AQUANEWS

Sustainable Aquaculture for a Secure Future

AQUACULTURE COLLABORATIVE RESEARCH SUPPORT PROGRAM NEWSLETTER

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New Fish Species Studied for Aquaculture Potential by Aquaculture CRSP Researchers

by Dhirendra Prasad Thakur, Asian Institute of Technology

Editor's note: This article is the first in a series on the biology of fish species being studied for aquaculture potential. Future articles will cover the mahseer (*Tor putitora*) and climbing perch (*Anabas testudineus*). Thakur worked with the Aquaculture CRSP at the Asian Institute of Technology from 1996 to 1998 and rejoined the team in April 2003 after obtaining his Ph.D. in Japan.

Stinging catfish (*Heteropneustes fossilis*)

Heteropneustes fossilis (Bloch, 1794) is commonly known as the stinging catfish. The name is well earned, taken from its ability to inflict severe, painful wounds with the dorsal spines and to inject a poison produced by glandular cells in the epidermal tissue covering the spines (Nelson, 1994): this is a venomous fish.

The species is a highly-prized air-breathing freshwater fish from the Indian subcontinent and southeast Asian region. The range encompasses India, Thailand, Bangladesh, Pakistan, Nepal, Sri Lanka, Myanmar, Indonesia, and Cambodia (Smith, 1945; Burgess, 1989). Primary habitat includes ponds, ditches, swamps, and marshes. It can tolerate slightly brackish water. The fish adapts well to hypoxic water bodies and to high stocking densities (Dehadrai et al., 1985).

The family Heteropneustidae includes two species, of which *H. fossilis* is the better known.

Heteropneustidae are extremely

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ABDUL WAHAB

Several stinging catfish in bucket.

Program Update

As previously reported in *Aquanews*, USAID last year commissioned expert evaluations of three agriculture subsectors—aquaculture and fisheries, integrated pest management, and sustainable agriculture and natural resource management.

All three subsector reports were submitted to the Strategic Partnership for Agricultural Research and Education (SPARE)—a subcommittee of the Board for International Food and Agricultural Development (BIFAD), which is a presidentially-appointed body that advises USAID—in May.

The Fisheries and Aquaculture Subsector Report presents a vigorous case for enhanced support of international development assistance in global fisheries and aquaculture. For those interested, the report can be downloaded as a PDF from the program website at <pdacrsp.oregonstate.edu>.

SPARE will present its recommendations to BIFAD in October, and BIFAD will thereafter develop recommendations to present to USAID.

In the meantime, the Aquaculture CRSP has an exciting portfolio of research underway in the program's Eleventh Work Plan. The research focus is aquaculture development in coastal and inland areas, with emphases on production technology, watershed management, and human welfare, health, and nutrition. Research sites include Mexico, Honduras, Peru, Brazil, Kenya, South Africa, Thailand, Bangladesh, Nepal, Vietnam, and the Philippines. Numerous related regional outreach activities in neighboring countries are also underway.

Helping to Build Capacity at the Aquaculture Department of IAAS in Nepal

by Madhav K. Shrestha, Institute of Agriculture and Animal Science

The Institute of Agriculture and Animal Science (IAAS), located in the south of central Nepal, started its postgraduate program in 1998. Initially disciplines included agriculture and animal sciences. The Aquaculture Department started its master's program in 1999 with one student and very limited facilities—just a laboratory and research ponds. Three master students have already graduated to date.

My involvement in the Aquaculture CRSP directly or indirectly has been since 1989 when I was doing my master's degree thesis at the Asian Institute of Technology (AIT) in Thailand. This work was supported by a supplementary part of AITs research fund. Further support for my doctoral research was provided during 1991 to 1994 at AIT. Finally, I was supported by the Aquaculture CRSP while a postdoctoral research fellow at AIT.

Experimental tanks at IAAS.

Following a period of discussion with the regional Aquaculture CRSP team at AIT on the possibility of starting a new CRSP site in south Asia and Nepal, a research study at IAAS was approved under the Tenth Work Plan. This work, which supported Narayan Pandit's master's thesis research (see Graduate Student Profile, facing page), is now completed.

New Aquaculture CRSP research under the Eventh Work Plan is presently getting underway.

