



AQUAFISH COLLABORATIVE RESEARCH SUPPORT PROGRAM NEWSLETTER

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AQUAFISH CRSP ANNUAL MEETING IN SAN DIEGO

Offering a valuable opportunity for AquaFish CRSP researchers and associates from around the world to gather, the AquaFish CRSP Annual meeting was held this year in San Diego on 28 February preceding the WAS World Aquaculture 2010 conference. With the first phase of the program drawing a close, this year's meeting was an opportunity for participants to reflect on their accomplishments and look forward to the next steps. Each of the Lead Principal Investigators presented a short synopsis of the progress that's been made and the research to come.

At noon, the 58 meeting participants split up into small groups to discuss project integration over lunch. Each group represented one of the three Regional Centers of Excellence (RCE) and also included a group made up of the seven attending AquaFish CRSP graduate students from around the world. This time served as a chance for formal discussion on improving communications across borders and provided a more relaxed opportunity for catching up.

...Annual Meeting continued on page 3



AquaFish CRSP graduate students meet with EPAC Representative, Christine Crawford, and AquaFish PI, Jim Bowman during the AquaFish CRSP Meeting working lunch. RCE groups dine and discuss project integration in the background. (Ford Evans)

AQUAFISH CRSP BROADENS NETWORKING OPPORTUNITIES

The AquaFish CRSP is now on Facebook! Visit our page to connect with current and previous CRSP students, colleagues, organizations, and fans. Share stories, experiences, photos, and information related to aquaculture and fisheries. We will post new educational and employment opportunities, photos and video, news articles, and project updates on our page. Connect to some of our "favorite pages" on Facebook such as SARNISSA, WorldFish, FAO, WWF, and USAID. Find us on Facebook through a direct link on our website or search AquaFish CRSP on Facebook. Become a fan today!



Also new on the [AquaFish CRSP website](#)....Translate our page contents into any one of over 50 languages, and check out the global reach of AquaFish CRSP on GoogleEarth.



AQUAFISH CRSP OUTSTANDING ACHIEVEMENT AWARD: JIM DIANA



Jim Diana (Jim Bowman)

Jim Diana received the **AquaFish CRSP Outstanding Achievement Award** during the opening session of the WAS World Aquaculture 2010 conference in San Diego. AquaFish CRSP Director Hillary Egna presented Diana with the award before a packed audience, honoring his accomplishments and contributions in aquaculture, and those of Yang Yi, who Diana collaborated with over the past 20 years.



Goings-on in the Pond...



It is with sadness that we announce the passing of **Dr. David Homer Buck**, one of our early CRSP participants in the former Pond Dynamics/ Aquaculture CRSP. Dr. Buck possessed a deep knowledge about fish biology and an interest in ending hunger, which helped to shape the PD/A CRSP. This is a great loss to the AquaFish CRSP community and he will be dearly missed.

Dr. Charles Ngugi, AquaFish CRSP Host-Country Lead PI for the Purdue University Project, recently joined the faculty of the Department of Agricultural Resource Management at Kenyatta University in Nairobi, Kenya. AquaFish CRSP's relationship with Moi University continues with Dr. Julius Manyala who has assumed the role as Moi's HC Co-PI. This new partnership with Kenyatta University is a positive step toward expanding the CRSP presence in Kenya.

The **Yang Yi** Memorial Webpage is now featured on the AquaFish CRSP website. This is a permanent site, that honors the memory of our dear friend and esteemed colleague through stories and photographs. Please consider making an contribution to the site which can be found at: aquafishcrsp.oregonstate.edu/YangYi/

It is with great sorrow that we announce the passing of our dear friend and colleague, **Dr. Marta Jaroszewska**. At the young age of 35 she was already an accomplished scholar and researcher in the field of fish morphology. She passed away on 23 May 2010 and will be deeply missed.

Kevin Fitzsimmons and **Jim Diana** organized the AquaFish CRSP student awards for best student poster at the World Aquaculture 2010 conference. The award winners are as follows:

First Place

Murni Marlina Abd Karim, University of Rhode Island

Second Place

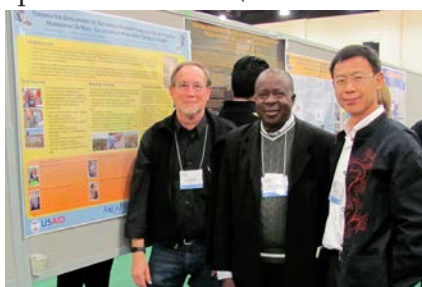
Oscar Basilio Del Rio Zarafoza, Centro de Investigación en Alimentación y Desarrollo (CIAD)

Second Place

Eduardo Abimorad, Universidade Estadual Paulista

AQUACULTURE 2010 SESSION IN HONOR OF YANG YI: OPTIMIZING SMALL-SCALE AQUACULTURE FOR THE POOR

In an Aquaculture 2010 session on 3 March chaired by AquaFish CRSP Director, Hillary Egna and co-chaired by Research Project Manager, Ford Evans, participants were provided the opportunity to honor the memory of Dr. Yang Yi with talks on research in "Optimizing Small-Scale Aquaculture for the Poor." Jim Diana started with a memorial presentation on Dr. Yang Yi's life and work. With a full day of 27 presentations, the session provided a comprehensive display of the wide range of AquaFish CRSP and ACRSP research over the years. Further increasing the conference-wide awareness of AquaFish CRSP work, four posters were on display throughout the week providing general program information as well as project specific material. (Posters listed in side bar)



