

**AQUACULTURE & FISHERIES
COLLABORATIVE RESEARCH SUPPORT PROGRAM**

**IMPLEMENTATION PLAN 2007–2009
ADDENDUM**

SEPTEMBER 2009

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**AquaFish Collaborative Research Support Program
IMPLEMENTATION PLAN 2007–2009, Addendum
September 2009**

The mission of the AquaFish Collaborative Research Support Program (CRSP) is to enrich livelihoods and promote health by cultivating international multidisciplinary partnerships that advance science, research, education, and outreach in aquatic resources. Bringing together resources from host country institutions and US universities, the AquaFish CRSP emphasizes sustainable solutions in aquaculture and fisheries for improving health, building wealth, conserving natural environments for future generations, and strengthening poorer countries' ability to self-govern.

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INTRODUCTION

This addendum to the AquaFish CRSP *Implementation Plan 2007-200* includes a work plan change for investigation 07HHI05UH and adds an investigation summary.

REVISED WORK PLAN: 07HHI05UH

As reported in the AquaFish CRSP *Second Annual Report*, the University of Hawaii at Hilo investigation work plan for 07HHI05UH changed. The revised work plan presented here was approved in December 2008 by the Director after consultation with the USAID CTO and with reviewer input from representatives of the AquaFish CRSP Technical Advisory Groups (DTAP and RCE).

SYNTHESIS STUDY

The synthesis study “Evaluating AquaFish Accomplishments in a Systems Framework” is the research component of the ME’s Synthesis Project. A preliminary Concept Note was included in the *Second Annual Report*. The investigation summary, which reflects internal reviewer input, is provided here in this addendum. This study will undertake broad evaluative syntheses of the AquaFish CRSP program which will assist the Director and the Technical Advisory Groups—Development Themes Advisory Panel (DTAP) and Regional Centers of Excellence (RCE)—in evaluating data across themes and regions. When completed, this study will provide feedback to the program on minimum dataset sizes to reduce duplication and streamline data collection.

**TOPIC AREA
HUMAN HEALTH IMPACTS OF AQUACULTURE**



MICROBIOLOGICAL QUALITY OF BIVALVE GROWING WATERS AND TISSUES

Human Health Impacts of Aquaculture/Experiment/07HHI05UH

Collaborating Institutions & Lead Investigators

Pacific Aquaculture & Coastal Resources Center,
University of Hawaii at Hilo (USA)
Louisiana State University (USA)
Centro de Investigación de Ecosistemas
Acuáticos, Universidad
Centroamericana (Nicaragua)

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Carlos Rivas Leclair
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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 *Anadara* spp. taken from the estuary;
- 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.

SYNTHESIS PROJECT



EVALUATING AQUAFISH ACCOMPLISHMENTS IN A SYSTEMS FRAMEWORK

Collaborating Institutions & Lead Investigators

Oregon State University
North Carolina State University
Purdue University
University of Arizona
University of Connecticut–Avery Point
University of Hawaii at Hilo
University of Michigan

Steve Buccola
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Kwamena Quagrainie
Kevin Fitzsimmons
Robert Pomeroy
Maria Haws
James S. Diana

Objectives

1. Develop a framework for characterizing AquaFish project accomplishments, taking into account project objectives and resources.
2. Apply the framework to assess AquaFish contributions by Topic Area.

Significance

The AquaFish CRSP seeks to improve food security by fostering sustainable aquaculture development and aquatic resource management in developing countries. The current AquaFish CRSP program began in 2007 to fund US Lead Institutions that partner with host country institutions on investigations in the host countries to be completed on 30 September 2009.

Each US Lead Institution project focuses on one of four AquaFish CRSP Themes, while attending to the remaining three: (a) Improved Health and Nutrition, Food Quality, and Safety; (b) Income Generation for Small-Scale Fish Farmers and Fishers; (c) Environmental Management for Sustainable Aquatic Resources Use; and (d) Enhanced Trade Opportunities for Global Fishery Markets. Each sub-award project and the investigations they finance must 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 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.

USAID requires as well that AquaFish CRSP demonstrate its successes in achieving the investigations' stated objectives. Success must be demonstrable both qualitatively and quantitatively. In their quarterly and annual reports, US Lead Institutions provide quantitative information about their project's investigations using the DTAP (Development Theme Advisory Panel) indicators, which AquaFish CRSP has developed for specific use by AquaFish CRSP investigators. Besides these indicators, US Lead Institutions along with their US and host country partners provide qualitative

information about investigation goals; institutional, technological, and social environments; and investigation outcomes and difficulties.