The Aquaculture CRSP has been instrumental to our aquaculture department in capacity building in research, developing science facilities, and ultimately in providing quality education at IAAS. This is a great help to developing countries.

New earthen ponds under construction at IAAS.

Aquaculture CRSP Researchers Receive AES Award

On 20 February 2003, four Aquaculture CRSP researchers, C. Kwei Lin, Madhav K. Shrestha, Yang Yi, and Jim Diana, were awarded an Aquacultural Engineering Society Honorable Mention Paper Award. The award recognizes their contribution to aquacultural engineering literature of exceptional merit. The article is "Management to Minimize the Environmental Impacts of Pond Effluent: Harvest Draining Techniques and Effluent Quality" (C. Kwei Lin, M. K. Shrestha, Y. Yi and J. S. Diana, Aquacultural Engineering, 25:125-135), published with Aquaculture CRSP Accession Number 1222.

Aquaculture CRSP Works with colleagues in Ho Chi Minh City, Vietnam

by Le Thanh Hung and Vu Cam Luong, University of Agriculture and Forestry

Although Aquaculture Collaborative Research Support Program (CRSP) researchers worked informally with Vietnamese colleagues for years as part of the Global Experiment, they recently broke new ground in Ho Chi Minh City. Last year the Aquaculture CRSP supported an investigation at the University of Agriculture and Forestry (UAF) entitled, "Development of a Trophic Box Model to Assess Potential of Ecologically Sound Management for Cove Aquaculture Systems in Tri An Reservoir, Vietnam."

Working from basic principles of limnology, numerous studies have been carried out to construct a trophic model of cove aquaculture in Tri An Reservoir.

One of the most important priorities was to set up a team for the project. Necessary teamwork involves researchers, lab assistants, field assistants, government officers, and farmers.

Dr. Le Thanh Hung, vice dean of Faculty of Fisheries of UAF, was a team leader of the project. One Asian Institute of Technology (Thailand) doctoral student and three UAF bachelors students also participated. Other team members were two lab assistants, one field assistant, one government officer, and two local farmers.

In constructing a trophic box model of natural food chains in the reservoir's cove, all trophic levels were investigated for biomass and productivity: terrestrial vegetation, detritus, phytoplankton, zooplankton, benthos, shrimp, and fish. Water quality parameters including pH, dissolved oxygen, temperature, Secchi disk depth, and nutrients in water (nitrogen and phosphorus) were also measured. Eighteen sampling stations inside and outside of the cove were set up.

It took from two to four hours to get around the stations by small boat.

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Graduate Student Profile: Narayan P. Pandit

by Roger Harris

Nepal is a name that conjures up images of snow-covered peaks and tough mountaineers. But Nepal native Narayan P. Pandit has a different vision. He would like to see Nepal's aquaculture realize its potential to become a major contributor to the country's food production.

With the help of the Aquaculture CRSP, he is on his way to making this a reality. For ten months from March 2002, he was supported by the Aquaculture CRSP under the tutelage of Madhav Shrestha, an Aquaculture CRSP Host Country Principal Investigator, also from Nepal.

Growing up in a farmer's family, the seeds of Pandit's interest were sown during his childhood. These formative years inspired his interest in agriculture, so in November 1993 he decided to attend the Institute of Agriculture and Animal Science (IAAS) located near the town of Chitwan in south-central Nepal. He completed his bachelor's degree in agriculture at IAAS in 2002, and was inspired by Shrestha to study for his master's degree in aquaculture.

Pandit's interest in aquaculture derives from his love of the natural environment and awareness of both the limitations and potential for the industry in his country.

Obstacles to establishing a strong aquaculture sector in Nepal include lack of skilled personnel and appropriate research, inefficient resource management, and an inadequate marketing infrastructure, says Pandit. On the plus side, he recognizes that the country's "vast water resources and diversified geographical conditions" are ideal to culture a wide range of fish species. Marginal swampland and irrigated paddy fields offer particular promise to integrate aquaculture into the Nepalese economy.

RAMU DARAI

Narayan P. Pandit

Pandit wants to help his country overcome the problems. To this end, his CRSP-supported work has been on a master's project: "Women in Aquaculture in Nepal." This is aimed at increasing the involvement of Nepalese women in aquaculture. Specific goals include enabling women to raise fish as well as engage in normal household activities and to provide a supplemental food source and income. In all, 82 small ponds (100 to 200 m^2) were built adjacent to family houses, where women took responsibility for the pond and were trained in aquaculture.