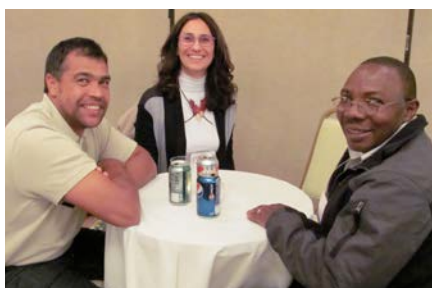
Jim Bowman, Héry Coulibaly, and Yuan Derun gather in front of the Mali Associate Award Project poster. (Lisa Reifke)

...Annual Meeting continued from page 1

Following the working lunch, the meeting continued with programmatic updates and information. Hillary Egna had the opportunity to introduce the *SOU-CRSP Yang Yi Young Scientist Travel Fund*, in memory of the late Dr. Yang Yi. The recipient of the travel award this year was Zexia Gao. (For more on the Travel Fund and Zexia Gao please see page 5)

The meeting adjourned as scheduled at 5:30 pm allowing the meeting participants to mingle at the AquaFish CRSP reception and to prepare for the weeklong World Aquaculture 2010 conference occurring in the following days.

From left to right, AquaFish Researchers, Khalid Salie (South Africa), Maria Céla-Portella (Brazil), and Charles Ngugi (Kenya) reconnect during the AquaFish CRSP reception. (Jim Bowman)



AquaFish CRSP researchers gather for a photo during a break in conference proceedings. (Jim Bowman)

AQUAFISH POSTERS AT AQUACULTURE 2010

PROMOTING SUSTAINABLE AQUACULTURE AND FISHERIES THROUGH CAPACITY BUILDING: A SYNOPSIS OF SHORT- AND LONG-TERM TRAINING CONDUCTED UNDER THE AQUAFISH CRSP
Lisa Reifke, James Bowman, Hillary Egna

TOWARDS THE DEVELOPMENT OF SUSTAINABLE FRESHWATER AQUACULTURE AND FISHERIES MANAGEMENT PRACTICES IN MALI: COLLABORATIVE WORK UNDER THE AQUAFISH CRSP
James Bowman, Lisa Reifke, Héry Coulibaly, Charles Ngugi, Yang Yi, Liping Liu, Nancy Gitonga, Peter Nzungi, Hillary Egna

AQUAFISH CRSP: MITIGATING THE NEGATIVE ENVIRONMENTAL IMPACTS OF AQUACULTURE PRACTICES
Ford Evans, Stephanie Ichien, Laura Morrison and Hillary S. Egna

AQUAFISH CRSP: ADVANCING RESEARCH, EDUCATION, AND OUTREACH IN AQUATIC RESOURCES THROUGH INTERNATIONAL PARTNERSHIPS
Ford Evans, Stephanie Ichien, Laura Morrison and Hillary S. Egna



As a slide show honoring Dr. Yang Yi's memory plays in the background, AquaFish CRSP Director, Hillary Egna welcomes the meeting attendees to the AquaFish CRSP Annual Meeting in San Diego. (Jim Bowman)



Two graduate students from Ghana working with the Purdue University Project, Gifty Anane-Taabeah (left) and Yaw Ansah (right) enjoy a conversation with Oregon State University journalist Peg Herring (center) during the AquaFish CRSP reception. (Jim Bowman)

THE BIDII FISH FARMERS ASSOCIATION: A SUCCESS STORY OF FISH FARMING CLUSTERS IN KENYA

By Kwamena Quagrainie

Aquaculture in Kenya is mainly comprised of small-scale farmers practicing extensive fish farming in earthen ponds. To help address the challenges of inefficiencies in production and marketing that these farmers face, the USAID office in Kenya initiated a program for fish farmers in 2006 aimed at providing business development services (BDS) that would lead to new aquaculture enterprises and new markets for fish farmers. The Kenya BDS program focused on training small-scale farmers by providing technical advice and information transfer.

In 2007, AquaFish CRSP partnered with the Kenya BDS program to help farmers come together into clusters for the production of catfish fingerlings as baitfish for the Lake Victoria fisheries, and to assist with market integration of cluster farmers with baitfish markets. The program began with the formation of four fish farmer clusters located in districts around Lake Victoria in Kenya's Western Province— Bidii Fish farmers (Vihiga cluster), Bukhayo Self Help Group (Mundika cluster), Funyula North Fish farmers (Funyula cluster), and the Tumainin Self Help Group (Matayos cluster).

Today, the Bidii Fish farmers Cluster has become a model that is motivating the formation of other fish farmers groups. George Ambuli, Bidii Chairman, explained that the beginning was not easy. "The group started off with 10 individual fish farmers as members," he said. "Each member owns their own ponds but the group coordinates production and sells collectively. They also started off interested in exchanging ideas on fish rearing."

With guidance from Moi University and the Ministry of Fisheries and funding from AquaFish CRSP, the group decided on their name, developed a constitution, and established a leadership structure. The group then registered with the Kenya Ministry of Gender, Sports, Culture, & Social Services.

Ambuli recalled the group's venture into the baitfish business in 2007. "The first three attempts



George Ambuli, chairman of the Bidii Fish Farmers Cluster receiving an award from Dr. Jennifer Dennis, specialty crops marketing specialist, Purdue University. (Courtesy of Kwamena Quagrainie)

to culture catfish failed with 100 percent losses due to poor management skills and improper feed. This resulted in the withdrawal of three members. However, knowing there was a need for baitfish by fishermen on Lake Victoria, the remaining seven pledged to continue learning fish propagation."

