indicators | AquaFish CRSP Indicators |
|---|---|
| 5.1-11<br>5.1-C1<br>5.2-14<br>5.2-15<br>5.2-16<br>5.2-26 | (1) Development and adoption of innovative technologies that increase profitability and environmental stewardship in the context of aquaculture and fisheries. |
| 5.1-11<br>5.2-27 | (2) Students enrolled in formal long-term training programs within Host Country, regional, and US universities. |
| NA | (3) Increased awareness of stakeholder constraints and opportunities related to responsible aquaculture and fisheries management. |
| 5.2-26<br>5.2-28 | (4) Applicable extension activities associated with each research project conducted to ensure wide dissemination of research results. |
| 5.1-C1<br>5.2-16 | (5) AquaFish CRSP results and technologies adopted for farm operations and policies for responsible aquatic resource management created. |
| IR 1.2 | (6) Increased farm income and local economic growth through enhanced market access in project areas. |

## Alignment with USAID's Impact Reporting Matrix

CRSP reports under USAID's various frameworks to achieve outcomes that have meaning for stakeholders, including Missions, HC decision makers, and end-users. The framework reports that were filed with USAID for this reporting year are presented in this section in a truncated format for illustrative purposes. AquaFish CRSP predominantly reported under USAID-EGAT 5.2 Agricultural Productivity and partially under 5.1 Enabling Environment indicators. For IEHA, FY 2008 reporting was only under Output Indicators (see Footnote 4 above).

***USAID-EGAT Indicator Reporting***

Indicators for which AquaFish CRSP reported are presented in Tables V-6 to V-13. The tables are truncated versions of the full FY 2008 reports to the agency, listing only the indicators for which there were targeted and actual results. Tables V-10 to V-11 cover the EG 5.1 and 5.2 Custom Indicators; Tables V-12 to V-13 cover the EG 5.1 and 5.2 FACTS Standard Indicators. Investgation codes clarify the specific project source for reported results.

Table V-10. EGAT Agriculture Program Custom Indicators

| Enabling Environment EG 5.1-C1 | | | Sector Productivity EG 5.2-C1 | | |
|---|---|---|---|---|---|
| Policy Studies Undertaken | | | Partner Organizations Benefiting | | |
| FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target |
| 1 | 1 | 0 | 25 | 28 | 28 |
| | 07TAP01UC (underway) | | | See Table V-11. | |

Table V-11. Partner Organizations Benefiting (EG 5.2-C1) Indicator: Listing by Investigation.

| Investigation Code | No. of Partners | Organization |
|---|---|---|
| 07BM02UM | 1 | RIDS-Nepal |
| 07BMA04UM<br>07IND03UH<br>07HHI03UH<br>07HHI04UH<br>07HHI05UH<br>07WIZ02UH | 15 | Oyster Growers–Nayarit, Sinaloa & Sonora♦Women's Oyster Culture Cooperatives of Nayarit & Puerto Penasco♦Conservation International♦ISA♦Ecocostas♦Federation of Shrimp Cooperatives♦ MARENA♦ 3 Nicaraguan fishers & women's groups♦NOAA International Sea Grant♦USAID-SUCCESS♦CESASIN |
| 07SFT0204UA | 2 | Maharaja Oil Mill |
| 07TAP01UC | 1 | Fisheries Administration–Cambodia |
| 07TAP03UA | 8 | CLAR♦Egyptian Ministry of Agriculture & Land Reclamation♦ WorldFish♦Egyptian Society of Agribusiness♦American Soybean Assn♦United Animal Feed Producers♦United Animal Feed Producers♦ United Cooperative of Fishermen♦Academy of Scientific Research & Egyptian Universities |
| 07MER03PU | 1 | Kingolwira National Fish Center |

Table V-12. EGAT Agriculture Program Standard Enabling Environment (EG 5.1): FACTS Standard Indicators

| FACTS Standard Indicators | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Number of policies/regulations/administrative procedures analyzed as a result of USG assistance EG 5.1-12** | | | **Short-term Training Female EG 5.1-11** | | | **Short-term Training Male EG 5.1-11** | | | **Long-term Training Female EG 5.1-11** | | | **Long-term Training Male EG 5.1-11** | | |
| FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target |
| 2 | 2 | 0 | 10 | 10 | 0 | 10 | 10 | 0 | 4 | 4 | 0 | 4 | 4 | 0 |
| | | | 07FSV01UC♦07TAP01UC♦ 07TAP01UC (underway) | | | 07FSV01UC♦07TAP01UC♦ 07TAP01UC (underway) | | | UConn project has 13 women in degree training but most are in 5.2 Prod and not enabling; 2 are tbd | | | UConn project has 10 men in degree training but most are in 5.2 Prod and not enabling; 2 are tbd | | |

Table V-13. EGAT Agriculture Program Standard Sector Productivity (EG 5.2): FACTS Standard Indicators

| FACTS Standard Indicators | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Technologies Under Research EG 5.2-14** | | | **Technologies Under Field Testing EG 5.2-15** | | | **Technologies Avail Transfer EG 5.2-16** | | | **Vulnerable Households EG 5.1-18** | | | **Rural Households EG 5.2-19** | | |
| FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target |
| 12 | 12 | 12 | 12 | 14 | 13 | 3 | 3 | 6 | 100 | 94 | 100 | 1000 | 10000 | 1200 |
| **To be completed in FY2009:**<br>07SFT01UC♦07SFT02NC♦<br>07SFT05UC♦07SFT06PU♦<br>07IND01UA♦07QSD01NC♦<br>07HHI02UA♦07WIZ02UH♦<br>07MNE01UC♦07MNE06UA♦<br>07SFT03NC<br><br>**To be started in FY2009:**<br>07HHI01UM | | | **Underway:**<br>07IND03UH♦07IND04UH♦<br>07QSD02PU♦07HHI05UH♦<br>07MNE03UM♦07MNE04UM♦<br>07MNE05UM♦07MER01UC♦<br>07MER02PU♦07MER03PU♦<br>O7MER04NC♦07SFT02NC07<br>TAP01UC♦ 07TAP02UC | | | **Underway:**<br>07SFT01UC♦ 07MER01UC<br><br>**Podcast started:** 07TAP01NC | | | 07MNE02NC (IP:94 trainees) | | | **Households:**<br>07IND01UA (800–900)<br>07IND02UA (36–100)<br>07QSD02PU (60 max)<br>07FSV01UC (7000)<br>07MER02PU (tbd)<br>07MER03PU (50; incr 20%)<br>07MNE02NC (tbd)<br>07MNE03UM (tbd)<br>07MNE04UM (tbd)<br><br>**Communities:**<br>07IND04UH (26) | | |