The purpose of this study is to employ the above information, in conjunction with additional data, to express the contributions of the AquaFish CRSP sub-award projects, and their funded investigations. The analysis will provide USAID and others interested in developing-nation aquaculture with a coordinated view of how the wide-ranging AquaFish CRSP investigations work together to improve productive efficiency, raise incomes, enhance human health and safety, expand markets, and mitigate fish farming's environmental impacts.

Quantified Anticipated Benefits

This study will provide two outputs:

- (i) descriptive analyses, by Topic Area, of AquaFish CRSP accomplishments; and
- (ii) quantitative analyses, by Topic Area, of the impacts of AquaFish CRSP inputs on outputs.

The descriptive analysis will be designed to bring out those aspects of the AquaFish CRSP projects that most effectively satisfy the CRSP objectives, and at the same time identify sources of problems that prevent full attainment of anticipated CRSP benefits. The quantitative analysis will consist of an examination, at the Topic Area level, of how the sizes and qualities of investigation inputs affect investigation outputs and value. The descriptive and quantitative analyses will be combined to form a picture of what has been accomplished under each Topic Area.

Research Design and Activity Plan

Each AquaFish CRSP investigation concentrates on a particular Research and Outreach Topic Area. Topics are organized under one of two Topic Area Groups as follows:

Integrated Production Systems

Production System Design and Best Management Alternatives
Sustainable Feed Technology
Indigenous Species Development
Quality Seedstock Development

People, Livelihoods, and Ecosystem Interrelationships

Human Health Impacts of Aquaculture
Food Safety and Value-Added Product Development
Technology Adoption and Policy Development
Marketing, Economic Risk Assessment and Trade
Watershed and Integrated Coastal Zone Management
Mitigating Negative Environmental Impacts

The systems orientation of the AquaFish CRSP suggests that investigations be evaluated in groups similar to these. The above groupings 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 this study ought to vary according to Topic Area Groups or Topic Areas.

However, Topic Areas grouped under *People, Livelihoods, and Ecosystem Interrelationships* probably are too heterogeneous to be included in a single evaluative study. It is important, then, to show how the AquaFish CRSP's Topic Areas might be better grouped for evaluative purposes. The illustrative descriptions of the Topic Areas suggest, in terms of conceptual or scientific paradigm, that we group them into the following five categories.

Category I
Production System Design and Best Management Alternatives
Sustainable Feed Technology
Indigenous Species Development
Quality Seedstock Development

This Category comprises all four Topic Areas in the *Integrated Production Systems* Topic Area Group. Its focus is aquaculture and fisheries production. Its main analytic paradigm is physical, and especially biological, science. As such, the AquaFish 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, taking systems interrelationships into account?

Category II
Human Health Impacts of Aquaculture
Food Safety and Value-Added Product Development

This Category's focus is fish processing and food value. Its main analytic paradigm is, again, the physical and biological sciences. Therefore, the AquaFish 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 Adoption and Policy Development

Evaluative paradigms in this Category differ greatly from those in I and II. We 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, Economic Risk Assessment and Trade

Investigations in this Category should be assessed in terms of the social sciences. We will 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 Integrated Coastal Zone Management
Mitigating Negative Environmental Impacts

This Category is best assessed in terms of the biological sciences and management, for example in terms of ecology and ecosystem management. We will 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.

Data and other information for this study will be taken from each project's annual responses to DTAP questionnaires, in addition to conversations with and a survey of the principal investigators. The survey will be designed to gather project input and output data unavailable in the DTAP responses. The quantitative analysis employing these data likely will take the form of distance function estimation, a method of characterizing input-output relationships (Fare and Primont).

Schedule

The study will proceed as follows:

1. *January – September 2009:* Examine US Lead Institution award and sub-award documents, including research/outreach/activity Implementation Plans and progress reports.
2. *July – December 2009:* Communicate with US Lead Institution and investigator personnel to obtain further qualitative information about AquaFish CRSP investigations and their outputs.
3. *October 2009 – March 2010:* Conduct survey of US Lead Institution projects to obtain investigation input and predicted output data not available in qualitative reports or DTAP reports.
4. *January – September 2010:* Based on the above information, conduct preliminary qualitative analysis of AquaFish CRSP Topic Area accomplishments.
5. *April – December 2010:* Conduct preliminary quantitative analysis of AquaFish CRSP input-output relationships by Topic Area.
6. *September 2010 – August 2011:* Respond to US Lead Institution projects and other comments on qualitative and quantitative studies, perform any re-estimation, and write final reports.

General Readings

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