

# AQUANEWS



Sustainable Aquaculture  
for a Secure Future

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## New Partnerships Enrich CRSP Asia Research

This issue of *Aquanews* highlights Tenth Work Plan activities planned by new and continuing CRSP partners in South and Southeast Asia. Since its inception in 1982, the PD/A CRSP has been involved in research in Southeast Asia, with Thailand and the Philippines its long-term partners. Research was conducted in Indonesia through 1987 as well. The Tenth Work Plan sees a tremendous expansion of the geographic scope of research throughout South and Southeast Asia, primarily through the Thailand Project. Partnerships have been forged

with researchers at institutions in Bangladesh, Cambodia, Laos, Nepal, and Vietnam.

The article beginning on this page was contributed by Yang Yi, CRSP researcher at the Asian Institute of Technology. Yi's research under the Tenth Work Plan includes collaborations with US investigators at the University of Michigan and the University of Arizona and with colleagues in Bangladesh, Nepal, and Vietnam. Among the proposed investigations are those dealing with polyculture of carp and tilapia in Nepal and trials of fertilization regimes in Bangladesh. The Vietnam research will investigate the use of watershed ponds for aquaculture, the environmental effects of aquaculture in coves, and cage culture of catfish in rivers.

Another article (p. 3) was contributed by Chris Knud-Hansen, with colleagues at Michigan State University (MSU). The new MSU project comprises an investigation in Thailand on the use of zeolites to improve soil and water quality and workshops on optimizing fertilization efficiency in Cambodia, Laos, Thailand, and Vietnam.

On page 6, a piece contributed by Amrit Bart, of the Asian Institute of Technology, describes some of the surprising realities he encountered in setting up a research project in Nepal. Bart is collaborating with colleagues at the Regional Agricultural Research Station at Tarahara, Nepal, and at the University of Michigan.

To summarize the range of new research, a table of Tenth Work Plan investigations taking place in Asia, organized by host country, appears on page 2. Eleven new research partners are introduced in an article beginning on page 4. Finally, the student profile this issue features Kom Silapajarn, a Thai graduate student working with Claude Boyd at Auburn University (p. 7).



YANG YI

Feed preparation at top of cage, Vietnam

## PD/A CRSP Expands to Vietnam, Nepal, and Bangladesh

by Yang Yi

Under the Tenth Work Plan, the PD/A CRSP has expanded to Vietnam, Nepal, and Bangladesh, making the Thailand Project into a truly regional project. To reflect this expansion, it is the time to rename the Southeast Asia Regional Project to the South and Southeast Asia Regional Project.

The studies in Vietnam are focusing on relatively unconventional aquaculture methods. In the mountainous areas of central and northern Vietnam, a large number of watershed ponds

and reservoirs have been created mostly for household water supply and crop irrigation, while aquaculture in these areas has not been well developed. For most inhabitants in these areas, the supply of animal protein is relatively limited, including only small contributions from fish. The watershed study will survey biophysical and socioeconomic aspects of watershed areas in the Thai Nguyen district, develop a GIS database for planning of aquaculture development,

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## Tenth Work Plan Research Portfolio in Asia

Host Country	Investigation Title	Research Code	Collaborators		
			US	Host Country	
BANGLADESH	Workshops on Using Principles of Pond Dynamics to Optimize Fertilization Efficiency	10PDR2	Batterson, Garling, Knud-Hansen	Grover	
	On-Station and On-Farm Trials of Different Fertilization Regimes Used in Bangladesh	10ATR4	Diana	Wahab	
CAMBODIA	Workshops on Using Principles of Pond Dynamics to Optimize Fertilization Efficiency	10PDR2	Batterson, Garling, Knud-Hansen	Viseth	
LAOS	Workshops on Using Principles of Pond Dynamics to Optimize Fertilization Efficiency	10PDR2	Batterson, Garling, Knud-Hansen	Litdamlong	
NEPAL	Polyculture of Grass Carp and Nile Tilapia with Napier Grass as the Sole Nutrient Input in the Subtropical Climate of Nepal	10FFR3	Diana	Shrestha	
	Transfer of Production Technology to Nepal for Nile Tilapia, <i>Oreochromis niloticus</i>	10PDVR3	Diana	Rai	
PHILIPPINES	IGF as a Growth Rate Indicator in <i>Oreochromis niloticus</i>	10RCR3	Brown	Bolivar	
	Survey of Tilapia-Shrimp Polycultures in Philippines	10NSR3E	Fitzsimmons	Bolivar	
	Cost Containment Options for Tilapia Production in Central Luzon, Republic of the Philippines	10PDVR2	Brown	Bolivar	
THAILAND	Effects of Pond Age on Bottom Soil Quality	10PDR1	Boyd	Boonyaratpalin	
	Workshops on Using Principles of Pond Dynamics to Optimize Fertilization Efficiency	10PDR2	Batterson, Garling, Knud-Hansen	Bart	
	Polyculture of Grass Carp and Nile Tilapia with Napier Grass as the Sole Nutrient Input in the Subtropical Climate of Nepal	10FFR3	Diana	Lin, Yi	
	Development of a Trophic Box Model to Assess Potential of Ecologically Sound Management for Cove Aquaculture Systems in Tri An Reservoir, Vietnam	10ASMR1	Diana	Lin, Yi	
	Survey of Tilapia-Shrimp Polycultures in Vietnam and Thailand	10NSR3A	Fitzsimmons	Yi	
	Stocking Densities for Tilapia-Shrimp Polyculture in Thailand	10NSR3B	Fitzsimmons	Yi	
	Environmental Impacts of Cage Culture for Catfish in Chau Doc, Vietnam	10ER3	Diana	Lin, Yi	
	On-Station and On-Farm Trials of Different Fertilization Regimes Used in Bangladesh	10ATR4	Diana	Lin, Yi	
	Use of Clinoptilolite Zeolites for Ammonia-N Transfer and Retention in Integrated Aquaculture Systems and for Improving Pond Water Quality before Discharge	10ATR5	Batterson, Garling, Knud-Hansen	Bart	
	A Study of Aquaculture Brownfields: Abandoned and Converted Shrimp Ponds in Thailand	10GISR1	Diana, Brechin	Bart	
	Assessing Watershed Ponds for Aquaculture Development in Thai Nguyen, Vietnam	10GISR2	Diana	Lin, Yi	
	Transfer of Production Technology to Nepal for Nile Tilapia, <i>Oreochromis niloticus</i>	10PDVR3	Diana	Bart	
	VIETNAM	Workshops on Using Principles of Pond Dynamics to Optimize Fertilization Efficiency	10PDR2	Batterson, Garling, Knud-Hansen	Tuan
		Development of a Trophic Box Model to Assess Potential of Ecologically Sound Management for Cove Aquaculture Systems in Tri An Reservoir, Vietnam	10ASMR1	Diana	Hung
Survey of Tilapia-Shrimp Polycultures in Vietnam and Thailand		10NSR3A	Fitzsimmons	Yi (Thailand)	
Environmental Impacts of Cage Culture for Catfish in Chau Doc, Vietnam		10ER3	Diana	Phuong	
Assessing Watershed Ponds for Aquaculture Development in Thai Nguyen, Vietnam		10GISR2	Diana	Luu	

### PD/A CRSP Expands to Vietnam, Nepal, Bangladesh

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and identify suitable watershed ponds for aquaculture. In some reservoirs, cove culture has been adopted to enhance fish production; however, little information is available on the natural food productivity in coves. The goal of the cove-culture study is to determine biomass production of various trophic levels in fish culture coves, develop a trophic box model for a selected cove, and develop recommendations on ecologically sound management strategies for cove aquaculture.