Table V-13 (cont). EGAT Agriculture Program Standard Sector Productivity Indicators (EG 5.2): FACTS Standard Indicators

| FACTS Standard Indicators | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Producer Orgs, etc EG 5.2-20 | | | Ag Firms, etc EG 5.2-21 | | | Public-Private Partnerships EG 5.2-22 | | | Short-term Training Females EG 5.2-26 | | | Short-term Training Males EG 5.2-26 | | |
| FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target |
| 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 9 | 500 | 500 | 500 | 500 | 500 | 500 |
| Women's Oyster Culture Cooperative of Nayarit & Puerto Penasco♦Oyster Growers of Naayrit, Sinaloa & Sonora♦Fishers & Women's groups in 3 Nicaraguan estuaries♦Federation of Shrimp Cooperatives♦ American Soybean Assn♦ National Aquaculture Assn of Guyana♦San Ramon Fisheries Cooperative | | | BIOTECHMAR♦Dong Nai Fisheries Company-Vietnam♦ Huiting Reservoir Fisheries Management Company-China♦ Maharaja Oil Mill♦ Von Better Aquaculture♦ Zhanghe Reservoir Fisheries Management Company-China | | | Ecocostas♦MARENA♦ Aquaculture without Frontiers♦ Asia-Pacific Economic Cooperation♦ CETRA♦CIAD♦CIFAD♦ Guyana Trade & Investmant Support Project♦ Instituto Sinaloense de Acuacultura♦ Kenya Business Development Services | | | 07BMA02UM♦07BMA03UA♦ 07BMA04UH♦07SFT05UA♦ 07SFT06PU♦07IND01UA♦ 07IND02UA♦07IND03UH♦ 07IND04UH♦07HHI01UM♦ 07HHI04UH♦07HHI05UH*♦ 07TAP02NC♦07MER03PU♦ 07MNE02NC♦07MNE03UM♦ 07MNE04UM | | | 07BMA02UM♦07BMA03UA♦ 07BMA04UH♦07SFT05UA♦ 07SFT06PU♦07IND01UA♦ 07IND02UA♦07IND03UH♦ 07IND04UH♦07HHI01UM♦ 07HHI04UH♦07HHI05UH*♦ 07TAP02NC♦07MER03PU♦ 07MNE02NC♦07MNE03UM♦ 07MNE04UM | | |

*Work Plan Change, see Appendix 2.

Table V-13 (cont). EGAT Agriculture Program Standard Sector Productivity Indicators(EG 5.2): FACTS Standard Indicators

| FACTS Standard Indicators | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Long-term Training Females** | | | **Long-term Training Males** | | | **Women's Organizations** | | |
| **EG 5.2-27** | | | **EG 5.2-27** | | | **EG 5.2-28** | | |
| FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target | FY 2008 Revised Target | FY 2008 Results | FY 2009 Target |
| 42 | 60 | 65 | 42 | 59 | 62 | 1 | 5 | 6 |
| | | | | | | | 07BMA02UM: 1<br>07IND03UH: 2–3<br>07HHI03UH: 2–5 | |

***USAID IEHA Indicator Reports***

Table V-14 lists the six applicable Output indicators for IEHA reporting. These indicators directly correlate with the EG 5.2 FACTS Standard Indicators (See footnote 4 above).

Table V-14. IEHA Output Indicators

| EGAT Agriculture Program Standard Indicator | | AquaFish CRSP | |
|---|---|---|---|
| **Definition** | **EG Indicator No.** | **FY2008 Target** | **FY2008 Actual*** |
| Number of rural households that benefited directly in this reporting year from USG assistance | 5.2-19 | 6 | 6 |
| Male attendance at long-term agricultural sector productivity training in this reporting year as a result of USG assistance | 5.2-27 | 3 | 3 |
| Female attendance at long-term agricultural sector productivity training in this reporting year as a result of USG assistance | 5.2-27 | 5 | 5 |
| Number of public-private partnerships formed in this reporting year as a result of USG assistance | 5.2-22 | 1 | 1 |
| Number of new technologies or management practices under research in this reporting year as a result of USG assistance | 5.2-14 | 1 | 1 |
| Number of new technologies or management practices under field testing in this reporting year as a result of USG assistance | 5.2-15 | 1 | 1 |

***IEHA investigations for Ghana, Kenya, and Tanzania underway. Capacity building and supply chain components in Kenyan *Clarias* baitfish investigation are in early stages of development in partnership with the Kenya Business Development program. First stage for development of a Supply Chain Network in Ghana and Kenya has been successful in preparing for the survey/model step. Graduate training is underway with 8 MS students (5 female; 3 male).

USAID also identified three IRs for potential reporting by AquaFish CRSP. None of these indicators was applicable for FY 2008 as noted below:

**IR 1.1: Adoption of Targeted Technologies.** There was no IEHA data to report.

**IR1.2 Enhanced Human and Institutional Capacity fo Technology Development, Dissemination, and Management.** There was no IEHA data to report for FY2008. Two investigations will be evaluated in FY2009 with Partner Institutional Viability Assessments (PIVA) as follows:

> **07MER02PU: Supply Chain Framework** Initial steps have been undertaken to build framework for developing market chains for fish. Results from an analytical marketing model will be used to train farmers in supply chain management and operation and market development for tilapia and catfish.
>
> **07QSD02PU Baitfish Market** Initial steps have been undertaken to build a new market for farm-raised baitfish. Participating farmers are identified and begun to develop marketing skills, including collective marketing. Steps to build a market connection with dealers is underway.

**IR2: Improved Policy Environment:** There were no IEHA data to report.

# VI. LESSONS LEARNED

*Submitted by Hillary Egna, CRSP Director*

**AquaFish CRSP has many new systems and structures in place for streamlining organizational functions and enhancing advisory impact. These systems were introduced to Lead US and Host Country PIs at an orientation meeting in May 2007, and again through various emails, additional documentation, and interactively at the annual meeting in May 2008. However, there remains a need for additional learning opportunities for new systems, especially for the US Lead PIs who are themselves responsible for implementing the new systems.**

> **Recommendation: Reallocate existing budget to allow for more face-to-face and virtual meetings among lead US Partners and Management, and also among US Partners and HC counterparts**.

Observation by the EPAC from the 2008 Annual Meeting: *There appears to be a slow recognition and acceptance of new USAID and CRSP requirements by some researchers from US universities and HC participants. It is advisable that participants accept that the new requirements, such as site descriptions and impact indicators, are mandatory. It is equally important to recognize these requirements and to develop quick and effective means of meeting them. For US PIs who are now not fulltime employees of their university, it may be necessary to bring on board co-PIs to assist with some of these administrative issues.*

Activities to date to meet this challenge: The Director has initiated a quarterly US Lead PI conference call to engage project leaders in a continual learning activity regarding reporting, responsibilities, outputs, and problem-solving. Four of the six US Lead PIs are the DTAP coordinators for the four AquaFish CRSP themes. The three RCE coordinators (all HC PIs) recommended, at the 2008 Annual Meeting, holding a networking activity with the DTAP, initiated by the advisory groups but inviting Management to join, perhaps on a virtual network.