After completing his degree in summer 2003, Pandit plans to study towards a Ph.D. in aquaculture. This is a significant challenge given there is no aquaculture doctorate program in Nepal. If support were available, he would like to pursue his interests in aquatic resource management, water quality, and biometrics.

Vietnamese Collaboration with the University of Agriculture and Forestry

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Field work, therefore, had to be carefully scheduled to fit the plan.

We usually spent around four days every month working intensively in the field, while the rest of the time was spent working in the laboratory.

When traveling in the reservoir accompanying researchers and field assistants, the government officer plays an important role in securing and managing relationships between researchers and farmers. For their part, while cooperating with the project, farmers imparted their indigenous technical knowledge and learned much from the researchers.

Throughout our research, we never lost focus of our core mission: better utilization of all natural food resources for higher economic returns is the goal of cove aquaculture in reservoirs.

After one year working together, all our team members still have many good memories from the project.

A new CRSP investigation, "Mitigating Environmental Impact of Cage Culture through Integrated Cage-Cum-Cove Culture System in Tri An Reservoir of Vietnam," is supported under the Eleventh Work Plan.

VU CAM LUONG

Setting up equipment for field measurements in Tri An Reservoir.

The Aquaculture CRSP became a beloved name to all members, who hope the Aquaculture CRSP will be staying at UAF for many years.

Changes in Types of Feeds for Pangasius Catfish Culture Improve Production in the Mekong Delta

by Truong Quoc Phu and Tran Thi Thanh Hien, College of Aquaculture and Fisheries, Can Tho University

Culture of the Pangasius catfish has developed rapidly in recent years along the Mekong River, especially in four provinces: Angiang, Dongthap, Can Tho, and Vinhlong. The two main culture systems are cage culture and earthen pond culture. In 2002, it was estimated that 6,809 cages and 2,917 ha of pond were engaged in Pangasius catfish culture. This is a two-fold increase over figures for 1995. To foster the development of Pangasius catfish culture, many kinds of artificial feeds, notably commercially manufactured pellets were produced, but the use of pellets in catfish culture is still limited.

Feed cost for Pangasius catfish culture is one important parameter affecting profit of production, as it usually occupies a high proportion (65 to 70%) of total operating costs. Therefore, selection of appropriate feeds is of primary concern to farmers. A survey conducted as part of the Aquaculture CRSP project and provincial reports in 2002 showed that most farmers used homemade feeds for their production.

For cage culture systems, 95 to 97% of cages used homemade feeds (Angiang, Dongthap, and Vinhlong provinces). The proportion of cages in which fish were fed pellets only was very low, typically 3 to 5%. In Hongngu district, no cages used pellets only (Aquaculture CRSP project survey). However, among the cages that used homemade feeds, pellets were supplemented in almost all cages at the beginning of crop when fishes were of small size. In Can Tho province, the percentage of cage culture systems that used pellets only was rather high at 32%.

PHAM THANH LIEM

Fish pond and feeding hut.

As with cage culture systems, in earthen pond systems homemade feeds were mainly used. The percentage of pellet use is relatively higher than in cage culture. Can Tho province again has a high percentage of pellet use, 46%, whereas in the other three provinces only 5 to 10% of ponds used pellets.

There are interesting reasons to explain why artificial feeds have not been accepted by farmers:

- Materials for making feeds are locally available and cheap. Thus, the cost of pellets is higher than homemade feeds. Interview data from the Department of Agriculture and Rural Development (2002) showed the average feed conversion ratio (FCR) for homemade feed ranges from 2.7 to 3.0 and for pellets ranges from 1.4 to 1.5. The price of homemade feed is about US$0.12 to 0.13 and for pellets US$0.27 to 0.30 per kilogram. Hence the feed cost for producing one kilogram of fish ranges from US$0.31 to 0.39 for homemade feed and US$0.38 to 0.45 for pellet feed. Thus, farmers reduce feed cost if they make feeds themselves. This is the main reason why farmers have not been using artificial feeds for production.
- Payment for materials for making feeds can be delayed, while pellets have to be paid for in cash. Because of limitation on investment, farmers have to select homemade feed for their production.
- Farmers can change the ingredients of homemade feed according to necessity. Feeding is divided into two stages. The first stage uses feed containing a high level of protein and minerals to help fishes gain maximum length. In the second stage (last three months), farmers usually increase the carbohydrate concentration of homemade feed for fattening fishes before harvest. They expect their fishes to grow heavier (contain more fat) and thus result in higher production.