AquaFish CRSP activities through Moi University focused on technical assistance with hands-on experiences with catfish propagation and hatchery techniques. After a series of training programs, fish farmers in the Bidii Cluster improved their farming skills and started realizing 10 percent survival of catfish fingerlings. By early 2008, survival had improved to 25 percent. By May of 2008, the cluster had established a marketing link with baitfish dealers and was consistently supplying catfish fingerlings.

The Bidii Cluster has grown to 25 fish farmers, including nine women. Its wholesale price of fingerlings ranges from KSh (Kenya Shilling) 3.50 to KSh 5.00 per piece, depending on fingerling size. Besides selling to baitfish dealers and farmers, the Bidii Cluster also sells to other catfish farmers for stocking their ponds. The group's governance structure provides for three executive officers: chair, secretary, and treasurer. The revenue sharing arrangement developed by the group requires that 80 percent of revenue be returned to the members while 20 percent is kept by the group for administrative and other promotional expenses.

...Bidii Cluster Continued on page 7

THE YANG YI TRAVEL AWARD was established this year in memory of Dr. Yang Yi (1963-2009) with the *SOU-CRSP Yang Yi Young Scientist Travel Fund*. The award is expected to support excellent young scientists from one of the Asian partner institutions to present their research at the World Aquaculture Society conferences. Zexia Gao from Huazhong Agricultural University was awarded the first award.

GRADUATE STUDENT PROFILE: ZEXIA GAO

The first winner of the *SOU-CRSP Yang Yi Young Scientist Travel Fund Award*, Zexia Gao had the opportunity to travel from China to the US to attend the AquaFish CRSP Annual Meeting and Aquaculture 2010 conference in San Diego, California this March. At the conference, Zexia presented at the Finfish Genetics Session on her research with yellow cheek carp and had the chance to interact with aquaculture researchers from around the world.

Zexia is currently a PhD candidate in a joint education program with Huazhong Agricultural University (HAU) and the Ohio State University (OSU). Her dissertation, "Analysis on sex determination mechanism and sex-related DNA markers in bluegill sunfish (*Lepomis macrochirus*)," will potentially improve our understanding of the underlying basis for sex determination of monosex male populations of bluegill. Working under her two major professors, Weiman Wang from HAU and Han-Ping Wang from OSU, Zexia hopes to complete her degree in September 2011.

Exposed to aquaculture at an early age, Zexia grew up in Sichuan, China where her father was a fish farmer. As fish became a central part of her life, Zexia developed a love for seafood and a fascination with biology, ecology, and fish behavior. Her interest in the natural world led her to HAU's notable Life Sciences Department, where she completed her undergraduate degree in aquaculture in June 2007.

Zexia has been involved in AquaFish CRSP work in China over the last two years. Her first CRSP investigation experience, "Assessing the effectiveness of current waste management

practices for intensive freshwater aquaculture in China" ended in 2009. With waste management as one of the major issues under the AquaFish CRSP topic area, "Mitigating Negative Environmental Impacts", this project produced information about proper stocking densities and suitable waste mitigation techniques. It also included a social aspect in which a series of interviews and questionnaires revealed that Chinese tilapia and carp farmers appear to realize the importance of water quality and environmental impacts. Zexia sees this awareness as an indication of a positive step toward the development of a more sustainable aquaculture industry in China.



(Courtesy of Zexia Gao)

Zexia has been involved with two of the more recent AquaFish CRSP projects in China. Continuing with the theme of mitigating negative environmental impacts in the waste management project, she is now

working on an investigation that is comparing water quality parameters during the grow-out phase of traditional and improved cages in order to estimate a carrying capacity for commercial aquaculture cages in deep water lakes in China. Another investigation is more related to Zexia's own PhD work in fish genetics. This project is studying the impacts of the rapid invasion of red swamp crayfish (*Procambarus clarkii*) in China through changes in the population genetic structure.

With the rapid growth of China's aquaculture industry in recent years, Zexia recognizes the need for the development of cleaner and more efficient practices. While China contributes a high percentage of the global fish supply, the aquaculture industry faces a multitude of challenges. Zexia is encouraged by new developments in Chinese legislation regarding water quality, and hopes that the Chinese

...Zexia Gao Continued on page 14

SAFE AND HEALTHY SEAFOOD FROM SINALOA, MEXICO

Maria Haws, Eladio Gaxiola Camacho, and Irma Lorena Camacho Lopez

The The University of Hawaii, Hilo led AquaFish CRSP project has been working in Mexico for the last three years to build capacity among aquaculture producers, processors, and vendors to improve seafood safety during all stages of production and marketing. Aquaculture production in the States of Sinaloa and Nayarit, Mexico, consists largely of shrimp, tilapia, and bivalve shellfish in coastal areas. Expanding bivalve and tilapia production have been prioritized by the Mexican National and Sinaloa State governments as a means of diversifying aquaculture, which is now dominated by shrimp culture. Research done under the former ACRSP in 2006 suggested that seafood safety and quality were problematic for nearly all aquaculture and seafood products at all stages of production and marketing. Large-scale shrimp culture was one exception, as shrimp is produced mainly for export and is thus subject to strict safety standards and inspections. Other products were mainly affected by the general lack of awareness of producers and vendors as to specific techniques to maintain hygienic standards, although most people are aware of the need to handle and select seafood carefully. The cultural preference of coastal residents in Mexico to consume seafood raw, pickled, or lightly cooked highlights the importance of food safety standards. Most Mexicans are keenly aware of the need for special attention to seafood safety. For example, an ACRSP marketing survey conducted in 2007 by Drs. Fong (University of Alaska, Fisheries Technology Industry Center) and Cordero (CIAD) revealed that oyster consumers placed a high priority on knowing the origin of oysters and water quality of the growing grounds. Members of the CRSP team has also been leading the way in identifying emerging risks to seafood, such as the spread of gnathosomiasis, a worm-like parasite carried by freshwater and brackish water fish which causes illness and death. Drs. Silvia Paz, Marcela Vergara, and Magdalena Uribe have studied this parasite and its fish hosts, and have conducted outreach to affected coastal communities which to prevent further spread. One issue is the increasing popularity of using freshwater fish for sushi and ceviche which can spread the disease.