**AquaFish CRSP projects together are training 119 degree students at universities in the US and internationally. This is impressive. It appears that some projects are able to get more students trained on a limited budget due to the long connections CRSP has had with particular universities. However, there is a need for greater understanding of when to shift degree-training efforts from one Host Country university to another.**

> **Recommendation: Form a subcommittee to look at this issue during the next annual meeting, with the aim of suggesting a strategy for shifting capacity building resources at current HC universities within a given project.**

Observation by the EPAC: *It would be interesting to understand the role of achieving the capacity building goals for a Host Country University. Specifically, when does the CRSP determine that the amount of projects and funding for a host country University have made a sufficient difference in capacity to justify restricting certain Universities from gaining more funds from the CRSP? This is not a criticism of the Host Country Universities currently involved in the AquaFish CRSP, but rather a true gap in understanding for some of the EPAC members.*

**AquaFish CRSP is making excellent headway on important issues with its limited funding and huge arena of focus. CRSP has a strong vision as articulated by the ME in its RFP for partners, and in the program description authorized by USAID. CRSP cannot be all things to**

**everyone. CRSP Management wisely anticipated a need for balancing the portfolio in a mid-term adjustment, prior to the release of its second RFP (last RFP for the first 5 year grant).**

> **Recommendation: Weigh systems-thinking and inclusion of social and economics topics more heavily in awarding projects under the next RFP.**

Observation by the EPAC from the 2008 report: *In the introduction to the Implementation Plan 2007–2009, it is stated that the mission of the AquaFish Collaborative Research Support Program (CRSP) is to (among other things) cultivate international multidisciplinary collaborations formed around core USAID identified program components, including a systems approach. A systems approach is defined as that which integrates topic areas from Integrated Production Systems, and from People, Livelihoods and Ecosystem Interrelationships. Despite the presence of a few projects that clearly involve researchers from many disciplines and a collection of investigations which tackle different angles of an aquaculture system, there still seems to be gaps across the portfolio in relation to social and economic issues, with most projects having an emphasis on aquaculture production. For projects aiming at commercial production, environmental accreditation and traceability through the supply chain are increasingly becoming more important and impacting on markets; however these issues have not been addressed in any projects. This is particularly important with food quality and food safety (Theme A) and enhanced trade opportunities (Theme D). The marginalization of small farmers by certification schemes seems to be untouched and likely will be the determining factor in the future of these farmers' livelihoods.*

**AquaFish CRSP successfully sought and was awarded an Associate Award (AA) for a new project activity in Mali. Integrating this de novo project, in a country not previously in either ACRSP or AquaFish, and without a US subcontracting partner, has incurred high costs for the ME. The role and responsibilities of AA researchers need clarification.**

> **Recommendation: Form a subcommittee to look at this issue during the next annual meeting, with the aim of suggesting a strategy for integrating Associate Award projects into the DTAP and RCE. Discuss the benefits and costs of holding AAs to the same standard of scientific excellence as the other projects, beginning with proposal review. Make a recommendation on the reasonableness of applying the core CRSP processes and procedures evenly and reasonably given the different structures of AA projects.**

Observation by the ME: The integration of AAs should be done in a mindful manner. The ME has revisited some of the growing pains of integrating an externally (non-core) funded project, and has evaluated whether this new project's integration can be generalized for future AAs. In other words, is the new Mali project unique or are there commonalities and considerations that can be broadly applied? By way of brief history, the USAID/Mali mission requested assistance from the CRSP, which pulled together project ideas and was awarded a 3-year project in October 2007. The Mali project emphasizes outreach and training. Due to the timing of the award, the project did not undergo CRSPs standard scientific peer-review process for core research proposals. Hence, this project is considered a "central" project and not part of the core research portfolio. However, the ME seeks to bring elements of this project into the mainstream portfolio and integrate members of the AA into the internal technical advisory structures (RCE and DTAP). It remains unclear whether the AA members are sufficiently engaged and have resources to adhere to additional CRSP policies and procedures, since the AA members are already reporting to another authority, which has its own distinct requirements.

To date, under the AquaFish CRSP LWA, one Associate Award has been made by the Mali Mission for $750,000. The Director responded to an RFA issued by the Mali Mission in September 2007 and the award was made in October 2007 for three years, through 30 September 2010. Like the core grant, funding is obligated to the ME in increments and builds to the final award amount by the grant end date. All funds are provided to OSU on a reimbursement basis,

thus there is usually a lag in reporting and funding, made even more challenging in years when there are funding cuts. The Director receives no compensation under the Mali award, and overall, ME staffing support is low. Mali activities are further bolstered by the gestalt of the overall AquaFish CRSP core program. The Mali project does not require cost-share, however, so the institutionalization at the host country tends to be somewhat lower than in core projects which are co-funded by 50%.The Mali Associate Award began in November 2007 with a site visit to Mali, followed by selection of Project Coordinators at OSU and Mali, and refinement of the work plan. Activities accomplished during the reporting year are presented in the *Program-Wide Report*s chapter.

# VII. FINANCIAL SUMMARY

The following data show obligations from USAID to the ME, and allocations to projects and activities from the AquaFish CRSP ME. Please note that the funds received unexpectedly but gladly in late summer 2008 were not programmed for this reporting period. They will be programmed for the following fiscal year. As stated in the *Introduction*, the total award amount for AquaFish CRSP is $8.9 million, with an additional $3 million for associate awards, for a ceiling of $11.9 million, as stated in the CA/LWA.

**AquaFish CRSP**

**USAID Funding from inception through 9/30/08**

| Date of Award* | Description | Estimated Grant Amount | Amount Obligated Core |
|---|---|---|---|
| 9/29/06 | Original grant | 8,900,000 | 900,000 |
| 9/18/07 | Modification 1 | | 2,760,000 |
| 8/28/08 | Modification 2 | | 3,160,000 |
| | | | **6,820,000** |
| Associate Awards up to $3,000,000, as noted in USAID's RFA for the CA/LWA for this CRSP | | | |
| 10/1/07 | Mali Associate Award | 750,000 | 250,000 |

* note that date of award usually diverges from date of notification by OSU to PI/Director and Management Team by days, or in some cases, weeks.

These financial data are intended to supplement and not replace the official financial reports filed by the University with USAID. SF269 reports and other financial data are sent to the offices indicated in the CA/LWA on a quarterly basis. This section provides a snapshot of program funding through this reporting period.

Of the $3.66 million awarded to CRSP for its first two years of operations, through the end of this current reporting period, two-thirds ($2.4 million) was allocated to core research projects. Another 20% went to central research and capacity building activities, and less than 14% went to management.

USAID's $3.16 million allocation, received at the end of this reporting period for the next Fiscal Year(s), will go towards funding new project(s) under the IEHA RFP, and continuing funding for successful and promising core research projects and central activities. The $3.16 million obligation provides funding into the fourth year of operations.