In the Mekong Delta of Southern Vietnam, cage culture of *Pangasius* catfish is a common practice and is very important for the local economy. However, there are widespread concerns that cage culture is resulting in environmental degradation as well as mismanagement of cages. The cage-culture study will assess environmental impacts of catfish cage culture in rivers and recommend methods for

pollution mitigation.

In Nepal, polyculture of herbivorous carp is a common practice. However, the major constraints for small-scale, resource-poor farmers are fish feeds and chemical fertilizers, which are expensive and unavailable, while livestock manure is traditionally used for land crops. By using the principle of traditional Chinese polyculture "one grass carp raises three silver carp," the study in Nepal will develop a polyculture system of grass carp and Nile tilapia with napier grass as the sole nutrient input. The outcome of this study will benefit resource-poor farmers in many other countries.



Fish culture cage operation in river at Dong Thap, Vietnam

Bangladesh is one of the poorest countries in the world. Fisheries and aquaculture in particular are vital to Bangladesh's national economy in terms of nutrition, income, employment generation, and foreign exchange earning. In Bangladesh, a variety of aquaculture and fisheries development projects have been

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## MSU: An Early Partner Rejoins the Team

by Chris Knud-Hansen

After an eight-year hiatus from active PD/A CRSP participation, Michigan State University (MSU) is very pleased to join the PD/A CRSP Tenth Work Plan activities. Under the direction of Ted Batterson, Chris Knud-Hansen, and Don Garling, MSU is returning to the Asian Institute of Technology (AIT), Pathumthani, Thailand, where it was a PD/A CRSP participant from 1988 to 1993. The two MSU activities funded under the Tenth Work Plan are the "Use of Clinoptilolite Zeolites for Ammonia-N Transfer and Retention in Integrated Aquaculture Systems, and for Improving Pond Water Quality before Discharge" (Appropriate Technology/Experiment), and "Workshops on Using Principles of Pond Dynamics to Optimize Fertilization Efficiency" (Pond Dynamics/Activity).

The Appropriate Technology research project examines potentially new applications for natural clinoptilolite zeolites in aquaculture. Natural zeolites are aluminosilicate minerals found in volcanogenic sedimentary rocks worldwide, and possess several important properties including adsorption, cation-exchange (particularly with ammonium ions), dehydration-rehydration, and catalysis. They are inert and have no associated environmental risks. Current environmental applications include soil improvements for water and nutrient

retention, treatment of water and wastewater, and dietary supplements for farm-raised animals. Clinoptilolite use in aquaculture has focused on ammonia removal for aquaria and other freshwater culture systems.

Our PD/A CRSP research will adapt clinoptilolite's capability to sequester/release ammonia nitrogen in order to provide a more socially acceptable way to integrate animal manures with pond fertilization. Crushed clinoptilolite, enriched with manure-derived ammonia, can fertilize ponds without additional oxygen demands or unnecessary organic inputs. Clinoptilolite can also capture soluble nitrogen and phosphorus (by flocculation) from discharged pond water, facilitating the recycling of on-farm nutrients which would otherwise degrade downstream environments.

The clinoptilolite research will take place at AIT within the Agriculture, Aquatic Systems and Engineering Program in the School of Environment, Resources and Management during the spring and summer of 2002. AIT faculty Amrit Bart is serving as host country principal investigator, with Yang Yi providing technical and logistical assistance. Laboratory and tank experiments will be conducted during 2002 by Yuan Derun, a doctoral student within the aquaculture program. AIT will also provide important logistical support for the pond dynamic workshops.

The pond dynamic workshops are designed to teach through demonstrations, presentations, and informal discussions how to 1) manage ecological factors (e.g., nutrient and light availability) which control natural food production in fertilized ponds, 2) identify ecological benefits/limitations of organic versus inorganic fertilizers as related to pond dynamics, 3) understand pond characteristics (e.g., pond location, pond depth and area, source water, bank stabilization, and use of hapas and cages) which can affect fertilization decisions, 4) evaluate common methods for determining fertilization requirements (e.g., fixed-input, computer modeling, algal bioassays), and 5) use an algal bioassay test kit for identifying pond- and time-specific pond fertilization requirements. The portable algal bioassay kit, designed and tested through PD/A CRSP research previously conducted at AIT, requires no water chemistry, electricity or computers, and may be assembled using local materials.

Workshops are planned for June and July 2002, and will be given by Chris Knud-Hansen at five locations where the PD/A CRSP and/or AIT have established formal connections: AIT, Bangkok, Thailand; Cambodia Dept. of Fisheries, Phnom Penh, Cambodia; Regional Development Coordination for Livestock and Fisheries, Savannakhet, Laos; Research Institute for Aquaculture No. 1, Bac Ninh, Vietnam; Research Institute for Aquaculture No. 2 and the University of Agriculture and Forestry, Ho Chi Minh City, Vietnam. The workshops will each have about 15 to 20 participants including university students and faculty, government extension officers, and provincial fisheries staff. Algal bioassay test kits will be available for workshop participants and subsequently left with the host country institutions.


Email contact information:  
 Ted Batterson: [batters2@msu.edu](mailto:batters2@msu.edu)  
 Don Garling: [garlingd@msu.edu](mailto:garlingd@msu.edu)  
 Chris Knud-Hansen:  
[cknudhansen@worldnet.att.net](mailto:cknudhansen@worldnet.att.net)  
 Amrit Bart: [bart@ait.ac.th](mailto:bart@ait.ac.th)  
 Yang Yi: [yangyi@ait.ac.th](mailto:yangyi@ait.ac.th)

## PD/A CRSP Expands to Vietnam, Nepal, Bangladesh

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funded with international aid. However, many NGOs have been promoting aquaculture development independently through their own extension networks, with little involvement of academic and governmental institutions. The first step of CRSP work in Bangladesh is to bring different NGOs and academic institutions together through both on-station and on-farm comparative trials of fertilization regimes prescribed by

NGOs, extended by the Bangladesh Agricultural University, and developed by CRSP. Finally, an appropriate fertilization strategy will be developed to assist small-scale farmers.

With this expansion of the PD/A CRSP, we believe that the successful models of the PD/A CRSP in the past two decades will help aquaculture development in South and Southeast Asia regions. 



## New Researchers Join CRSP Projects in Asia

by Jeff Burreight

The Tenth Work Plan highlights an unprecedented amount of research from countries new to the PD/A CRSP. These studies, experiments, and activities are accompanied by a host of new investigators who will bring a refreshingly broad range of cultural and educational backgrounds to the program. Below are brief introductions to some of the new Principal Investigators conducting research in Asia under the Tenth Work Plan, as well as a table (facing page) with a complete listing of all Tenth Work Plan investigations in Asia sorted by country. Please also refer to other articles in this issue of *Aquanews* (p. 1) to learn more about some specific new investigations in Asia.

**Le Thanh Hung** is the Senior Lecturer of the Faculty of Fisheries at the University of Agriculture and Forestry in Vietnam. He has experience in freshwater aquaculture systems in the tropics and fish nutrition and feeding with a focus on catfish. Under the Tenth Work Plan, he will be collaborating with C. Kwei Lin, Yang Yi, and Jim Diana on a study in Thailand and Vietnam that will explore ecologically sound



*Le Thanh Hung*

stocking and management strategies for cove aquaculture, enhancing fish production and economic returns and establishing management systems that are more ecologically sustainable than current cage culture.

**Le Thanh Luu** is the Vice-Director of the Research Institute for Aquaculture #1, Vietnam, with over 25 years experience in the aquaculture field. He has experience in small-scale aquaculture in brackish and freshwater ecosystems with attention to many aspects including different culture systems, resource management,



*Le Thanh Luu*

watershed areas in Thai Nguyen and provide an objective means for planners to determine potential aquaculture development in the province.