TRUONG QUOC PHU

Feeding machine.

DUONG NHUT LONG

Feed pellets, 18 to 32% protein.

The difference between Can Tho and other provinces in feed use is due to many cages and ponds in Can Tho belonging to pellet-producing companies.

Some of the companies involved in pellet producing, fish culture, and even fish processing are also engaged in Pangasius culture. Hence, pellets that those companies have produced are also used in their cages and ponds. Many of the same companies have widely promoted their culture techniques to farmers in the area in recent years. Thus, the marketing and extension programs of pellet-producing companies have

TRUONG QUOC PHU

Trash fish.

contributed to promoting pellet use among farmers.

Although the ratio of artificial feed use to homemade feed use remains low, it seems to have changed compared with a few years before. The survey in 1993 showed all farmers used homemade feeds (Tuan and Binh, 1994). Then some farmers added 13% commercial feed concentrates to improve protein content of homemade feeds (Phuong, 1998). Today, many farmers supplement with pellets at the first stage of the crop while some farmers use pellets for the whole crop.

The ingredients for processing homemade feeds were also improved in comparison with former practice. According to the 1993 survey, feeds for Pangasius catfish were made from agricultural byproducts (rice bran and broken rice), vegetables (water spinach, squash, carrots, etc.), and trash fish in the proportions 40, 45,

TRUONG QUOC PHU

Homemade feed, 15 to 25% protein.

and 15%, respectively. All farmers used vegetables for making feed (Tuan and Binh, 1994). Recently, the main ingredients of homemade feeds are trash fish, marine fish (30 to 40%), and rice bran (60 to 70%) depending on the size of fishes and investment capacity of farmers. Homemade feeds are also supplemented with vitamins, minerals, and vegetables. However, only 2% of farmers add vegetables to homemade feeds.

Improvements in feeds used by farmers have significantly contributed to increases in growth rate, survival of fishes, and shortening of the culture

DUONG NHUT LONG

Fish feeding.

cycle. This demonstrates that today most farmers realize the nutritional role of feed, but they still use homemade feeds because of economic aspects.

Still, despite its greater affordability, homemade feed can have low and sometimes imbalanced nutritional value, which causes low quality of marketable fishes due to high fat accumulation in the fish abdomen. This in turn reduces the proportion of fillet meat in the processed fish and fails to meet the international market's increasing requirement for quality low fat products.

In the future, pellets are expected to gradually replace homemade feeds as Pangasius catfish culture expands and more attention is paid to product quality.

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Stinging catfish

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hardy and are able to withstand severe drought conditions with the aid of accessory breathing organs.

Heteropneustidae have an elongated, subcylindrical body; just beyond the ventral fin bases, the body tapers off to the tail.

The head is depressed and bony plates cover the top and sides. The snout is depressed, and the nostrils are far apart; the slit-like anterior nostrils are positioned behind the nasal barbules. There are four pairs of rather long barbels, the maxillary pair extending as far as the ventral fins, and the two pairs of mandibular barbels and the nasal barbules reaching the end of the pectoral fins. The mouth is small and terminal. The eyes are relatively small, lateral in position, and with a free orbital rim. The gill openings are wide and the gill membranes are free from the isthmus. There are seven branchiostegal rays. The gas bladder is enclosed in a bony capsule (Burgess, 1989).

Heteropneustids possess a pair of long, hollow, cylindrical cavities extending backward on each side of the body from the gill cavity through the muscle of the back. These are accessory breathing organs that serve as primitive lungs enabling the fish to utilize atmospheric oxygen, and thus they are also called lung fish. This appears to be a necessary adaptation to living habitually in oxygen deficient stagnant pools and swamps. They are not able to live completely out of water for many hours but, like the clariids, can cross dry stretches of land in search of better conditions (Burgess, 1989).