**AquaFish CRSP Allocation Summary for the 2007-08 reporting year**

| INDEX | LOCATION / PI | Projected end date for current contract | APPROVED (COMPLETED) BUDGET |
|---|---|---|---|
| **Core Research Projects** | | | |
| 11G-A | University of Arizona | Sep 30 2009 | $400,401.00 |
| 11G-B | University of Michigan | Sep 30 2009 | $428,800.00 |
| 11G-C | North Carolina State | Sep 30 2009 | $339,828.00 |
| 11G-D | Purdue | Sep 30 2009 | $434,823.00 |
| 11G-E | Univeristy of Connecticut | Sep 30 2009 | $458,441.00 |
| 11G-F | University of Hawaii | Sep 30 2009 | $300,000.00 |
| | indirect on subcontracts less than $25,000 paid for by ME on behalf of subcontractors | | $62,250.00 |
| | **Total Core Research Projects** | | **$2,424,543.00** |
| **Central Research, Outreach and Capacity Building Projects** | | | |
| 11C | Capacity Building and Host Country | Sep 30 2011 | $488,158.00 |
| 11N | Synthesis Project | Sep 30 2011 | $240,000.00 |
| | **Total Central Research** | | **$728,158.00** |
| **Management** | | | |
| 11A | Management | Sep 30 2011 | **$507,299.00** |
| **TOTAL ALLOCATED FROM USAID OBLIGTIONS THROUGH AUGUST 2008** | | | **$3,660,000.00** |
| | Additional USAID obligation posted in Sep 2008 | | |
| | These funds are slated for programming in the next FY | | $3,160,000.00 |
| | for awards under an IEHA RFP and core research continuations | | |

At 21.5%, the IEHA attribution is slightly lower than the 25% target for this CRSP. With the addition of a new IEHA project in the coming year, the IEHA attribution will shift to a higher percentage. Note that through the Mali Associate Award, central activities and management effort support an additional IEHA country.

| **IEHA Attribution from Inception through 9/30/08** | |
|---|---|
| Purdue Project (Kenya and Ghana) | $354,927.00 |
| Purdue Subcontract Cost | $10,375.00 |
| Apportionment of Central Projects/Activities | $247,573.72 |
| Apportionment of Management | $172,481.66 |
| **Total More than meets the 25% goal** | **$785,357.38** |
| 25% of programmed expenditures from above | $915,000.00 |

Country level reporting shows attributions across the board. The idea is that all aspects of the program support the CRSP mission primarily in various countries, and secondarily to a much lesser extent in the US.

| **Estimated attributions to regions by Central Activities and Management** | |
|---|---|
| Africa (primarily IEHA) | $420,055.38 |
| Asia | $407,700.81 |
| Latin America & Caribbean | $407,700.81 |

| **Estimated Country-Level Allocations to be made by Core Research Projects, as stated in their Project Award Coversheets** | |
|---|---|
| Mexico | $527,171 |
| Guyana | $43,974 |
| Egypt | $31,564 |
| Nepal | $63,603 |
| China | $337,197 |
| Vietnam | $245,695 |
| Philippines | $299,023 |
| Indonesia (split with Philippines) | $40,805 |
| Tanzania | $79,896 |
| Kenya | $232,015 |
| Ghana | $122,912 |
| Cambodia | $242,746 |
| Nicaragua | $63,709 |
| USA or unassigned | $94,233 |

# APPENDICES

**APPENDIX 1. Program Participants**

**APPENDIX 2. Work Plan and Personnel Changes Approved in the Reporting Period**

**APPENDIX 3. Linkages**

**APPENDIX 4. Acronyms**

# APPENDIX 1. PROGRAM PARTICIPANTS

## Management Entity Office Staff

Oregon State University, Corvallis, Oregon USA

| | |
|---|---|
| Hillary Egna | Director |
| Bernie Kepshire* | Research Projects Manager |
| Jim Bowman** | Capacity-Building & HCPI Project Coordinator |
| Dwight Brimley | Office/Business Manager |

* from December 2007 to June 2008
**part-time

## United States Agency for International Developmennt

Washington, DC USA

| | |
|---|---|
| Harry Rea | Cognizant Technical Officer |

## Advisory Bodies

*External Program Advisory Council*

| | |
|---|---|
| Christine Crawford | Chair, University of Tasmania, Hobart, Australia |
| Jason Clay | World Wildlife Fund, Washington, DC |
| Nathanael Hishamunda | FAO, Rome, Italy |
| Marcia Macomber | CGIAR Challenge Program on Water & Food |

*Ex-Officio Members*

| | |
|---|---|
| Harry Rea | USAID |
| Hillary Egna | Oregon State University |

## Development Themes Advisory Panel: Lead Coordinators

| | | |
|---|---|---|
| Maria Haws | DTAP A | University of Hawai'i at Hilo |
| Kwamena Quagrainie | DTAP B | Purdue University |
| James Diana | DTAP C | University of Michigan |
| Robert Pomeroy | DTAP D | University of Connecticut–Avery Point |

## Regional Centers of Excellence: Lead Coordinators

| | | |
|---|---|---|
| Charles Ngugi | Africa | Moi University, Kenya |
| Remedios Bolivar | Asia | Central Luzon State University, Philippines |
| Wilfrido Contreras-Sanchez | LAC | Universidad Juárez Autónoma de Tabasco, Mexico |

## Core Research Project Participants

### NORTH CAROLINA STATE UNIVERSITY

| Participants | Status | Country |
|---|---|---|
| | | **USA** |
| Russell Borski | US Lead PI | North Carolina State University |
| Kevin Fitzsimmons | US Co-PI | University of Arizona |
| | | **Philippines** |
| Remedios B. Bolivar | HC Lead PI | Central Luzon State University |
| | | **Indonesia** |
| Hassan Hasanuddin | HC Co-PI | Ujung Batee Aquaculture Center, Banda Aceh |

### PURDUE UNIVERSITY

| Participants | Status | Country |
|---|---|---|
| | | **USA** |
| Kwamena Quagrainie | US Lead PI | Purdue University |
| Rebecca Lochmann | US Co-PI | University of Arkansas at Pine Bluff |
| Emmanuel Frimpong | US Co-PI | Virginia Polytechnic Institute & State University |
| | | **Kenya** |
| Charles Ngugi | HC Lead PI | Moi University |
| | | **Ghana** |
| Stephen Amisah | HC Co-PI | Kwame Nkrumah University of Science & Technology |
| | | **Tanzani**a |
| Sebastian Chenyambuga | HC Co-PI | Sokoine University of Agriculture |

### UNIVERSITY OF ARIZONA

| Participants | Status | Country |
|---|---|---|
| | | **USA** |
| Kevin M. Fitzsimmons | US Lead PI | University of Arizona |
| Reynaldo Patiño | US Co-PI | Texas Tech University, Lubbock |
| | | **Mexico** |
| Wilfrido Contreras-Sanchez | HC Lead PI | Universidad Juárez Autónoma de Tabasco |
| Pablo Gonzales Alanis | HC Co-PI | Universidad Autónoma de Tamaulipas |
| | | **Guyana** |
| Pamila Ramotar | HC Co-PI | Department of Fisheries |

### UNIVERSITY OF CONNECTICUT–AVERY POINT

| Participants | Status | Country |
|---|---|---|
| | | **USA** |
| Robert S. Pomeroy | US Lead PI | University of Connecticut-Avery Point |
| David Bengtson | US C0-PI | University of Rhode Island |
| | | **Cambodia** |
| So Nam | HC Lead PI | IFReDI |
| | | **Vietnam** |
| Tran Thi Thanh Hien | HC Co-PI | Can Tho University |