Mexican coastal cuisine depends on very fresh seafood, fruit and vegetables, with relatively light seasoning. Most of these seafood dishes are also "heart-healthy."
(Maria Haws)

As fish culture grows, prevention becomes more critical. The Center for Food and Development Research (CIAD) in Mazatlan has produced a series of best management practices manuals for shrimp, bivalves, catfish, and tilapia. Dr. Omar Calvario will be leading upcoming work with an intensive series of workshops for producers and vendors in best management practices related to seafood and hygiene using the manuals as a part of the course content. Shellfish sanitation has been a key theme in the CRSP project since the beginning, and headway has been made in raising awareness of the need for, and components of, shellfish sanitation programs among a wide variety of stakeholders. Again, this is important due to the tradition of consuming bivalve shellfish raw and because of their susceptibility to post-harvest contamination.

Promotion of seafood and aquaculture products consumption is also important—the average Mexican consumes only about 12 kilograms of seafood per year, with most of this consumption is by coastal residents. Aquaculture can help provide some of the protein needs in areas which still have food security issues, including many coastal areas. For example, a typical toddler would only need one ounce of fish or shellfish to meet his or her daily protein requirements.

Sinaloa is famous for its fresh seafood dishes, which are among the most exquisite examples of Mexican cuisine. Many dishes involve combinations of fresh or raw seafood, raw vegetables, and delicious, easy-to-prepare sauces. Many of the sauces also include citrus juice which increases vitamin content and helps lower fat consumption. It is worth noting that Sinaloa is not only a source of fish, shellfish, fruit, and vegetables for Mexico, but supplies much of the U.S. and Canada, making food safety of all products an international issue. The recipes presented below are quick to make and

...Sinaloa Seafoods continued on page 10

IIFET 2010 MONTPELLIER AQUAFISH CRSP AWARDS

The International Institute of Fisheries Economics & Trade (IIFET) will be holding their biennial international conference in Montpellier, France 12-16 July 2010. This is a forum for IIFET members and others to learn about important research developments in seafood trade, aquaculture, and fisheries management issues. Through the years AquaFish CRSP has co-sponsored IIFET by supporting for developing country students, thus providing many worthy scientists the opportunity to attend and participate in the forum. This year AquaFish CRSP supports the Developing Country Aquaculture Economics Best Student Paper Prize and the Aquaculture Economics Professional Travel Awards through which the four winners will be able to attend IIFET 2010 Montpellier.

AQUACULTURE ECONOMICS PROFESSIONAL TRAVEL AWARD

U.S. Catfish Farm Supply under Uncertainties
Giap Nguyen (Vietnam)

Poverty Analysis in Households with Fish-based Livelihoods Strategies in the Riverine Areas of Southwest Nigeria
Taiwo Ejiola Mafimisebi (Indonesia)

The Economic Performance of Fishpond Culture in Parigi Moutong Regency, Central Sulawesi-INDONESIA: The Way Forwards for Food Security Strategy
Indah Susilowati (Indonesia)

BEST STUDENT PAPER

Impact of Sanitary and Phytosanitary (SPS) Measures on Indian Seafood Industry: A Macro and Micro Level Analysis
Jayasekhar Somasekharan (India)



...Bidii Cluster Continued from page 4

The group currently has two bank accounts, and their future plans include developing a well-equipped hatchery as well as owning a feed mill. Feed supply is a major challenge to the aquaculture industry.

The success of the Bidii Cluster has drawn attention and financial support from the Women in Fishing Industry Project (WIFIP) based along the shores of Lake Victoria, Kenya. "WIFIP helps women fish traders to identify income generating activities," said Jennipher Kere, executive director. The project seeks to engage women in aquaculture by providing additional household income and supporting them during the annual fishing ban on Lake Victoria, when income is at its lowest.

WIFIP has solicited the help of the Bidii Cluster farmers to train women in fishpond construction and catfish breeding. According to Daniel Juma Ebole, secretary of the Bidii Cluster, the group receives KSh3,000 each day to train women's groups and other fish farming clusters.

The Bidii Cluster has trained six groups since 2008: the St. Vincent Cluster, the Todo Cluster, the



*Paul Otieno, Chairman of the Visiki Cluster.
(Courtesy of Kwamena Quagrainie)*

Visiki Cluster, and three other fish farmer groups in the Kisumu and Vihiga Districts. At a June 2009 workshop on marketing and supply-chain development, AquaFish CRSP presented the Bidii Cluster with an award recognizing their exemplary commitment to fish farming and assistance to other fish farming groups.



RICE-FISH CULTURE IN MALI

Jim Bowman and Stephanie Ichien


Rice-fish culture, which can be traced as far back as 2,000 years ago in China, is still practiced today throughout Asia. The rice-fish system is an integration of fish culture and paddy-based rice production, often (but not always) in irrigated areas. Each system is a modification of an existing rice field to accommodate the additional requirements of a crop of fish. Due to the potential of rice-fish culture to provide new opportunities to farmers and improve local diets, the AquaFish CRSP Mali project is transferring rice-fish techniques from China to selected areas in Mali, including the Baguineda irrigation scheme near the capital city of Bamako. The addition of fish to the rice fields not only provides a new source of income and nutrition for farmers and their communities, but it can also benefit rice production through the reduction of weeds, improved insect control, loosening of the soil, and direct fertilization from fish excreta.