**Nguyen Thanh Phuong** received his Ph.D. in Agricultural Sciences with a specialization in Aquaculture and Aquatic Environments from the Institut Nationale Polytechnique de Toulouse, France. He is a consultant for the International Development Research Centre (IDRC) studying community-based aquaculture and mangrove integrated farming for the sustainable use of resources in the Ca Mau province of Vietnam. Under the Tenth Work Plan, he will be collaborating with C. Kwei Lin, Yang Yi, and Jim Diana on a study in Thailand and Vietnam that explores



*Nguyen Thanh Phuong*

the environmental impacts of catfish cage culture in Vietnam.

**Md. Abdul Wahab** is currently a Professor of Limnology and Water Quality & Environmental Impacts at the



*Md. Abdul Wahab*

aquaculture education and training, and fish nutrition. He will be collaborating with C. Kwei Lin, Yang Yi, and Jim Diana on a study in Thailand and Vietnam that will survey

Bangladesh Agricultural University (BAU) with over 20 years of experience in teaching and research. He was also the founding head of the Department of Fisheries Management at BAU in 1996, and he was responsible for developing the new department's curriculum and structure. He will now join the CRSP for the first time, working in Bangladesh and Thailand with Kwei Lin, Yang Yi, and Jim Diana on a study and activity that will evaluate and compare different fertilization regimes used for aquaculture in Bangladesh and recommend the best systems to small-scale rural farmers.

**Madhav Shrestha** received an M.Sc. and Ph.D. from AIT, and his theses coincided with CRSP research and were supervised during their respective times by Chris Knud-Hansen and C. Kwei Lin. He was also involved with the CRSP in 1996-1997 when he worked as postdoctoral researcher. Currently, he is an associate professor at the Institute of Agriculture and Animal Science, Nepal. He will be collaborating with C. Kwei Lin, Yang Yi, and Jim Diana on an experiment in Nepal and Thailand to determine the composition of foods consumed by Nile tilapia and the optimal ratio of grass carp to Nile tilapia and polyculture.



*Madhav Shrestha*

**Steven Brechin** is an Associate Professor of Environmental Sociology at the University of Michigan with a focus on International Environmental Issues. He is a first-time CRSP collaborator studying



*Steve Brechin*

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## New Asia Partners

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abandoned and converted shrimp ponds in Thailand and their potential for alternate usage along with Amrit Bart and Jim Diana.

**Mali Boonyaratpalin** is a fish nutritionist with the Department of Fisheries of Thailand where she advises the government on policy matters concerning fish feed and nutrition. She continues to conduct research on problems that address both productivity and environmental issues such as healthy feed and low pollution diets. She received her Ph.D. in Fisheries from Auburn University in 1978. She will be studying the effects of pond age on bottom soil quality with CRSP researcher Claude Boyd under this work plan.



Mali Boonyaratpalin

**Ted Batterson** is a Professor in the Department of Fisheries and Wildlife at Michigan State University with a focus on water quality, limnology, and fertilization. He has had prior CRSP experience with his work on the Indonesia and Thailand Projects from 1985 to 1993, on which he worked closely with fellow CRSP Principal Investigator Christopher Knud-Hansen.



Ted Batterson

**Donald Garling** is also a Professor in the Department of Fisheries and Wildlife at Michigan State University. He received his Ph.D. in Zoology from Mississippi State University. A member of the PD/A CRSP Technical Advisory



Donald Garling

## CRSP Co-Sponsors WAS China Conference

**W**orld Aquaculture 2002, hosted by the China Society of Fisheries (CSF) and the World Aquaculture Society (WAS), will take place 23 to 27 April 2002 in Beijing, China. The event is co-sponsored by the PD/A CRSP.

The conference will feature the annual meetings of WAS and CSF, as well as numerous informational sessions ranging from training and education to fish nutrition. The program of the conference will cover most species involved in aquaculture around the world, as well

as addressing the issues and concerns facing the aquaculture industry.

The World Aquaculture meetings have become major events with well over 3,000 people attending from over 90 countries.

For more information about the conference, please visit the WAS website located at <www.was.org> or write to:

World Aquaculture 2002, Conference

Manager, 2423 Fallbrook Place, Escondido, CA 92027.

The early registration deadline is 28 February. 🐟



Committee for five years starting in 1982, he also co-authored one of the chapters in the book *Principles and Practices of Pond Aquaculture: A State of the Art Review*, published by the CRSP in 1983.

**Christopher Knud-Hansen** is currently the president of Aquatic Solutions, a consulting company for lake management and aquaculture pond systems, in Boulder, Colorado. He has previously been an associate professor and a visiting professor in his

over 25 years of experience. He worked on the Indonesia and Thailand

Projects with Ted Batterson from 1987 to 1993, and he also authored a practical handbook for the CRSP titled *Pond Fertilization: Ecological Approach and Practical Application* in 1998.

Under the Tenth Work Plan, Batterson, Garling, and Knud-Hansen will be working together with Amrit Bart on an experiment in Thailand and an activity in Bangladesh, Cambodia, Laos, Thailand, and Vietnam. The activity's aim is to spread existing scientific knowledge generated by the PD/A CRSP on how to improve the predictability of pond management and productivity through an understanding of pond dynamics by teaching the host country universities, governments, and aquaculture extension personnel how to practically apply ecological principles to improve pond fertilization efficiencies. The experiment will attempt to adapt existing technologies

using natural clinoptilolite zeolites in an effort to provide a more socially acceptable and efficient way to integrate animal manures in pond fertilization, conserve and recycle on-farm resources, and lessen environmental impacts. 🐟



Chris Knud-Hansen

## Stocking Fish in Nepal: The Real-World Version

by Amrit Bart

A recent visit to Nepal was intended primarily to purchase supplies and materials in Kathmandu and to stock previously delivered fish fry from AIT in Thailand in the ponds at the Tarahara research station for a tilapia study that was already two months delayed. The tasks, although seemingly simple, turned out to be everything but...

My trip to the market turned out to be an adventure. I was looking to purchase a "Hac Kit" for water quality analysis for the study. The vendor explained that any reagent containing hazardous material was unavailable because of the recent tightening of airline shipping controls. Besides, replacement reagents were difficult to import since they came from the US. It took us three days to settle on a combination of tools to be able to carry out six water quality analyses. A dissolved oxygen meter was purchased from an Indian supplier, who forgot to enclose the probe along with the meter. When we enquired, the vendor was unavailable and we were stuck with a DO meter without a probe. At this point I realized that I am more than a little spoiled by the ease with which we can purchase scientific material and supplies in Bangkok. It took some effort to find a compatible probe through other local vendors.

Stocking of fish in the pond was meant to be an even simpler task, which also turned out not to be the case. The ponds that were intended to be 100 m<sup>2</sup> were actually 200 m<sup>2</sup>. In order to have the appropriate stocking density we therefore had to divide these ponds in two. After dividing six ponds into two parts each, we harvested the 30-day-old fry that three weeks before were stocked in separate ponds. To our dismay less than 3,000 were recovered from 12,000 stocked. We also found that handling these fish at temperatures between 19 to 20°C resulted in a large number of unexpected deaths. This required the ponds to be further split in 3 in order to keep the same stocking density (3 fish/m<sup>2</sup>).

This project is the first of its kind in Nepal. Discussions with the Directors of the Nepal National Research Council revealed that they have had other CRSP-related activities, and there is potential to involve PD/A CRSP in other integrated research activities.