### UNIVERSITY OF HAWAI'I AT HILO

| Participants | Status | Country |
|---|---|---|
| | | **USA** |
| Maria Haws | US Lead PI | University of Hawaii at Hilo |
| John Supan | US Co-PI | Louisiana State University |
| | | **Mexico** |
| Eladio Gaxiola Camacho | HC Lead PI | Universidad Autónoma de Sinaloa-Culiacán |
| Omar Calvario Martinez | HC Co-PI | CIAD |
| | | **Nicaragua** |
| Nelvia Hernandez | HC Co-PI | CIDEA-UCA |

### UNIVERSITY OF MICHIGAN

| Participants | Status | Country |
|---|---|---|
| | | **USA** |
| James S. Diana | US Lead PI | University of Michigan |
| | | **China** |
| Yang Yi | HC Lead PI | Shanghai Ocean University |
| Lai Qiuming | HC Co-PI | Hainan University |
| Wang Weimin | HC Co-PI | Huazhong Agricultural University |
| Song Biyu | HC Co-PI | Wuhan University |
| | | **Nepal** |
| Madhav K. Shrestha | HC Co-PI | Institute of Agriculture & Animal Science |
| | | **Vietnam** |
| Le Thanh Hung | HC Co-PI | University of Agriculture & Forestry |
| Flavio Corsin | "US" Co-PI | World Wildlife Fund in Asia |

# APPENDIX 2. WORK PLAN AND PERSONNEL CHANGES APPROVED IN THE REPORTING PERIOD

## University of Arizona Project: Guyana Prinicpal Investigator Change

In October 2008, Tejnarine Geer, the Host Country PI for Guyana, notified CRSP of his promotion to Minister of Fisheries. He and the Ministry requested that Pamila Ramotar take his place. The change, submitted by Kevin Fitzsimmons in his capacity as Lead US PI for Guyana Project, was approved by the Director just after the close of this reporting period.

## University of Hawai'i at Hilo: Project Investigation Change

The change was approved by the Director after consultation with USAID CTO and reviewer input from representatives of CRSP technical advisory groups (DTAP) and (RCE).

## Microbiological Quality of Bivalve Growing Waters and Tissues

*Human Health Impacts of Aquaculture/Experiment/Investigation 07HHI05UH*[8]

***Collaborating Institutions & Lead Investigators***

| | |
|---|---|
| Pacific Aquaculture & Coastal Resources Center, University of Hawaii at Hilo (USA) | Maria Haws |
| Louisiana State University (USA) | John Supan |
| Centro de Investigación de Ecosistemas Acuáticos, Universidad Centroamericana (Nicaragua) | Carlos Rivas<br>Nelvia Hernandez del Socorro<br>Erick Jose Sandoval Palacios |

***Objectives***

This work aims to strengthen current efforts to culture and manage the black cockle (Anadara spp.) and other bivalve fisheries, as well as aquaculture, in Nicaragua by; 1) monitoring water quality in a coastal estuary where cockles are intensively fished by poor communities; 2) conducting depuration trials in open water and in the laboratory; and 3) monitoring pathogens in cockle tissues to provide the long-term data needed to identify suitable areas for shellfish collection and culture. A market trial will be conducted for depurated and certified cockles to assess the comparative economic advantage for this product. A cost benefit analysis will determine if increased prices for "clean" product off-set depuration costs.

Specific objectives include:

- Monitor the presence of Salmonella spp., Echerichia coli and Vibrio parahaemolyticus in the waters of the Aserradores Estuary at six stations and in the tissues of Andara spp. taken from the estuary;

[8] Note: this work plan change is not intended to substitute for Investigation 07IND04UH which will be conducted for oysters in Mexico.

- Establish a depuration site in the estuary and conduct controlled depuration trials in the laboratory for two species of Anadara cockles; and
- Conduct a market trial for depurated cockles and a cost-benefit analysis.

***Significance***

This investigation represents a change in work plan from the original investigation. Originally it was planned to conduct water quality sampling in three estuaries and assess microbiological quality for cockle tissues from the same estuaries in order to determine from which areas and at which times during the year shellfish might be safely collected and consumed which would benefit both fisheries management and aquaculture efforts. Preliminary water quality sampling in the three estuaries indicated that for at least two of the estuaries, water quality is so poor that meeting either Nicaraguan and U.S. standards (which are similar) for approved shellfish growing areas would be impossible. It was therefore decided that focusing on the estuary with cleaner waters (Aserradores Estuary in the Department of Chinandega) would allow for a greater chance of finding areas with sufficiently good water quality to allow for shellfish collection and depuration. This work will serve as a model for other areas of Nicaragua. It is clear that relay and/or depuration methods will be needed in most coastal areas of Nicaragua, so gathering more information on depuration rates and feasible depuration methods is needed and will be of national relevance. The primary species under question are black cockles, *Anadara similis* and *Anadara tuberculosa*, the most commonly consumed bivalves in Central America and for which very little information is available regarding depuration issues. A previous short survey indicated that cockles which were depurated and certified as safe by the university would have a price advantage for vendors. A short market trial will be conducted once depurated product is obtained to validate this preliminary finding and establish a price point for the product. This information will be used for a cost-benefit analysis to determine whether higher prices off-set the additional costs incurred by relay and depuration. Branding of the depurated product as a "clean" and "environmentally-friendly" product will also be evaluated and if deemed feasible, marketing trials will include this improved product. Target consumers include Nicaragua consumers and both international and local tourist in nearby areas.

Dozens of species of open ocean and estuarine bivalves are a critical fisheries resource for Nicaragua, as well as other Latin American countries, but are threatened by overfishing and suspected increasing levels of contamination as coastal populations and activities grow. Numerous species are fished and consumed in Nicaragua including *Crassostrea rhizophorae* (mangrove oyster), *Crassostrea gigas* (Japanese Oyster), *Ostrea iridescens* (rock oyster), *Anadara tuberculosa*, Anadara similis (black cockles), *Iphigenia altior* (beach clam), *Pinctada mazatlanica* (pearl oyster), *Spondylus* sp. (thorny oyster). Two species of black cockle, *Anadara similis* and *A. tuberculosa*, are particularly important for the poor coastal communities of Nicaragua. Many communities around coastal estuaries depend on daily fishing of cockles for income and as a basic food source. The latter use is particularly important as cockles are the food of last resort when poor families have no other source of food as these bivalves are readily found and harvested close to home. Single, female heads of households are especially dependent on the cockle resource. The Nicaraguan bivalve populations are also important on a regional basis since fishers from El Salvador and Honduras routinely fish in Nicaraguan waters and sell their catch in their respective countries. UCA has been leading efforts in recent years to conduct research into basic cockle biology and ecology, develop culture methods for cockles and other bivalves, and test alternative management regimes for bivalve fisheries. The latter is of importance since current regulations depend on a long closed season which does not appear to coincide with the peak reproductive season or other biological attributes, and is based simply on the time during which demand is highest. There is also an overall lack of compliance with the existing regulations as little outreach has been done to the fishers and enforcement capacity is minimal. Current research to improve management involves participatory research with local communities to establish community-controlled no-take zones for cockles and allowable fishing