In June 2009, the process of converting two



Rice-fish culture in Mali. (Jim Bowman)

rice fields in the Baguineda irrigation area for rice-fish culture began with the modification of the fields to provide a sump and access channels for the fish. After a five-

month culture period, the farmers harvested both rice and fish by November 2009. A combination of tilapia and Clarias catfish provided a total of over 140 kg of fish between the two sites. Net profits of the rice-fish systems summed to CFA 150,210. Rice alone produced CFA 73,760 and fish produced CFA 76,450. Budget analyses show that using the whole area solely for rice production would have resulted in a net CFA 89,490, demonstrating that the addition of fish to the field produced CFA 60,720 extra income for the farmers. The experience of these two farmers generated interest among other farmers in the Baguineda area; some are already modifying their systems so they can add fish during the next rice production cycle. 


IMPACT ASSESSMENT & COMMUNICATIONS PROJECT WORK

In conjunction with the AquaFish Annual Meeting, Steve Buccola (Lead US PI, Oregon State University) and John Antle (US Co-PI, Montana State University) led an all-day project planning meeting on 1 March with US and Host Country researchers to discuss details of the new Impact Assessment Project. In the morning session, Steve and John introduced their respective project components. With each taking a different methodological approach, Steve is focusing on technology discoveries to evaluate AquaFish CRSP accomplishments while John is drawing upon economic indicators to assess quantifiable impacts



From the left: Steve Buccola, Laura Morrison, Pablo Gonzales Alanis, and Kevin Fitzsimmons discuss assessment tools. (Jim Bowman)

of ongoing research and outreach activities. As a first step in data gathering, Steve and his CRSP PhD student Lin Qin worked with the seven project groups in completing their discovery data collection forms. During the afternoon session Steve and John, along with MSU PhD student Roberto Valdivia, met separately with each project group to discuss plans for further data gathering and input by the Host Country participants who will work directly with them. Among the larger goals of this first-time AquaFish CRSP project is to empower Host Country researchers with impact assessment tools that they can use in all aspects of their work.

Taking advantage of the unique opportunity of having so many AquaFish CRSP researchers together, the journalism team met with each of the project groups to gather information for the new Communications Project. Led by science writer Peg Herring, the team includes videographer Jeff Hino and journalist Tiffany Woods; all from Oregon State University. Their goal is to tell the story of AquaFish CRSP from the view of both the researchers and stakeholders. In lively meetings with the project teams, they interviewed researchers, learning their stories and developing ideas for the final products. 

FEED REDUCTION STRATEGIES AND ALTERNATIVE FEEDS EFFECTIVE IN REDUCING THE COSTS OF POND-CULTURED TILAPIA IN THE PHILIPPINES

Russell Borski and Remedios Bolivar

Feed constitutes 60-80% of total variable costs for producing tilapia. Therefore, any strategies that prove effective in limiting the quantity of feed used for fish growout and the cost of formulated feeds could reduce overall feed costs, improving the efficiency of tilapia culture and the subsequent incomes of farmers. Investigators at Central Luzon State University (CLSU) in the Philippines and North Carolina State University (NCSU) show that feeding reduction protocols and the replacement of costly fishmeal in formulated diets are effective in decreasing overall costs in the semi-intensive pond culture of tilapia in the Philippines.

Earlier CRSP work at CLSU showed that 1) delaying the onset of supplemental feeding to either 45-days or 75-days in fertilized ponds reduces the amount of feed consumed without any negative impact on the production of marketable tilapia, 2) feeding at a sub-satiation level of 67% did not reduce measurable production of marketable fish relative to fish fed at 100% satiation level, and 3) feeding only on alternate days saved approximately half of feed cost without a significant reduction in growth, survival, or market yield of Nile tilapia in growout ponds. The first of a series of studies led by Remedios Bolivar of CLSU and Russell Borski of NCSU, and their students and collaborators, tested the utility of combining delayed and reduced feeding strategies to evaluate if production costs of tilapia for farmers in the Philippines could be further reduced. They examined a feeding management strategy that incorporated an initial period of 60 days delayed feeding, followed by 30 day alternate day feeding, and then 67% satiation feeding. They compared the growth and yield of fish on the combined delayed-reduced feeding protocol to that of fish fed daily at prescribed levels. The study lasted 120-days and was done on the farms of local tilapia growers in the Central Luzon region. Each farm allocated two ponds, one each for the delayed-reduced and

the normal feeding protocol. Ponds were fertilized weekly to provide supplemental planktonic feed. Fish raised on the delayed-reduced feeding protocol showed lower growth rates and survivorship and overall harvest size than fish fed daily at full prescribed levels. Approximately 55% less feed was applied to animals on the combined delayed-reduced feeding regimen relative to those fed on a traditional full daily feeding schedule. Overall, they found that the combined delayed and reduced ration feeding method is less effective at improving the cost-effectiveness of tilapia farming than when used individually.




Sampling tilapia. (Courtesy of Russel Borski)

In a second on-farm growout trial, they evaluated if a 50% reduction in daily ration level might prove an additional option for reducing costs of tilapia production, over and above that observed previously with 67% satiation feeding. Production variables were measured in tilapia fed daily at 50% subsatiation versus those on a full daily ration. Fish on the reduced ration level had growth and survival rates, and final harvest size that did not differ significantly from fish fed a full daily ration over 120 days. Fish on the reduced ration also consumed 56% less feed and had 100% improved feed conversion relative to fish fed full ration. Hence, it took substantially less feed to produce marketable fish when tilapia are raised on half the normal feed ration. A basic cost-benefit analysis indicates the net return of fish on the reduced ration level was approximately \$1375/hectare compared with \$14/hectare for tilapia on the typical full daily ration. Collectively, these results show that farmers have the potential to dramatically improve incomes while reducing nutrient loading in pond waters.