## FIELD NOTES ON THE HEADLINE NEWS

Evening curfews, frequent checkpoints, and sidewalks lined with uniformed and plain clothed military personnel with loaded assault rifles in their hands were a common site in Kathmandu, traditionally remembered as "a city of Hindu temples and Buddhist stupas." The recent massacre of the Royal Family coupled with an uprising of Maoist rebels that have gone on a shooting rampage killing police and whoever else got in their way has shaken this country. "All my years in Kathmandu I have never experienced anything like this," explained one of our Nepalese Research Associates. Tarahara, one of the new CRSP aquaculture research sites southeast of Kathmandu, is in one of the affected areas.

Gnawing at my subconscious during the trip was my concern that domestic and international air transportation might be affected as a result of the Mao activities, and I was fearful of getting caught in a further escalation of the civil unrest.

The laborers and drivers working in the station in Tarahara feel that these national events have little relevance to their day-to-day lives. They seem interested in neither politics nor the Royal Family's affairs; they were happy we were there to help them produce cheap fish so that they can provide some protein for their children's plates.

*CRSP researcher Amrit Bart, at the Asian Institute of Technology, is a principal investigator on the Product Diversification Research activity "Transfer of production technology to Nepal for Nile tilapia, Oreochromis niloticus," collaborating with A.K. Rai at the Regional Agricultural Research Station at Tarahara, Nepal.* 🐟

## Goings-On in the Pond

**Claude Boyd**, CRSP researcher at Auburn University, used CRSP information in a workshop in on Inland Shrimp Farming on 23-24 October 2001 in Guayaquil, Ecuador. Boyd was asked to arrange a session on warmwater pond aquaculture for the Bioengineering Section of the American Fisheries Society Symposium to be held in Portland, Oregon, in 2002. He is also planning a conference titled "Agriculture and the Environment in Alabama" to be held in November 2002.

**William Camargo**, CRSP researcher at Southern Illinois University at

Carbondale working on the Peru Project, was invited to Costa Rica to write a proposal for CYTED (Science and Technology Iberoamerican Organization) with other Latin American colleagues to create an Iberoamerican aquaculture nutrition network.

Konrad Dabrowski, CRSP researcher at Ohio State University, presented a seminar on "New development in diet formulation for larval fish" in La Molina, Peru, on 12 November 2001. Approximately 100 people, including faculty,

students, and government employees, attended the seminar.

We welcome a new addition to the Board of Directors. **Ron Jones** is currently the Director of the Southeast Environmental Research Center and a professor in the Department of Biological Sciences at Florida International University. An active researcher for over 25 years, Jones is currently studying water quality, and his interests lie in the biogeochemistry of nitrogen and phosphorus. 🐟



Ron Jones, new PD/A CRSP Board member



## Graduate Student Profile: Kom Silapajarn

by Mary Nidiffer

CRSP graduate student Kom Silapajarn attributes his interest in the aquacultural sciences to his childhood love of the sea. Prompted by this early interest, Silapajarn was led to further studies of fisheries, which recently brought him to the PD/A CRSP.

Silapajarn is currently attending Auburn University in pursuit of a Ph.D. Auburn's excellent reputation in the areas of fisheries and aquaculture lured him to the program, as did the prospect of working with CRSP researcher Dr. Claude Boyd. "Hav[ing] the chance to study under the direction of Prof. Boyd makes me most proud," said Silapajarn.

Silapajarn began working with the CRSP in July 2001 and is now involved in Boyd's Pond Dynamics investigation, "Effects of Pond Age on Bottom Soil Quality," which connects Auburn University and Kasetsart University in Thailand, where Silapajarn studied Fisheries Biology as an undergraduate student. The four objectives of this investigation are to determine relationships between pond age and other key bottom soil quality variables; to evaluate the neutralizing value, particle-size distribution, and calcium and magnesium content of liming materials normally used by fish

farmers in Thailand and use the data on soil characteristics and liming materials to improve the liming technique; to compare different methods of pond soil organic matter analyses; and to prepare recommendations on pond bottom soil management that consider changes in soil quality in ponds.

Silapajarn will bring his expertise to the project from having over 20 years of experience as a fisheries scientist. He says that the results from this study could bring about better understanding of water and soil pond dynamics and ultimately improve the information required for pond management.

Silapajarn recalls that developing tropical mollusk hatchery techniques in Thailand has been one of the most challenging things that he has ever done. "Molluscan hatcheries are new businesses in tropical countries like Thailand. It started about fifteen years ago and I had a chance to be part of the pioneer group working on this project," says Silapajarn.

Although Silapajarn's project will not be complete until April 2003, he is already looking forward to life after graduation, when he hopes to bring his knowledge of aquaculture and pond management back to Thailand. He is enthusiastic about the many factors that make Thailand well suited for

aquaculture, such as an ideal temperature range for the rapid growth of most aquatic species, tropical weather rarely troubled by severe storms, and muddy soils suitable for pond construction. Silapajarn mentions that a major obstacle facing aquaculture development in Thailand seems to be an insufficiency in resource management and planning. At the same time, however, he notes that Thai people have a

long history of prosperous work in the aquaculture industry.

Silapajarn wishes to eventually teach at the university level in Thailand. When he isn't working with the CRSP, Silapajarn enjoys traveling abroad to meet different people and see different cultures. 🐟



*Kom Silapajarn, PD/A CRSP graduate student at Auburn University*

## Oldways Conference to Seek Balanced Solutions for Fish Farming

The Water Farming-World's Future Conference, the first public event of the Water Farming Initiative (WFI), will be held 12 to 14 February 2002 at the Renaissance Harborplace Hotel in Baltimore, Maryland, by the Oldways Preservation and Exchange Trust.

"The idea of presenting reality in a scientific context is important," said Cliff Goudey, Director of the Center for Fisheries Engineering Research at MIT Sea Grant and co-chair of the Scientific Advisory Committee for the Conference. "Most of the information about aquaculture in the media seems to come from vocal opponents, and industry's responses to these challenges often doesn't get taken seriously. The Oldways approach has great potential as they don't have a clear stake on either side, and they have a track record in making progress in controversial areas."

This science-based, solutions-driven conference will feature experts from science, academic, government, and industry who will present information on a variety of aquaculture issues. Moderated discussion and question/answer sessions will be held to identify obstacles and areas of agreement on baseline data for water farming.

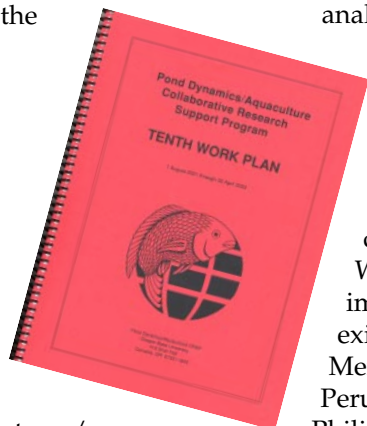
"It's time to focus on solutions," said Dun Gifford, President of Oldways Preservation & Exchange Trust, a Boston-based, nonprofit educational organization. "It is more and more clear that 'clean water farming' is a sound environmental partner for soil farming. With this conference we hope to bridge differences by encouraging calm negotiation and discouraging divisive argument."

For more information or to register for the conference, please visit the Oldways Preservation website located at <[www.oldwayspt.org](http://www.oldwayspt.org)>. 🐟

## Tenth Work Plan Available

Get yours while it's hot... The new *Tenth Work Plan* is a whopping 148-page document describing the activities to be conducted by PD/A CRSP researchers from 1 July 2001 through 30 April 2003 under the program's current USAID grant.