Stinging catfish is reported to be highly nutritive, recuperative, and possessing of medicinal properties. This fish is esteemed for its invigorating qualities (Alikunhi, 1957). Its flesh is rich in protein and iron, and fat content is lower in comparison to that in other fishes. This fish is popular particularly because it can be cultivated in swampy areas and derelict water bodies without involving costly reclamation. Unlike water-breathing

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Stinging catfish

...from p. 5

fish, air-breathing fish can be easily stored and transported live to consumers. Thus, this species is ideal for wastewater aquaculture (Tharakan and Joy, 1996). The maximum-recorded size of stinging catfish is 38 cm (Sinha, 1993).

The fish is heterosexual. Externally, sexes can be accurately distinguished only during breeding when secondary sexual characteristics become prominent. The best morphological character indicative of a good *H. fossilis* brood female is a well-rounded abdomen, the fullness of which extends posteriorly past the pelvic fins. The males, on the other hand, look lean. In a mature female, the genital papilla remains in the form of a raised prominent structure, round and blunt with a slit-like opening in the middle. In males, it remains in the form of a pointed structure. Sexual maturity is attained at the end of the first year of life.

Stinging catfish breed in confined waters during the rainy season but can breed in ponds, derelict ponds, and ditches when sufficient rainwater accumulates.

Seed for stocking in grow-out ponds can be collected from the wild or can be produced by artificial breeding and rearing the larvae to marketable size. Kohli and Vidyarthi (1990) summarized the biological and embryonic development of *H. fossilis*. They reported the first time breeding was induced for this fish (in Maharastra, India).

Chatterjee et al. (1991) found a yearly spawning cycle with a single breeding season from July to August. Breeding activity is highly sensitive to water temperature. The optimum temperature for successful breeding is 22°C (Saxena and Sandhu, 1994).

The mature female lays a sticky cluster of yellowy-green eggs in the aquarium substrate. Both parents tend to the clutch, fanning the pit to ensure water circulation around the eggs. Care continues well after the fry emerge. Fecundity varies from 3,000 to 45,000 depending upon the size of the fish (Azadi and Siddique, 1986; Burgess, 1989). A female weighing 100 g produces 8,000 eggs on average. Fertilized eggs are mildly adhesive in nature and are either green or brown in color. The incubation period varies from 18 to 24 hours depending on water temperature (Singh et al., 1982; Roy and Pal, 1986; Alok et al., 1993).

Hatchlings average 2.72 mm in length. Yolk gets completely absorbed by the end of the fourth day, but the larvae commence feeding from the third day. Zooplankton, such as ciliates and rotifers, serve as the choicest food of the larvae at this stage. Aerial respiration apparently commences on the eighth day of development. The larval survival rate is low. Low survival may be due to cannibalism, in which the fish devours its own eggs and fry when there is a lack of food (Sinha, 1993).

Stinging catfish is omnivorous and a bottom feeder but can be trained to accept large cichlid foods from the water surface. Larger adults require large foods such as earthworms and frozen prawns. It has a great liking for gastropods.

H. fossilis is best suited for monoculture but can be cultured in combination with *Clarias batrachus* or *Anabas testudineus*. In semi-intensive culture, the recommended rate of stocking for *H. fossilis* is 60,000 fingerlings per hectare (Thakur and Das, 1986). In monoculture the reported production range was 1,642 to 7,300 kg ha-1 in four to 11 months of culture period, the average being 4,510 kg ha-1.

Optimum pH and temperature range for *H. fossilis* are 6.0 to 8.0 and 21 to 25 C. During summer when water bodies start drying up, the fish buries itself in the soil and aestivates. Many fishes live together in such pits. There can be a number of pits in large ponds. *H. fossilis* also makes nest holes in the embankment of a pond and lives there in colonies. Such holes are usually about a foot below the water surface in the form of anastomosing tubes having several exits. *H. fossilis* is best suited for culture in shallow ponds to 1 m depth. In addition to its suitability for culture in derelict waters, it can also be cultured in conventional well managed ponds for high production. To reach marketable size, a period of six months is normally quite sufficient.

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Aquaculture CRSP Highlights Sustainable Aquaculture at Earth Day 2003

April 22 marks Earth Day celebrations around the world. At Oregon State University (OSU), the Aquaculture CRSPs booth informed the community about ways in which we have contributed to a more sustainable future for aquaculture. The display, "Sustainable Aquaculture Around the World" (below) depicted case studies of aquaculture projects.