zones, and efforts to elucidate key parameters such as size at maturity to inform efforts to development better management regimes. USAID and other donors have recently funded these efforts which are beginning to yield positive results. The Nicaraguan Ministry of the Environment (MARENA) is a partner in these efforts which emphasize co-management with the local communities. Shellfish-borne illnesses are of serious concern for shellfish harvested from coastal areas. Gastrointestinal illness due to *E. coli*, and outbreaks of salmonella and *Vibrio parahaemolyticus* appear to be on the rise based on the sparse data collected by rural health clinics and urban hospitals and observations by field workers. This data is probably highly inaccurate due to poor diagnosis and under-reporting, but incidences are high. Infants and children in rural areas appear to be particularly prone to serious illness and death due to these diseases. A key aspect of long-term sustainability for the culture and fisheries management efforts is the eventual classification of shellfish growing and fishing waters to assure that harvested shellfish are safe to eat. Nicaragua's fished bivalves are exported widely within the country, and allegedly, illegally to other Central American countries, so the food quality and safety of these widely consumed shellfish is of national and international concern. This work would develop methods for depuration based on the depuration rates of these species and under local conditions. Protocols are similar to those recommended by the U.S. National Shellfish Sanitation Program (NSSP 2006). This work will also be accompanied by outreach activities intended to educate cockle fishers and the public on issues related to shellfish sanitation to reduce the incidence of serious disease. UCA will lead this effort with support from UHH (M. Haws) and LSU (J. Supan).

***Quantified Anticipated Benefits***

This work will allow researchers and managers to determine which areas are safest for bivalve fishing and culture, and provide this information to stakeholder groups on the coast to guide co-management activities. This information may help reduce the incidence of serious and potentially fatal diseases. It is also thought that due to increasing consumer awareness and fear of shellfish-borne diseases, shellfish that can be certified as being harvested from clean waters may have added market value, and minimally, may guide poor coastal residents who intend to consume shellfish, to collect in areas that are the safest and avoid contaminated areas. It will also benefit current efforts to develop shellfish aquaculture by providing key information to the site selection process. Additionally, it will assist in efforts to clean up coastal areas and with community sanitation programs by demonstrating a clear link between harmful practices and community health and pinpointing areas where improvement is most needed. Target groups for this work include: aquaculture extension workers and researchers in Nicaragua and key private sector representatives. Approximately 24 communities that depend on bivalve resources surrounding the three estuaries will benefit from this work. Groups benefiting in Nicaragua include extension and research staff at the Central American University and partner organizations such as MARENA, and fishers and women's groups in three Nicaraguan estuaries. Linkages will also be made to the NOAA International Sea Grant efforts through participation of Maria Haws and John Supan, Sea Grant personnel/associated faculty from Hawaii and Louisiana and Alaska. This work will inform and complement activities of the USAID coastal zone management projects, "Sustainable Coastal Communities and Ecosystems (SUCCESS)." Quantifiable benefits will include: new culture methods developed; existing methods transferred to new user groups; increased skill levels for improving areas of health and sanitation related to aquaculture; improved knowledge of the linkages between the environment and health.

Metrics:

- Number of institutions directly or indirectly benefiting: 9
- Number of individual participants in technical training: 20
- Number of communities benefiting: 24
- Number of documents produced or contributed to: 1
- Students involved: 1 undergraduate
- Publications: 2 (technical report and article for CRSP newsletter)

- Number of new or improved products: 1

***Research Design & Activity Plan***
A depuration station will be established in the center of the Aserradores Estuary where preliminary work indicates that water quality is probably the best in the area. Cockles will be relayed to this station and depurated. Water quality will be monitored at the station as well as at five additional stations within the estuary. Three of these will be in the proximity of the current no-take zones for cockles that are part of the SUCCESS program experiment with using no-take zones as a means of managing cockle population. If the no-take areas can also serve as depuration stations, it provides additional incentives for the community to continue protecting the no-take zones. Cockle tissues will also be collected during the depuration trials and from the other five stations to monitor levels of *Salmonella* spp., *E. coli* and *Vibrio parahaemolyticus*. Depuration trials will also be conducted in the laboratory to collect information on depuration rates for the two species of cockles under controlled conditions. A market trial will be conducted by surveying vendors, buyers and consumers of cockles using the depurated product to determine the amount of value-added for depurated and certified product. Marketing trials with the depurated cockles will be initiated once cockles have been successfully depurated. UCA is currently working with the shrimp industry to certify shrimp farms and the certification envisioned for the cockles would consist of a simple label with a statement that the cockles were depurated and tested under supervision of UCA. A cost-benefit analysis will determine whether the added market value justifies the increased costs of depuration. Outreach with communities, responsible government agencies (e.g., Ministry of Health, Environment), fishers, aquaculturists, and others will be conducted to raise awareness of these issues and to promote improved management of these estuary areas. The UCA undergraduate student will assist with this work.

***Schedule***
Because sampling sites have already been identified and protocols developed, the work can begin in August 2008, and will continue through September 2009. Outreach will be conducted to disseminate results and management recommendations once the first year of sampling has been completed, and will conclude in August 2009. Community members will be trained during each visit by researchers as each field visit includes a community meeting, short training event and active participation by community members in all field research activities.

***Personnel Changes***
Agnes Saborio has resigned as Director of CIDEA/UCA and will be replaced by Carlos Rivas as the HCPI.

***Literature Cited***
National Shellfish Sanitation Program (NSSP). 2006 Guide for the control of molluscan shellfish.

## University of Hawai'i at Hilo: Nicaragua Prinicpal Investigator Change

In correspondence dated 25 July 2008, Maria Haws, the Lead US PI, notified the ME that Agnes Saborio had resigned as Director of CIDEA-UCA and requested placing Carlos Rivas LeClair in the vacated HC Co-PI position. See Work Plan investigation change above for 07HHI05UH. This personnel change was conditionally approved by the Director pending materials to be submitted by the US Lead PI.

# APPENDIX 3. LINKAGES

Institutions, NGOs, and organizations listed below participate as partners in the EGAT-funded AquaFish CRSP research projects. The * indicates US and Host Country PI affiliations and direct funding recipients through subcontracts and MOUs but does not include financial support via travel reimbursement or personal services agreements, or other shorter term funding arrangements.