Tenth Work Plan investigations will once again address a wide range of research themes including pond dynamics; feeds and fertilizers; reproduction control; aquaculture systems modeling; new aquaculture systems/



new species; effluents and pollution; appropriate technology; GIS: planning, policy, and global data analysis; marketing and economic analysis; adoption/diffusion; food security; and product diversification. Work will be implemented at existing sites in Mexico, Honduras, Peru, Kenya, the Philippines, and


Thailand, as well as via collaborations with researchers and institutions in other locations, including El Salvador, Nicaragua, Panama, Brazil, South Africa, Bangladesh, Cambodia, Laos, Nepal, and Vietnam.

The *Tenth Work Plan* can be found online in both HTML and PDF formats at <pdacrsp.orst.edu/pubs/work\_plans>. Hard copies are also available upon request by email from mcelweek@ucs.orst.edu or from:

Publications  
Pond Dynamics/Aquaculture CRSP  
418 Snell Hall  
Oregon State University  
Corvallis OR 97331-1643 USA 

## Nineteenth Annual Administrative Report Is Out

Have you been wondering what the CRSP researchers have been up to for the past year? It's finally time to put those curiosities to rest and order the newly released *Nineteenth Annual Administrative Report*. This publication features summaries of and abstracts from the technical reports, as well as an overview of the program's activities and accomplishments during the period 1 August 2000 to 31 July 2001.

This report will be available in the near future at the PD/A CRSP website at <pdacrsp.orst.edu/pubs/annual\_reports>. Until then, printed copies can be ordered by sending an email to mcelweek@ucs.orst.edu or by mailing a request to the address listed above. 



### Tod Man Pla (Thai Fish Cakes)

5 shallots, chopped	1 tablespoon salt	2 pounds white fish, diced
4 cloves garlic, chopped	1 tablespoon ground pepper	vegetable oil for deep-frying
3 red chiles, seeded and chopped	4 dried kaffir lime leaves, crushed	cucumbers, pineapple, tomatoes for
3 tablespoons chopped cilantro	handful string beans, sliced into thin	garnishing
1/2 tablespoon shredded lime rind	rounds	

#### Directions:

Finely pound together the shallots, chiles, cilantro, lemongrass, lime rind, galangal, salt and ground pepper. Let marinate for 30 to 40 minutes, or overnight in the refrigerator.

Mince the marinated fish in a food processor and add, along with kaffir lime leaves and string beans, to marinated mixture. Knead until sticky enough to roll into balls.

Roll 1 tablespoon of the fish mixture into a ball. Make all the fish into balls in the same way. The fish balls can be stored in the refrigerator for 1-2 days.

To cook, flatten the fish balls into 1/2-inch disks by pressing them gently on a flat surface. Then deep-fry 5 or 6 at a time for 2-3 minutes in a wok or deep-fryer. Take them out with a slotted spoon and drain on paper towels. Transfer to a serving plate, garnishing with cucumbers, pineapple and tomatoes. Serve with a separate small dish consisting of sweet chili sauce mixed with thinly sliced cucumber wedges and crushed peanuts. Serve hot or warm as a snack. (*recipe modified from one posted on recipehound.com*)





# Notices of Publication

These Notices of Publication announce recently published work carried out under PD/A CRSP sponsorship. To receive a full copy of a report, please contact the author(s) directly unless it is otherwise noted.

## CRSP Research Report 02-176

### TILAPIA MARKETS IN THE AMERICAS, 2001 AND BEYOND

Kevin Fitzsimmons, Ph. D.  
University of Arizona  
2601 E. Airport Drive  
Tucson, Arizona, USA 85706

The total market for tilapia in the Americas was almost 300,000 metric tons of live weight fish in 2000. Production in the Americas was approximately 257,000 mt and the US imported fillets and frozen tilapia representing more than 30,000 mt of harvested fish from Eastern Hemisphere producers. Expanding demand sufficiently to absorb the rapidly expanding supply has become a critical task to support the current prices for tilapia products.

During the 1980's and 90's several different seafood publications declared tilapia to be the "new fish of the year". Since then tilapia has become one of the more popular seafood entrees in the Americas. As high quality tilapia products began to appear, its recognition as a quality seafood product has increased from Canada to Chile. Tilapia are not truly a new product in the Americas. Mossambique Tilapia, *Oreochromis mossambicus* were first introduced to the Caribbean by C.F. Hickling in 1947. They were quickly introduced throughout Central and South America. *O. aureus*, *O. niloticus* and several hybrid red strains were introduced in the 1960's and 1970's.

Mexico currently produces and consumes (~100,000 mt) more tilapia than any other country in the Americas. The US is the next biggest consumer (>90,000 mt) but just a minor producer (<9,000 mt). Brazil and Cuba are the next largest producers/consumers. Costa Rica, Honduras, Ecuador, and Jamaica are the major exporting countries. Each has a well-developed infrastructure of production, processing and export, with Honduras being the most recent. Each of these exporting countries has some domestic consumption, but the relatively small population base and high level of investment required for large-scale production has driven them to look toward US and European markets.

As supply continues to expand, consumer demand must also increase. "Push" and "pull" strategies are used by marketers to increase demand. Examples of these techniques are described as well as advertising and sales tools. One example of the efforts made by some producers to increase demand was the creation of a marketing entity. Several of the largest tilapia producers and importers/exporters to the U.S. have jointly funded the Tilapia

Marketing Institute (TMI). The TMI has begun a broad ranging program to increase U.S. demand for tilapia products. The Institute is pursuing a generic campaign to increase demand for all product forms of tilapia.

This abstract was excerpted from the original paper, which was published in D. Meyer (Editor), *6to. Simposio Centroamericano de Acuicultura Proceedings: Tilapia Sessions, 22-24 August 2001*. Tegucigalpa, Honduras, pp. 72-81.

## CRSP Research Report 02-177

### SUPERMARKET OUTLETS FOR TILAPIA IN HONDURAS: AN OVERVIEW OF SURVEY RESULTS

Nelson Omar Fúnez, Ivano Neira and Carole Engle  
University of Arkansas at Pine Bluff.  
Department of Aquaculture and Fisheries.  
Pine Bluff, Arkansas 71611. United States

Tilapia culture was initiated in Honduras in the late 1970's. In the last decade, tilapia production in Honduras has grown rapidly because of market expansion for fresh tilapia fillets in the United States. Domestic markets would provide stability by offering additional market alternatives hence reducing risks associated with one target market. A comprehensive study was designed to characterize existing supermarket channels for tilapia in Honduras and to identify strategies to further develop supermarket outlets in Honduras for farm-raised tilapia. A survey instrument was designed to elicit information on the types of fish and seafood sold, prices, availability of tilapia, and supermarket buyers' attitudes towards a variety of attributes of tilapia. The survey showed that tilapia is a well-known product in Honduran supermarkets. Overall, 50% of supermarket managers responded that they were either somewhat or very likely to sell tilapia in the next year. However, the lack of demand, freshness, and seasonal availability were mentioned as primary reasons for not selling or having stopped selling the product. These results suggest that, if tilapia farmers can combine adequate marketing strategies such as intense advertisement campaigns with availability of high quality tilapia, it maybe possible to further develop the domestic market for tilapia in Honduras.

This abstract was based on the original paper, which was published in D. Meyer (Editor), *6to. Simposio Centroamericano de Acuicultura Proceedings: Tilapia Sessions, 22-24 August 2001*. Tegucigalpa, Honduras, pp. 82-86.

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# Notices of Publication (cont.)