Besides answering questions on the Aquaculture CRSP, staff members handed out literature, including a highly popular environmentally friendly tilapia recipe book printed on recycled paper.

ROGER HARRIS

The Aquaculture CRSP display showcased sustainable aquaculture research around the world.

ROGER HARRIS

OSU students Kristen Lewis (l) and Brody Lowe discuss Aquanews at the 2003 Earth Day event on campus.

AAAS Aquaculture Symposium

Ranking among the nation's top science venues is the American Association for the Advancement of Science Annual Meeting. Aquaculture CRSP Principal Investigator Joseph Molnar, from Auburn University, has organized a symposium at next year's prestigious meeting, held in Seattle 12-17 February 2004.

The symposium's title is "Aquaculture: Recent Advances in Fish Culture, Breeding, and the Mitigation of Environmental Impact."

An impressive line-up of Aquaculture CRSP speakers slated to give presentations includes Claude Boyd, Chhorn Lim , and C. Kwei Lin. Sure to stimulate wide interest will be the panel discussion between three experts representing the environment, industry, and nongovernmental organization perspectives.

For more information on the symposium, contact: Joseph Molnar, Department of Agricultural Economics and Rural Sociology, Auburn University, Comer Hall 301, Auburn, AL 36849-5406, phone: 334-844-5615; email: <molnajj@auburn.edu>.

The Taste Test: Low-Food-Chain Species for Organic Aquaculture

by Roger Harris

From 11 to 13 July, 80 aquaculture professionals met in Minneapolis, Minnesota, to discuss low-food-chain species for organic aquaculture. Steve Sempier and Roger Harris represented the Aquaculture CRSP with a poster (co-authored with Kelli Lewis), entitled "Sustainable International Aquaculture: A Focus on Emerging Species and Low-Cost Appropriate Technology."

The International Organic Aquaculture Workshop was the second sponsored by the Institute for Social, Economic and Ecological Sustainability at the University of Minnesota.

Attending scientists directly connected with the Aquaculture CRSP included Chris Knud-Hansen and Amrit Bart, both of whom summarized their research in formal presentations.

During the conference a visiting dignitary read out a proclamation from the Governor of Minnesota naming 13 July "Organic Aquaculture Day."

Roger Harris, Amrit Bart, Chris Knud-Hansen, and Steve Sempier (l to r) at the 2003 International Organic Aquaculture Workshop.

Notice of Publication

Notices of Publication announce recently published work carried out under Aquaculture CRSP sponsorship. The following reports are published by the Aquaculture CRSP. The full reports can be downloaded as PDF files or read online at the CRSP website <pdacrsp.oregon-state.edu>. Print copies can be ordered via the website, by sending an email to <burrightj@onid.orst.edu>, or by writing to: Aquaculture CRSP, Oregon State University, 418 Snell Hall, Corvallis, OR 97331-1643.

CRSP Research Report 03-189

Potential for Supermarket Outlets for Tilapia in Honduras

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Honduran tilapia farmers currently face several problems regarding product size and export-quota requirements. One major obstacle is the production of undersized fish not suitable for the export market. Domestic markets would provide stability by offering additional market alternatives, thereby reducing risks associated with having only one target market. The goal of this project was to assess the domestic market as an alternative tilapia outlet. While the overall study includes analyses of supermarket, fish market, and restaurant market outlets, this document will focus on the supermarket segment. A census of the supermarkets listed in telephone books in the major urban areas and eight small towns in Honduras resulted in 54 completed supermarket questionnaires. The analysis provides important insights into supply characteristics, buyer patterns and preferences, and trends in the domestic market. The survey showed that tilapia is a well-known product in Honduran supermarkets. More than 40% of the supermarkets in the country sold tilapia, and 50% of supermarket managers responded that they were either somewhat or very likely to sell tilapia the next year. However, lack of demand, freshness, and seasonal availability were mentioned as primary reasons for not selling the product. Short-term strategies would focus on larger supermarkets catering to international, high-, and middle-income clientele groups. The presence of a specialized seafood section contributes to tilapia sales. Low daily volumes and lack of demand could be addressed through in-store demonstrations, samples, and point-of-purchase information. These results suggest that, provided tilapia farmers combine adequate marketing strategies with availability of high-quality tilapia, it may be possible to further develop the domestic market for tilapia in Honduras.