## US Partners

American Soybean Association
Cornell University
Delaware State University
Department of Commerce, NOAA*
Fisheries Industry Technology Center–University of Alaska
Florida International University
Louisiana State University*
National Oceanic & Atmospheric Administration–International Sea Grant
North Carolina State University*
Oregon State University*
Pacific Aquaculture & Coastal Resources Center–University of Hawaii at Hilo*
Pacific Shellfish Growers Association
Purdue University*
Texas A&M University
Texas Parks & Wildlife Department
Texas Tech University*
University of Arizona*
University of Arkansas at Pine Bluff*
University of Connecticut–Avery Point*
University of Hawaii at Hilo*
University of Michigan*
University of Rhode Island*
University of Rhode Island–Coastal Resources Center
University of Texas
US-Mexico Aquaculture TIES Program
U.S. Food & Drug Administration
Virginia Polytechnic Institute & State University*
World Wildlife Fund*

## International Partners

Aquaculture without Frontiers
Australian Centre for International Agricultural Research
International Development Research Centre (Canada)
Lake Victoria Environmental Management Project
Network of Aquaculture Centers in Asia (Thailand)
United Animal Feed Producers
United Cooperative of Fishermen
United Nations Food & Agriculture Organization
USAID SUCCESS program
World Aquaculture Society
WorldFish Center

***Brazil***
Centro de Acüicultura, UNESP

***Cambodia***
Fisheries Administration
Inland Fisheries Research & Development Institute (IFReDI)*

***China***
Hainan University*
Huazhong Agricultural University*
Huiting Reservoir Fisheries Management Company
Shanghai Ocean University* (formerly Shanghai FisheriesUniversity)
Sichuan Aquacultural Engineering Research Center
Wuhan University*
Zhanghe Reservoir Fisheries Management Company

***Costa Rica***
University of Costa Rica

***Ecuador***
Ecocostas

***Egypt***
Academy of Scientific Research & Egyptian Universities
Central Administration of Agricultural Foreign Relations
Central Laboratory for Aquaculture Research
Egyptian Society of Agribusiness
Ministry of Agriculture & Land Reclamation

***Ghana***
Fisheries Department, Ministry of Food & Agriculture
Kwame Nkrumah University of Science & Technology*
Water & Sewerage Company

***Guatemala***
San Carlos University

***Guyana***
Department of Fisheries
Maharaja Oil Mill
Mon Repos Aquaculture Center*
National Aquaculture Association of Guyana
USAID/GTIS Programme–Guyana
Von Better Aquaculture

***Honduras***
Zamorano University

***Indonesia***
Ujung Batee Aquaculture Center, Banda Aceh*
Indonesian Department of Fisheries
Ladong Fisheries College

***Kenya***
Kenya Business Development Services
Moi University*
National Investment Center

***Lebanon***
American University of Beirut

***Mexico***
Comite Estatal de Sanidad Acuicola de Sinaloa
Federation of Shrimp Cooperatives
Instituto Sinaloense de Acuacultura
Mariano Matamoros Hatchery
Research Center for Food & Development (CIAD)*
Sinaloa Institute for Aquaculture
Sinaloa State Fisheries Department
State Committee for Aquaculture Sanitation of Sinaloa (CESASIN)
Universidad Autónoma de Tamaulipas*
Universidad Autónoma de Sinaloa–Culiacán*
Universidad Autónoma de Sinaloa–Mazatlán*
Universidad Juárez Autónoma de Tabasco*
Women's Oyster Culture Cooperatives of Puerto Penasco

***Nepal***
Institute of Agriculture & Animal Science*
Rural Integrated Development Society

***Nicaragua***
Center for Research of Aquatic Ecosystems-Central American University (CIDEA-UCA)*
Nicaraguan Ministry of the Environment

***Philippines***
Bureau of Fisheries and Aquatic Resources (BFAR)*
Central Luzon State University*
Department of Agriculture
Genetically Improved Farmed Tilapia (GIFT) Foundation International, Inc
Southeast Asian Fisheries Development Center (SEAFDEC) AQD*

***South Africa***
University of Stellenbosch

***Tanzania***
Kingorwila National Fish Center
Mbegani Fisheries Development Centre
Ministry of Natural Resources & Tourism, Aquaculture Development Division*
Nyegezi Fisheries Institute
Sokoine University of Agriculture*
Tanzania Fisheries Research Institute
University of Dar-es-Salaam

***Venezuela***
BIOTECMAR

***Vietnam***
Can Tho University*
Dong Nai Fisheries Company
University of Agriculture & Forestry*

# APPENDIX 4. ACRONYMS

## Program-Related

| | |
|---|---|
| ACRSP | Pond Dynamics/Aquaculture CRSP |
| A&F CRSP | Aquaculture & Fisheries CRSP |
| AquaFish | Aquaculture & Fisheries CRSP |
| CRSP | Collaborative Research Support Program |
| HC | Host Country |
| ME | Management Entity |
| MOU | Memorandum of Understanding |
| NGO | Nongovernmental organization |
| PD/A CRSP | Pond Dynamics/Aquaculture CRSP |
| PI | Principal Investigator |
| RFA | Request for Assistance |
| RFP | Request for Proposals |

## General

| | |
|---|---|
| FAQ | Frequently Asked Questions |
| KSh | Kenya Shillings |
| NB | Nota Bene, note well |
| PDF | Portable Document Format |

## Institutions, Organizations, Government Entities & Programs

| | |
|---|---|
| ACIAR | Australian Centre for International Agricultural Research |
| AIT | Asian Institute of Technology |
| APEC | Asia-Pacific Economic Cooperation |
| ASEAN | Association of Southeast Asian Nations |
| ATA | American Tilapia Association |
| AwF | Aquaculture without Frontiers, USA |
| BAU | Bangladesh Aquacultural University |
| BFAR | Bureau of Fisheries & Aquatic Resources, Philippines |
| BIOTECMAR | Cultivos & Biotecnologíca Marina C.A., Venezuela |
| CESASIN | Comite Estatal de Sanidad Acuicola de Sinaloa (Sinaloa State Committee for Aquaculture Sanitation |
| CETRA | Centro de Transferencia Tecnológica para la Acuacultura (Center for Aquaculture Technology Transfer), Mexico |
| CI | Conservation International, Mexico |
| CIAD | Centro de Investigación de Alimentos y Desarrollo (Research Center for Food & Development), Mexico |
| CIDEA-UCA | Centro de Investigación de Ecosistemas Acuáticos de la Universidad Centroamericana (Center for Research on Aquatic Ecosystems-Central American University), Nicaragua |
| CIFAD | Consortium for International Fisheries & Aquaculture Development |
| CIMMYT | International Wheat & Maize Improvement Center, Mexico |
| CLAR | Central Laboratory for Aquaculture Research, Egypt |
| CLSU | Central Luzon State University |
| CRC/URI | Coastal Resources Center/University of Rhode Island |
| CTU | Can Tho University, Vietnam |
| DASP | Department of Animal Sciences & Production, SUA |
| DA-BFAR | Department of Agriculture-Bureau of Fisheries & Aquatic Resources, Philippines |
| DPN | Direction Nationale de la Pêche, Mali |
| EGAT | Bureau for Economic Growth, Agriculture, & Trade (USAID) |
| EPA | US Environmental Protection Agency |
| EU | European Union |
| FAC | Freshwater Aquaculture Center, Central Luzon State University, Philippines |