## CRSP Research Report 02-178

### MARKETS FOR TILAPIA (*Oreochromis sp.*) IN NICARAGUA: A DESCRIPTIVE ANALYSIS OF RESTAURANTS, SUPERMARKETS AND STANDS IN OPEN MARKETS

Ivano Neira, and Carole Engle  
University of Arkansas at Pine Bluff,  
Department of Aquaculture and Fisheries.  
Mail Slot 4912, 1200 N.  
Pine Bluff, Arkansas 71601, USA

No marketing studies, either qualitative or quantitative, have been done on the potential to develop a domestic market for farm-raised tilapia in Nicaragua. Domestic markets would provide stability by offering additional market alternatives that reduce risks associated with one target market. A comprehensive study was conducted in Nicaragua of potential buyers of farm-raised tilapia: restaurants, supermarkets, and open-stands market vendors. Three survey instruments designed for marketing studies in Honduras were used as a basis for the Nicaraguan studies. Approximately 20% of the restaurant managers, 66% of the stands in open-air markets, and 23% of the supermarkets sold tilapia. Restaurants, supermarkets, and open market vendors generally had positive attitudes towards tilapia. In the Northwest region, few people were familiar with tilapia. In the South-Central region, people had positive attitudes toward tilapia, but were afraid of contamination of tilapia from Lake Managua. It may be important for tilapia growers to differentiate farm-raised from wild-caught tilapia. According to the managers interviewed, consumers perceive tilapia as a freshwater fish caught in a polluted lake, and are unaware of the advantages of a high quality farm-raised fish. Tilapia farms and processors in Nicaragua will need to guarantee and ensure the flavor, quality, and safety of their product and promote these attributes. Broad-based consumer education and labeling programs may be needed to assist consumers to differentiate between farm-raised and wild-caught tilapia.

This abstract was based on the original paper, which was published in D. Meyer (Editor), *6to. Simposio Centroamericano de Acuicultura Proceedings: Tilapia Sessions*, 22–24 August 2001. Tegucigalpa, Honduras, pp. 87–91.

## CRSP Research Report 02-179

### TECHNOLOGY FOR SUCCESSFUL SMALL-SCALE TILAPIA CULTURE

Daniel E. Meyer  
Panamerican Agriculture School,  
Zamorano, Honduras

Tilapia are tropical African fish that adapt well to the artificial conditions of the culture environment. These fish are hardy and resistant to diseases. They gain weight quickly at temperatures between 25 and 30°C and they reproduce on the farm without special management or infrastructure.

Tilapia feed primarily on algae, other small organisms, and organic matter present in pond water and sediments. They quickly learn to consume artificial diets and can adapt to saltwater. Tilapia flesh is firm and white, and has an excellent flavor.

In spite of all the advantages of tilapia, most small-scale fish culture projects established in Central America during the past 30 years have failed. These failures are often related to several fundamental errors committed when establishing objectives for rural development projects, in the site selection process for building new ponds, and in the implementation of fish culture projects in rural areas.

In many instances the aim of the extension or development program is to improve the nutritional status of the rural family by providing techniques for culturing fish. Fish are an excellent source of animal protein for humans. Historically, the emphasis on improved family nutrition has not been sufficient motivation to make tilapia culture a part of traditional agriculture production in rural Central America. There has been too little emphasis on establishing fish culture to improve the economic status of rural families in the region.

We often make the mistake of constructing ponds at high elevation or in situations lacking adequate water resources. A warm climate and a year-round supply of adequate water are requirements for successful culture of tilapia.

Often farmers are unable to obtain fingerlings to continue culturing tilapia in subsequent cycles following the first harvest. Many extension agents promoting tilapia culture do not have adequate knowledge to advise and assist farmers in this new technology. Most farmers do not have the knowledge and skills to manage the use of basic inputs (fertilizers and feeds) for successful fish culture.

Small-scale tilapia production is not a panacea for rural poverty. Fish culture can provide high quality animal protein to improve the diet of rural families. The sale of fish can also contribute to improving the economic status of rural families in the region.

This abstract was excerpted from the original paper, which was published in D. Meyer (Editor), *6to. Simposio Centroamericano de Acuicultura Proceedings: Tilapia Sessions*, 22–24 August 2001. Tegucigalpa, Honduras, pp. 97–106.

# Notices of Publication (cont.)

## CRSP Research Report 02-180

### PRODUCTION AND MARKETING STRATEGIES USED BY SMALL AND MEDIUM-SCALE FISH FARMERS IN HONDURAS: PRODUCTION STRATEGIES CHARACTERIZING SMALL AND MEDIUM-SCALE TILAPIA FARMS

José A. Martínez Ayala  
Department of Agribusiness  
Panamerican School of Agriculture  
El Zamorano, Honduras

Joseph J. Molnar  
Department of Agricultural Economics and Rural Sociology  
Auburn University, Alabama USA

Freddy Arias  
Department of Agribusiness  
Panamerican School of Agriculture  
El Zamorano, Honduras

Tom Popma  
Department of Fisheries and Allied Aquacultures  
Auburn University, Alabama USA

This report examines samples of farms from Honduras departments have and do not have tilapia ponds as part of their farming systems. Data were obtained through personal interviews with 128 farmers, including 64 tilapia producers, in five departments: Olancho, Intibuca, El Paraíso, Francisco Morazán, and Santa Bárbara.

To obtain information about farms without tilapia, farmers were selected at random within the same community as the identified tilapia producers. Interviews were conducted in communities where the small-scale farmers with production of tilapia were located (Casley and Kumar 1988). The data are intended to constitute a representative sample of the population of the Honduran small aquaculture farmers in these departments. The analysis presents basic comparisons of landholding, farm, and personal characteristics of tilapia producers with the mirror sample of the farmers without tilapia. The analysis profiles basic differences between the two categories of farms, the operators, and their households. Younger farmers were more likely to become involved with tilapia farming. Those farmers more dedicated to their work inside their farm from which they obtain all their income, and whose principal occupation is being a farmer, were more inclined to adopt farming of tilapia. Farmers that use of their land more intensively and who dedicate themselves more to the farming of basic grains were more likely to adopt the farming of tilapia. Since Honduran small farmers tend to be a depressed segment economically, they tend to satisfy first

their subsistence necessities by maximizing the use of their resources. The financing for both tilapia growers and nongrowers tends to be a limiting factor because more than 80% of the population works without financing, a clear barrier to farm investments. Tilapia growers participated more in development projects.

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## CRSP Research Report 02-181

### LEEVE POND DESIGN MODEL

E.W. Tollner  
University of Georgia  
Athens, Georgia, USA

The levee pond model is an Excel® spreadsheet that computes a volume balance on a levee pond. The model is organized into the following pages: Directions and overview, table of contents, input, pond model, results and principal spillway. The design is based on answers to 15 key questions on the Input page. Each question has guidance in the form of a comment that becomes visible when clicked upon. The model computes a volume balance on the pond as shown in a drawing on a "Drawings" page. The model is designed to assist competent NGO personnel in helping small to medium producers.

After completing the initial inputs, proceed to the "Results" page. Maximum, Average and minimum pond volume changes based on net Inflow and net Outflow are computed. The pump in rate with zero pump out is used to determine the water balance required to satisfy evaporation, seepage and rainfall. One iterates on the pump in rate to achieve the desired near zero target for net outflow volume change. Volume changes based on net outflow should be zero to positive for the pond not to lose volume. Values on the results page are copied from the "Pondmodel" page that shows detailed computations. Most users would not be concerned with the computational details.

Volume changes based on net inflow should approach the volume change target set based on the level of management anticipated. After achieving the initial water balance, one adjusts both the pump in and pump out rates to achieve the desired volume change targets. The pump in rate exceeds the pump out rate by the initial volume balance in order to preserve the initial volume balance. Adjust these inputs until the desired volume changes are achieved based on net inflow. One may then proceed to the "Principal SW" page for a pipe-riser spillway design.