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...Sinaloa Seafoods continued from page 6

represent the very best examples of fresh Mexican cooking. The University of Hawaii AquaFish CRSP project would particularly like to thank Restaurant Mariscos Pavi owners, Roberto Villaverde and

Thelma Payan Villaverde, who prepared the dishes shown in the photographs and are sharing their recipes with the Aquanews CRSP readers. 

SINALOA SEAFOOD RECIPES

SINALONAN AGUACHILE (SHRIMP CHILE WATER)

"Aguachile" is prepared with fresh, raw shrimp and a lime juice-based sauce. Use only the freshest shrimp.

Ingredients

Serves 6 as an appetizer or 4 as a main dish.

- 2 pounds medium-sized shrimp, raw and deveined. Shrimp should be slit all the way along the back.
- Black sauce: mix equal parts soy sauce, worchester sauce and Maggi sauce (available in most U.S. grocery stores, if not, substitute any mild hot sauce) so that you have one cup of sauce
- Finely chopped fresh chile serranos (or any hot chile peppers), about 2 T.
- Small red, hot chiles. Can substitute chopped hot, red pepper if not available. About 2 T.
- White onion, finely chopped, ½ Cup
- Red onion in slices, ¾ Cup
- Two cucumber, in thick slices with seeds removed.
- Limes-enough to make 1 Cup juice
- Broth from cooked shrimp, about ½ Cup
- Salt and pepper to taste.

Put the chiles, white onion, and shrimp broth in a molcajete (stone mortar) or bowl, and then manually grind until an uniform, smooth mixture is obtained. A blender can also be used. Put shrimp in a bowl, add lime juice, salt, pepper and mix. Leave shrimp to soak for about 5 minutes. On a large plate, make a layer of the sauce you made in the molcajete, then place the shrimp on top of the layer of sauce, then cover with the black sauce. Then place the slices of red onion and cucumber around the shrimp, add salt, pepper and the chiltepin chiles to taste. Should be eaten slightly chilled with "tostadas", a fried, corn tortilla available in Mexican grocery stores, or with crackers or tortilla chips. Aguachile is eaten accompanied with crispy tostadas, often with mayonnaise and additional hot sauce.



Restaurant owner and chef, Mr. Roberto Villaverde (left), and CRSP HC Co-PI, Eladio Gaxiola Camacho (right) enjoying the aguachile. (Maria Haws)

THE GOVERNOR'S TACOS

Ingredients

- Corn tortillas
- Chihuahua cheese (found in Mexican groceries, or can substitute with half Jack and half Swiss Cheese), grated
- Smoked marlin (another famous Sinaloan product) or any smoked, white fish, or lightly steamed shrimp, chopped
- Finely chopped serrano chiles
- Finely chopped white onion
- Finely chopped tomato
- Sliced avocado

The Governor's Tacos are famous in Sinaloa, but are very simple to make. Here is one simple recipe.

In a heavy frying pan with vegetable oil, lightly saute the white onion, serrano chiles and tomatoes, seasoning with salt. Add the smoked marlin or shrimp, and cook for 5 minutes. In a separate, heavy frying pan or comal (flat iron or ceramic pan used to make tortillas), place the tortillas, then add the smoked marlin or shrimp mixture and sprinkle with the cheese. Fold the tortillas over, and fry until golden brown. Serve with avocado, fresh salsa and salad.

...Alternative Feeds continued from page 9



Monitoring water quality. (Courtesy of Russel Borski)

The cost of commercial fish feeds is rising sharply as the market demand increases to supply the growing aquaculture industry and the availability of fishmeal declines. About 20% of feed costs are attributable to fishmeal, which constitutes 7-10% of the feed formulation. Much of the fishmeal used for tilapia in the Philippines is imported, and costs are expected to rise in the future as global supplies become constrained by increasing demands and declines in commercial bait fisheries.


Because tilapia are omnivorous fish, which naturally feed on plankton, diatoms, small crustaceans, algae, higher plants and detritus, they do not require fish in their diet and they are an ideal group of species to recycle food by-products into high quality food protein for humans. Therefore, CLSU and NCSU investigators conducted a series of studies to evaluate the utility of other protein sources; namely, fermented mechanically deboned meat poultry byproduct, yeast extract protein, and poultry by-product meal in replacing fishmeal. They found that substitution of fishmeal with these ingredients was as effective as standard diets containing fishmeal in the growout of tilapia in tanks.

A critical element to subsequent investigations was to formulate diets to replace fishmeal that incorporate ingredients widely available in the Philippines. To this end, studies were conducted in cooperation with Sante Feeds Corporation in the Philippines to evaluate the efficacy of diets formulated with pork by-product meal as a replacement for fishmeal and that also included cassava meal, copra meal, coconut oil, rice bran,

and local fish oils produced in the Philippines. In testing the diets, they also used an alternate-day feeding scheme whereby fish were fed every other day rather than daily. This reduced feeding strategy previously was shown to produce fish of comparable yields as those fed daily, but at half the feed cost. An evaluation of the least-cost formulated diet containing 0% fishmeal showed it to be as effective as the standard diet containing 6% fishmeal on the growth performance and production characteristics of tilapia during a 120-day growout in experimental ponds at CLSU. A marginal budget analysis showed an 8% improved return on fish fed the cheaper diet lacking fishmeal. This along with the alternate-day feeding strategy has the potential to reduce overall feed costs for growing marketable size tilapia by > 60%.