| | |
|---|---|
| FAO | Food & Agriculture Organization, United Nations |
| FD | Fisheries Department, Kenya |
| FDA | US Food & Drug Administration |
| FDAP | Fisheries Development Action Plan, Cambodia |
| FiA | Fisheries Administration, Cambodia |
| FISH | The FISH Project (Fisheries Improved for Sustainable Harvest), Philippines |
| FIU | Florida International University |
| GESAMP | Joint Group of Experts in the Scientific Aspects of Marine Environmental Protection, FAO |
| GIFT | Genetically Improved Farmed Tilapia |
| GOP | Government of Philippines |
| GTIS | Guyana Trade & Investment Support Project |
| IAAS | Institute of Agriculture & Animal Science, Nepal |
| IARC | International Agricultural Research Center(s) |
| ICLARM | International Center for Living Aquatic Resources Management (= The WorldFish Center), Malaysia |
| IDRC | International Development Research Centre, Canada |
| IEHA | Initiative to End Hunger in Africa |
| IFREDI | Inland Fisheries Research & Development Institute, Cambodia |
| ISSC | Interstate Shellfish Sanitation Conference |
| ISA | Sinaloa Institute for Aquaculture, Mexico |
| ISTA | International Symposium on Tilapia in Aquaculture |
| KBDS | Kenya Business Development Services |
| KNUST | Kwame Nkrumah University of Science & Technology |
| LSU | Louisiana State University |
| MARENA | Nicaraguan Ministry of the Environment |
| MRC | Mekong River Commission |
| MSU | Michigan State University |
| NAAG | National Aquaculture Association of Guyana |
| NACA | Network of Aquaculture Centers in Asia, Thailand |
| NARS | National Agricultural Research System (of Host Countries) |
| NCSU | North Carolina State University |
| NIC | National Investment Center |
| NOAA | National Oceanographic & Atmospheric Administration (US) |
| NPRS | National Poverty Reduction Strategy, Cambodia |
| NSF | National Science Foundation, USA |
| NSSP | National Shellfish Sanitation Program |
| OSU | Oregon State University |
| PACRC | Pacific Aquaculture & Coastal Resources Center/University of Hawai'i at Hilo |
| RIDS-Nepal | Rural Integrated Development Society-Nepal |
| SEAFDEC/ AQD | Southeast Asian Fisheries Development Center/Aquaculture Department, Philippines |
| SEDPIII | Third Five-Year Socioeconomic Development Plan, Cambodia |
| SEMARNAT | Secretariat of Natural Resources, Mexico |
| SOU | Shanghai Ocean University (formerly Shanghai Fisheries University) |
| SUA | Sokoine University of Agriculture |
| SUCCESS | Sustainable Coastal Communities & Ecosystems (EGAT/USAID) |
| TIES | Training, Internships, Education & Scholarships Program (USAID-Mexico) |
| TNC | The Nature Conservancy |
| TTU | Texas Tech University, Lubbock |
| UA | University of Arizona |
| UAPB | University of Arkansas, Pine Bluff |
| UAS | Universidad Autónoma de Sinaloa (Autonomous University of Sinaloa) |
| UAT | Universidad Autónoma de Tamaulipas (Autonomous University of Tamaulipas) |
| UCA | Universidad Centroamericana (Central American University) |
| UG | University of Georgia |
| UHH | University of Hawaii at Hilo |
| UJAT | Universidad Juárez Autónoma de Tabasco (Autonomous University of Juarez, Tabasco) |

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|---|---|
| UJAT-CPSR | Cooperativa Pesquera San Ramón (San Ramón Fisheries Cooperative) |
| UBAC | Ujung Batee Aquaculture Center |
| UM | The University of Michigan |
| UNESP | Universidade Estadual Paulista (São Paulo State University) |
| URI | University of Rhode Island |
| US | United States |
| USG | United States Government |
| USAID | United States Agency for International Development |
| USEPA | US Environmental Protection Agency |
| VT | Virginia Polytechnic Institute & State University |
| WAS | World Aquaculture Society |
| WWF | World Wildlife Fund |

## Topic Areas

| | |
|---|---|
| BMA | Production System Design & Best Management Alternatives |
| FSV | Food Safety & Value-Added Product Development |
| HHI | Human Health Impacts of Aquaculture |
| ISD | Indigenous Species Development |
| MER | Marketing, Economic Risk Assessment & Trade |
| NE | Mitigating Negative Environmental Impacts |
| QSD | Quality Seedstock Development |
| SFT | Sustainable Feed Technology |
| TAP | Technology Adoption & Policy Development |
| WIZ | Watershed & Integrated Coastal Zone Management |

## USAID, Program & Project Terms

| | |
|---|---|
| AOP | Advanced Oxidation Process |
| BMP | Best Management Practice |
| BOD | Biochemical Oxygen Demand |
| BSE | Bovine Spongiform Encephalopathy |
| BW | Brackish Water |
| cDNA | complementary DNA (Deoxyribonucleic acid) |
| CFU | Colony Forming Units |
| CG | Compensatory Growth |
| DO | Dissolved Oxygen |
| DTAP | Development Theme Advisory Panel |
| EC | *E. coli* |
| EPT | *Ephemeroptera*, *Pleocoptera* & *Trichoptera* |
| EG | Economic Growth Indicators, USAID |
| FACT | "F" indicators database, Director of US Foreign Assistance–USAID |
| FCR | Food (Feed) Conversion Ratio |
| GIFT | Genetically Improved Farmed Tilapia |
| GIS | Geographic Information System |
| GLM | Generalized Linear Model |
| GMO | Genetically Modified Organism |
| GnRHa | Gonadotropin Releasing Hormone Analogue |
| HACCP | Hazard Analysis & Critical Point Control |
| HIV/AIDS | Human Immuno Virus/Acquired Immune Deficiency Syndrome |
| HPLC | High Performance Liquid Chromatography |
| HSD | Hepatosomatic Index |
| IGF-I | Insulin-like Growth Factor-I |
| IPM | Integrated Pest Management |
| IR | Intermediate Results indicators, IEHA program |
| LAC | Latin America & Caribbean Regions |
| LC/MS | Liquid Chromatography/Mass Spectrometry |
| LCA | Life Cycle Assessment |
| LCCA | Life Cycle Cost Analysis |
| LST | Lauryl Sulfate Tryptose |

| | |
|---|---|
| MC | Microcystins |
| mRNA | messenger RNA (Ribonucleic Acid) |
| MT | 17α-Methyltestosterone |
| NL | Notochordal |
| PDI | Pellet Durability Index |
| PMP | Program Monitoring Plan |
| PRCA | Participatory Rural Communication Appraisal |
| RCE | Regional Center of Excellence |
| RIA | Radioimmunoassay |
| RRA | Rapid Rural Appraisal |
| SGR | Specific Growth Rate |
| SPE | Solid Phase Extraction |
| SL | Standard Length |
| SR | Sex Reversed |
| SS | Salmonella-Shigella |
| TN | Total nitrogen |
| TP | Total phosphorus |
| TSS | Total suspended solids |
| UV | Ultraviolet |
| XLD | Xylose Lysine Desoxycholate |