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# Notices of Publication (cont.)

The intent of the levee pond model is to develop a complete volume balance on a pond with a recirculation target, which may range from 0 to any number of volume changes per month. The recommended procedure is to first set the output pump rate to zero. One may then determine the inflow pump rate necessary to balance seepage, rainfall and evaporation. In a given climatic region, based on net monthly net outflow as shown on the "Pondmodel" page. Monthly rainfall and evaporation are used in the monthly balances. Soil seepage is included, which should be determined from a soils analyses or seepage tests. Volume balances on net input should be near zero to have a sustainable pond. Next one may determine the pump out rate and pump in rates to meet the volume change target. This process begins by inputting a trial pump out rate. Input the initial pump in rate determined above, plus the trial pump out rate for the new trial pump in value. The volume balance based on net output should be near the volume change target. Maximum, average and minimum volume ratios are reported, based on monthly ratio computations. The principal spillway design is included. There is no watershed supply; therefore an emergency spillway was not included.

If springs or stream flow are not adequate for your desired pond size and management, one may wish to consider a watershed pond or a hillside pond for water harvesting. Another model, "Hondurascatchmentpond" is available for this application. Water harvesting is dependent on diverting runoff from a watershed collection zone to the pond. The design of the watershed pond or hillside pond is very site specific. You are strongly encouraged to consult with a competent pond designer. Ask a local NGO representative for help.

Experience suggests that valleys with available springs are the best levee pond candidates. Valleys frequently have soils of adequate clay for sealing purposes. Elevations above 1000 m become problematic for finding springs. In Latin America, there seems to be a correlation between both coffee and rice production with water availability. Areas with nearby hardwood forests tend to bode well for water availability.

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## CRSP Research Report 02-182

### TRAINING AND TECHNICAL ASSISTANCE IN WARM-WATER FISH CULTURE

Thomas J. Popma  
Department of Fisheries and Allied Aquacultures  
Auburn University, Alabama, USA

Daniel E. Meyer  
Escuela Agricola Panamericana  
Zamorano, Honduras

A central issue for aquaculture development in Honduras is fingerling supply. Previous PD/A CRSP research reported that farmers in remote places found that fingerlings were difficult to obtain but did not consider this sufficient reason for withdrawing from fish farming. The Zamorano PI and his technician in this project confirmed that the Comayagua research station "El Carao" was not a reliable supplier of fingerlings for producers. Private fingerling producers are few and generally geared to supply large-scale commercial operations. The overriding objective of our work was to provide technical assistance and training to current and potential fingerling suppliers to small- and medium-scale tilapia producers in Honduras.

A Peace Corps program of technical support to fish farmers was possibly the most focused on-farm assistance to small-scale fish farmers in Honduras, but this program ended in 1995. The national extension program in aquaculture has a presence in many regions, but the effort is fragmented and under-funded. A large number of non-governmental organizations (NGOs) have been active in rural development projects in Honduras, including several promoting fish farming, but expertise in this activity is often insufficient to provide critical technical information required for proper pond management.

During November 1999, we consulted with 13 representatives of national and international, government and non-government organizations. From these consultations, a strategy and timetable were developed for implementing technical assistance and training of fingerling suppliers and technicians working with NGOs currently, or potentially involved in small- and medium-scale fish culture development. At least 33 small- and medium-scale tilapia producers (each with 150 - 12,000 m<sup>2</sup> of water surface) and 26 restaurants were subsequently interviewed by the technical team to assess the production and marketing demands for tilapia in Honduras. With the collaboration of a local NGO, we invited representatives of NGOs with actual or potential interest in aquaculture development to a one-day seminar to describe opportunities and constraints for family-scale fish culture in Honduras. The Zamorano team continues to identify and provide technical assistance to regional fingerling producers and organizations involved

## Notices of Publication (cont.)

in aquaculture extension. During the life of this activity three technical workshops were provided by Zamorano and Auburn for actual and prospective fingerling producers and extensionists. More than 30 publications on fingerling production and pond management practices have been incorporated in a web-based information system developed by a local NGO, primarily in response to needs of local NGOs.

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### CRSP Research Report 02-183

#### WEB-BASED INFORMATION DELIVERY SYSTEM FOR TILAPIA FOR SUSTAINABLE DEVELOPMENT OF AQUACULTURE IN HONDURAS

Brahm P. Verma  
Biological and Agricultural Engineering  
University of Georgia  
Athens, Georgia, USA

Daniel Meyer  
Department of Biology  
Escuela Agricola Panamericana El Zamorano  
Zamorano, Honduras

Tom Popma  
Department of Fisheries and Allied Aquaculture  
Auburn University, Alabama, USA

Joseph J. Molnar  
Department of Agricultural Economics and Rural Sociology  
Auburn University, Alabama, USA

E. William Tollner  
Biological and Agricultural Engineering  
University of Georgia  
Athens, Georgia, USA

The project was focused on identifying and developing methods to create an enabling environment for sustainable development of aquaculture on Honduras. Honduras has large network of NGOs operating at village level, an exceptional educational institution in Zamorano with commitment to extend training and knowledge in aquaculture and an established in-country sustainable development electronic network operated by Red de Desarrollo Sostenible-Honduras (RDS-HN). We develop the concept of training the trainers (NGOs working with farmers at village level) by bringing together Zamorano and RDS-HN

and developing a Web-based Information Delivery System for Tilapia (WIDeST). In this approach WIDeST capture on the developed electronic information technology network and capacity of RDS-HN while providing a means to provide easy to use information developed by Zamorano. Furthermore, it provides a way to connect local NGOs, farmers, decision-makers for exchanging information and enabling them to make informed decisions. The WIDeST provides information on Tilapia production and related topics, natural resources of Honduras, contact information of NGOs, and chat room facilities for conducting virtual forums and discussions. The email facility enables the user to ask questions which is answered by an expert. Since the inauguration session in March 2001, the Website has had more than 6800 hits, and more than 300 individuals formally registered to receive information. The participants at training and workshop sessions have found this to be an easy and useful approach and have provided strong encouragement for adding new information. The number of individuals already reached as evidenced from the numbers of visits to the Website provide a strong evidence that is may be a way to build capacity of local institutions in developing and environment that enables farmers to adopt aquaculture as an alternative in their farms.

This abstract was excerpted from the original paper, which was published in D. Meyer (Editor), *6to. Simposio Centroamericano de Acuicultura Proceedings: Tilapia Sessions, 22-24 August 2001. Tegucigalpa, Honduras, pp. 126-134.*