Weighing out tilapia grower feeds. (Courtesy of Russel Borski)

Collectively, the series of studies discussed here show that reduced feeding strategies and substitution of diets containing fishmeal with cheaper and more sustainable sources of protein are effective options for reducing the costs without negatively impacting the production of tilapia. Future work at CLSU and NCSU will continue to harness the input and cooperation of farmers and local feed manufacturers to further the development practical strategies and technologies that yield additional cost savings for small scale farmers in the Philippines and other regions of the world. Complimentary outreach activities, including the development of Tilapia Podcast modules is underway to extend cost containment strategies to the tilapia farming community. 

Notices of Publication

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THE EFFECT OF THE INTRODUCTION OF NILE TILAPIA (*OREOCHROMIS NILOTICUS*, L.) ON SMALL INDIGENOUS FISH SPECIES (MOLA, *AMBLYPHARYNGODON MOLA*, HAMILTON; CHELA, *CHELA CACHIUS*, HAMILTON; PUNTI, *PUNTIUS SOPHORE*, HAMILTON) (09-252)

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This is the first controlled experiment to quantify the effect of introduced tilapia on indigenous species. This experiment was conducted in small earthen ponds (100m²) to assess the impact of mixed-sex or all-male Nile tilapia (*Oreochromis niloticus*) on small indigenous species (SIS) commonly found in south Asia, mola (*Amblypharyngodon mola*), chela (*Chela cachius*) and punti (*Puntius sophore*). Ponds were fertilized, then stocked with 0.56 fish m⁻² of water surface area in the mixed-sex and all-male tilapia treatments and 0.42 fish m⁻² in the treatment without tilapia. No additional nutritional inputs were applied after stocking. Treatments were: mixed-sex tilapia with SIS, mono-sex male tilapia with SIS and SIS without tilapia (control). All treatments were stocked with

14 fish per species. All species reproduced during the 21-month culture duration. The number of recruits varied by species, Tilapia reproduced in greater numbers than SIS. Tilapia numbers at harvest were the highest (451 \pm 25/100m²) in the mixed-sex treatment compared with mola (221 \pm 22/100m²), chela (94 \pm 8/100m²) and punti (100 \pm 7/100m²). The number of mola was higher (399 \pm 33/100m²) in the all-male tilapia treatment. There was reduction in the number of mola and chela in the treatment containing mixed-sex tilapia. Gut content analysis combined with water sampling revealed that all fish species fed selectively. Significant interspecies dietary overlap was found between Nile tilapia and SIS and among SIS. Thus, there is potential for tilapia to compete with indigenous fish species when space and other resources are limiting, but a longer duration study with varying level of management is needed to determine how successfully tilapia competes with locally adapted SIS.

This abstract was excerpted from the original paper, which was in *Aquaculture Research* 41.6: 904-912, 2010

ANALYSIS OF THE USE OF CREDIT FACILITIES BY SMALL-SCALE FISH FARMERS IN KENYA (09-253)

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The government of Kenya encourages aquaculture development by offering credit facilities through the government agricultural finance institution, Agriculture Finance Corporation. Nevertheless, the level of credit use in fish farming is very low. Access to credit is among several factors that affect

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farmers' decision of whether to use particular technology or services. The study examined factors that affected the decision of fish farmers in Kenya to utilize credit facilities in fish production using a probit model. The analysis suggests that farmers in the Western province will have a 19% more probability of using credit facilities for their fish farming operations than farmers from the other provinces such as the Rift Valley, Central, and the Eastern province. The effect of tilapia sales on the probability of credit use by fish farmers is more than three times that of catfish sales. Total pond acreage owned by fish farmers had a positive effect on credit use but the effect was very small and negligible. The level of fish farmers' use of credit facilities is very low, and there is probably the need to educate farmers on credit use and for the government agricultural lending agency and other commercial agricultural lenders to invest in this enterprise. Kenyan lending institutions have financed traditional agricultural enterprises, and with the growing production of farmed fish, more research is needed to document the aquaculture business model to assist in assessing the profitability potential in aquaculture.

This abstract was excerpted from the original paper, which was in *Aquaculture International* 18.3: 393-402, 2010

AQUACULTURE INFORMATION SOURCES FOR SMALL-SCALE FISH FARMERS: THE CASE OF GHANA (09-254)

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The Ghana ministry of fisheries and the ministry of Agriculture provide free extension services and other technical services to fish farmers in Ghana, e.g. producing fingerlings at government-

operated fish hatcheries for sale to farmers. Non-governmental organizations and universities have also provided some technical assistance to fish farmers in efforts towards the development of aquaculture in Ghana. The study identified the various sources of aquaculture information to Ghanaian fish farmers and examined the factors that affected their decision to utilize these alternative sources of information. Using choice modeling techniques, the study found that the probability of farmers seeking information on aquaculture from the Ghana government increases with literacy by about 43% more than with illiteracy and by about 34% with an increase in total size of ponds. The probability that a literate farmer will choose to obtain aquaculture information from a non-governmental organization decreased by about 10% compared with an illiterate farmer. The probability of choosing 'other sources' for aquaculture information increased by about 27% for farmers residing in Ashanti region compared with farmers in the Brong-Ahafo region but the probability of farmers seeking information from 'other sources' decreased with literacy and number of years farming.

This abstract was excerpted from the original paper, which was in *Aquaculture Research* 40:1516-1522, 2009.