## Upcoming Conferences and Expositions

Date	Topic/Title	Event Location	Contact Information
February 12–14, 2002	Oldways Water Farming Initiative	Baltimore, Maryland	Aimee Murdock or Deborah Good; Phone: 617-421-5500; Fax: 617-421-5511; Email: aimee@oldwayspt.org
February 14–17, 2002	Fish International 2002	Bremen, Germany	Burgerweide; D-28209, Bremen, Germany; Phone: 49-421-3505-260; Fax: 49-421-3505-681; Email: bavendiek@messe-bremen.de; Website: <www.fishinternational.de/english/home>
February 25–27, 2002	International Forum on Tilapia Farming in the 21st Century	Los Baños, Laguna, Philippines	Rafael D. Guerrero III; Phone: 63-49-536-5579; Fax: 63-49-536-1582; Email: pcamrd@laguna.net; Website: <www.laguna.net/pcamrd>
March 21–23, 2002	VIV Canada	Toronto, Ontario, Canada	Jaarbeurs Exhibitions & Media; PO Box 8500, 3503 RM Utrecht, Netherlands; Phone: 31-0-30-295-56-62; Fax: 31-0-30-295-57-09; Email: viv.canada@jaarbeursutrecht.nl; Website: <www.viv.net>
April 18–20, 2002	Aquaculture International 2002	Glasgow, Scotland, United Kingdom	Haines House, 21 John Street, London, WC1N 2BP, England; Phone: 44-0-207-505-3620; Fax: 44-0-207-831-2509; Email: liz.roe@informa.com
April 23–27, 2002	World Aquaculture 2002	Beijing, China	Director of Conferences; Phone: 425-485-6682; Email: worldaqua@aol.com; Website: <www.was.org>
May 18–23, 2002	American Feed Industry Association (AFIA) Annual Convention	Reno, Nevada	John Ascuaga's Nugget; Reno, Nevada; Email: afia@afia.org; Website: <www.aquafeed.com/dfmnr_events.html>
June 7–10, 2002	AquaPartners 2002, Third International Exhibition and Conference on Fishing and Aquaculture	Athens, Greece	Alexiis Caniaris; EuroPartners Ltd, 101 Syngrou Avenue, 117 45 Athens, Greece; Phone: 30-1-922-1254; Fax: 30-1-922-1589; Email: europart@hol.gr; Website: <www.europartners.gr>
June 11–13, 2002	AquaVision 2002	Stavanger, Norway	Vidar Julien; Communications Manager, Nutreco Aquaculture Communications, PO Box 319, N-4002, Stavanger, Norway; Phone: 47-51-88-59-02; Fax: 47-51-58-43-68; Email: info@aquavision.nu; Website: <www.aquavision.nu/>
July 21–26, 2002	International Congress on the Biology of Fish	Vancouver, Canada	Don MacKinlay; Phone: 604-666-3520; Email: MacKinlayD@pac.dfo-mpo.gc.ca; Website: <www.fishbiologycongress.org>

### Aquaculture America 2002

The World Aquaculture Society's (WAS) Aquaculture America 2002 meeting will take place 27 through 30 January 2002 in San Diego, California. The theme of this year's meeting is "Enviro-Friendly Aquaculture for the Americas." The event is sponsored by the US Aquaculture Society, the National Aquaculture Association, and the US Suppliers Association, along with many other associate sponsors, and it is hosted by the California Aquaculture Association. This meeting provides an excellent opportunity for those who are unable to attend the annual WAS meeting in Beijing.

The conference will feature the annual meetings of the US Aquacultural Society and the American Tilapia Association, as well as the meetings of

many other work groups and government agencies. The program will include technical sessions and producers seminars covering virtually all species involved with aquaculture, in topics ranging from finfish nutrition to crustacean culture.

Other highlights of the event will include a large tradeshow with nearly 200 booths showcasing the latest in products and services for the aquaculture industry. Three all-day tours have been set up for interested parties to view farms in Baja California, the Imperial Valley, and a fish hatchery in Carlsbad.

Anyone interested in attending Aquaculture America 2002 should visit the WAS website located at <www.was.org> for more information. 🐟





## Workshops and Short Courses

Date	Title/Topic/Site	Contacts
February 6–7, 2002	Opportunities in Aquaculture/Ft. Pierce, Florida, USA	Aquaculture Center for Training, Education, and Demonstration (ACTED); Harbor Branch Oceanographic Institution, 5600 US Hwy 1 North, Ft. Pierce, FL 34946; Phone: 800-333-4264 or 561-465-2400; Fax: 561-466-6590; Website: <www.aquaculture-online.org>
February 8, 2002	Small System Culture and Operation/ Ft. Pierce, Florida, USA	ACTED (see above)
February 23–29, 2002	Recirculating Aquaculture Systems/ Ft. Pierce, Florida, USA	ACTED (see above)
March 6–8, 2002	Shrimp Health Management/Ft. Pierce, Florida, USA	ACTED (see above)
March 19–21, 2002	27th Eastern Fish Health Workshop/ Charleston, South Carolina, USA	P.R. Bowser; Email: prb4@cornell.edu
March 19–April 22, 2002	Fish Health Management/Iloilo, Philippines	Pastor L. Torres Jr.; Head, Training and Information Division, SEAFDEC Aquaculture Department, Tigbauan, 5021 Iloilo, Philippines; Phone: 63-33-336-2937; Fax: 63-33-336-2891; Email: pltorres@aqd.seafdec.org.ph; Website: <aqd.seafdec.org.ph/4647.html>
March 21–22, 2002	Aquaculture Business Start-up/Ft. Pierce, Florida, USA	ACTED (see above)
April 2–30, 2002	Freshwater Aquaculture/Iloilo, Philippines	SEAFDEC/AQD (see above)
April 15–16, 2002	Tropical Aquaculture/Ft. Pierce, Florida, USA	ACTED (see above)
April 17–18, 2002	Opportunities in Aquaculture/Ft. Pierce, Florida, USA	ACTED (see above)
April 19, 2002	Small System Culture and Operation/ Ft. Pierce, Florida, USA	ACTED (see above)
April 23–May 22, 2002	Crab Seed Production/Iloilo, Philippines	SEAFDEC/AQD (see above)
April 23–26, 2002	Fish Vaccination Workshop/ Wageningen University, The Netherlands	G.F. Wiegertjes; Cell Biology & Immunology, PO Box 338, NL-6700 AH, Wageningen, The Netherlands; Phone: 31-317-482732; Fax: 31-317-483955; Email: fish.vaccination@celb.edc.wag-ur.nl
May 6–9, 2002	Management of Aquaculture Effluents/Hawaii, USA	Gary L. Jensen; National Program Leader–Aquaculture, US Department of Agriculture, Cooperative State Research, Education and Extension Service, Stop 2220, 1400 Independence Ave., SW, Washington, DC 20250-2220; Phone: 202-401-6802; Fax: 202-401-6156; Email: gjensen@reeusda.gov
May 9–10, 2002	Live Feeds Culture/Ft. Pierce, Florida, USA	ACTED (see above)
May 19–24, 2002	Aquatic Weed Control Short Course/ Ft. Lauderdale, Florida, USA	Beth Miller Tipton; Phone: 352-392-5930; Fax: 352-392-9734
May 28–June 26, 2002	Marine Fish Hatchery/Iloilo, Philippines	SEAFDEC/AQD (see above)
July 2–31, 2002	Management of Sustainable Aquafarming Systems/Iloilo, Philippines	SEAFDEC/AQD (see above)
July 22–26, 2002	Annual Aquaculture Water Reuse Systems Short Course/Shepherdstown, West Virginia, USA	Brenda Marchewka; Cornell University, Biological and Environmental Engineering, 302 Riley-Robb Hall, Ithaca, NY 14853, Phone: 607-255-2495; Fax: 607-255-4080; Email: bls19@cornell.edu

Pond Dynamics/Aquaculture CRSP  
Oregon State University  
418 Snell Hall  
Corvallis OR 97331-1643



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### CRSP Contact Information

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Corvallis, OR 97331-1643

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Director, Info. Mgmt.: Danielle Clair	<a href="mailto:claird@ucs.orst.edu">claird@ucs.orst.edu</a>
Asst. Dir., Info. Mgmt.: Kris McElwee	<a href="mailto:mcelweek@ucs.orst.edu">mcelweek@ucs.orst.edu</a>
Publications Ordering	<a href="mailto:mcelweek@ucs.orst.edu">mcelweek@ucs.orst.edu</a>

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Mary Nidiffer, and Steve Sempier

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