MARKETING EXTENSION AND OUTREACH IN SINALOA, MEXICO: A PRELIMINARY ANALYSIS OF PREFERENCES FOR OYSTERS (09-255)

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Shrimp mariculture, the leading form of aquaculture for the Pacific coast of Mexico is facing catastrophic losses due to disease and falling prices. Previous work conducted by a multi-institutional, international team since 1997 has built a solid foundation for diversification of aquaculture in Pacific Mexico emphasizing the

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...NOPs continued from page 13

use of native species, particularly those low on the food chain and with low culture technology requirements. Among the leading candidates are bivalves, which are currently cultured and fished extensively along the Gulf of California Coast, with much of the production attributed to wild capture fisheries. Great potential exists, however, to expand current aquaculture production through strengthening existing operations, either by developing new markets or increasing sales in current ones according to consumer preferences. From the Mexican government's perspective, specifically from CONAPESCA (National Aquaculture and Fishery Commission), economic diversification for aquaculture is stated as a prioritized policy goal. Today, the most available and feasible biotechnologies for species diversification in the country are tilapia and oyster farming (Martínez-Cordero 2007). In the last three years the Program *Alianza para el Campo* (Alliance for the countryside), which is the main federal program operated at the national level that promotes and supports the development of aquaculture projects, has financed tilapia and oyster projects at different scales of operation in many states. Social groups, like cooperatives, are usually selected to receive support for oyster farming, and in Sinaloa, coastal communities have benefited from this program. This includes fishermen entering aquaculture activities for the first time, which the Mexican government calls system conversion. Women's groups are also being involved in oyster culture efforts by the Autonomous University of Sinaloa. While monetary assistance has been given to help in the establishment of new aquaculture enterprises, little work has been done to assess the social and economic impacts of increased production. Moreover, research on assessing market demand for said species and assisting farmers in market identification and market penetration strategies is lacking. The objective of this work is to assist oyster aquaculture cooperatives in the region of Bahia Santa Maria (BSM), Mexico, to identify opportunities for the marketing of oysters within the state of Sinaloa.

This abstract was excerpted from the original paper, which was in *Marine Resource Economics* 24:89-95, 2009.

OUTREACH ASSESSMENT STUDIES EXAMINE AQUACULTURE LINKS TO THAI COMMUNITIES (09-256)

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Social surveys of three farming systems in Thailand showed significant differences. Prawn farming provided a good income and primary employment for farmers, who sold their prawns locally. Tilapia farming provided additional food and income to farmers who were otherwise employed, mostly in rice culture. Shrimp farming provided a good income and employment favored over other job opportunities. It added food locally as well as for export.

This abstract was excerpted from the original paper which was published in *Global Aquaculture Advocate* 12.6:10-12, 2009.

...Zexia Gao Continued from page 7

aquaculture industry can someday produce a more sustainable seafood product.

In her two years working with AquaFish CRSP, Zexia values the international connections that she has made. Her experience working with researchers from around the world has provided her the opportunity to learn about the different aquaculture issues in other countries. This exposure to diverse research questions has been her most enjoyable experience with AquaFish CRSP. Once she finishes her PhD, Zexia hopes to continue her career as an aquaculture researcher. 

Upcoming Meetings and Events...

The AquaFish CRSP is proud to support workshops and meetings designed to facilitate increased knowledge and communication in aquaculture. Meetings and workshops coming up include...

22nd International Conference of the Coastal Society

Shifting Shorelines: Adapting to the Future

13-16 June, 2010

Wilmington, North Carolina, USA

www.thecoastalsociety.org/conference/tcs22/index.html

IIFET 2010

12-16 JULY 2010

Montpellier, France

oregonstate.edu/dept/IIFET/



AQUACULTURE AMERICA 2011

28 February- 3 March 2011

New Orleans, Louisiana, USA

www.was.org/WasMeetings/meetings/Default.aspx?code=AA2011

Asia Pacific Aquaculture

The Future is Here

17-20 January 2011

Kochi, India

<https://www.was.org/WasMeetings/meetings/Default.aspx?code=APA2011>

9TH INTERNATIONAL SYMPOSIUM ON TILAPIA IN AQUACULTURE (ISTA9)

21-24 April 2011

Shanghai Ocean University

Shanghai, China

ag.arizona.edu/azaqua/ista/ISTA9/ISTA9.htm

WORLD AQUACULTURE 2011

6-10 June 2011

Natal, Brazil


<https://www.was.org/WasMeetings/meetings/Default.aspx?code=WA2011>

For more meeting and employment opportunities visit our Education & Employment Opportunities network database online, EdOpNet, at aquafishcrsp.oregonstate.edu/edop.php

AQUAFISH CRSP AT OREGON STATE UNIVERSITY EARTH DAY 2010



(Dwight Brimley)

The Earth Day Fair at Oregon State University took place on 19 April this year, kicking off the 2010 Earth Week. AquaFish CRSP hosted a booth at the event, providing the opportunity to expand the awareness of the AquaFish program. The booth featured brochures, tilapia cook books, an AquaFish CRSP poster, a sustainable seafoods game, and the introduction of the AquaFish GoogleEarth display. With a variety of people stopping by the booth from middle school students to professors, the event was a success. 

PONDERINGS...

Do OYSTERS SNEEZE?

IN THE NEW KID ON THE BLOCK

BY JACK PERLUTSKY

Do oysters sneeze beneath the seas,
or wiggle to and fro,
or sulk, or smile, or dance awhile
...how can we ever know?

Do oysters yawn when roused at dawn,
and do they ever weep,
and can we tell, when, in its shell,
an oyster is asleep?

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Your comments, stories, student profiles, and photos are always welcome! Send information to aquafish@oregonstate.edu (please include "Aquanews" in the subject line).

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