CRSP Research Report 03-190

Potential for Supermarket Outlets for Tilapia in Nicaragua

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Development of a domestic market for farm-raised tilapia in Nicaragua could provide an economic incentive for development of a farm-raised tilapia industry in Nicaragua. The goal of this project was to assess the domestic market as an alternative market outlet to the export market. While the overall study includes analyses of supermarket, fish market, and restaurant market outlets, this document will focus on the supermarket segment. A census of the supermarkets listed in telephone books in the major urban areas and small towns in the country resulted in 35 completed supermarket questionnaires. Information was collected on both tilapia and other types of fish and seafood sold, prices, most frequently sold fish products, marketing channels, supplier information, attitudes towards tilapia, and store characteristics. Survey results showed that only one-fourth of supermarkets in the country sold tilapia in spite of the substantial fishery for tilapia in Lake Nicaragua. Tilapia were not sold due to off-flavor (tastes like earth), lack of supply, and fears of selling contaminated fish from Lake Nicaragua. Nevertheless, those supermarkets that sold tilapia indicated that their sales in 2000 were higher than they had been in 1999. A high percentage of supermarkets indicated that they were very likely to begin selling tilapia in the coming year. Inconsistent supplies and insufficient quantities were the greatest supply problems. Fresh fillets were preferred but quality and availability needed to be improved. For a domestic market for farm-raised tilapia to develop in Nicaragua, the issue of consumer fears of contamination must be addressed. Broad-based consumer education, third-party certification, and labeling programs may be needed to assist consumers to differentiate between farm-raised and wild-caught tilapia. Tilapia farms and processors in Nicaragua will need to guarantee and ensure a consistent supply of good-flavor, high-quality, and safe tilapia products.

CRSP Research Report 03-191

Potential for Restaurant Markets for Tilapia in Honduras

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This report is part of a series of studies conducted during the third quarter of 1999 in Honduras. The project was designed to assess the Honduran market to determine the potential market for tilapia. Three different surveys were conducted: a supermarket survey, an open-air fish market survey, and a full-service restaurant survey. This report will focus on the latter. A random sample and a census of full-service restaurants were taken in all the major urban and selected rural areas of the country. The survey resulted in 72 completed questionnaires by restaurants randomly selected throughout the urban and selected rural areas. While the vast majority of restaurants were familiar with tilapia, only 30% sold tilapia. While tilapia sales were increasing, less than half of the restaurants promoted tilapia entrées. Restaurants that did not sell tilapia still rated it favorably on many attributes but had difficulty obtaining reliable supplies. These restaurant managers also were hesitant about customer reactions to tilapia. Reliable supplies, samples, and catch-of-the-day promotions in restaurants would likely be effective in increasing sales of tilapia. An emphasis on quality and year-round availability of fresh fillets will be critical factors to encourage more restaurants to experiment with tilapia.

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Potential for Restaurant Markets for Tilapia in Nicaragua

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Domestic markets for farm-raised tilapia could diversify marketing opportunities for Nicaraguan tilapia growers. The availability of alternatives to the US export market could reduce market-related risks. Three surveys were conducted in Nicaragua from August through September 2000. While the study includes surveys of supermarkets and fish market vendors, this report will focus on the restaurant market survey. A random sample of restaurants in all major urban and rural areas resulted in 118 completed restaurant questionnaires. Data were collected on aspects such as supply characteristics, supply channels, demand characteristics, preferences, and consumption patterns. Results indicated increasing potential sales of tilapia but also revealed problems such as negative perceptions by consumers of tilapia off-flavor, contaminated wild-caught fish, and inconsistency of supply. Tilapia is well known in Nicaragua. It was considered the fourth most important finfish sold, but restaurants were reluctant to admit selling tilapia due to off-flavor and consumer fears related to wild-caught tilapia from Lake Managua. Broad-based consumer education and labeling programs may be necessary to overcome perceptions of contamination. Tilapia farms and processors would need to guarantee and ensure the flavor, quality, and safety of their product. Promotional efforts that emphasize these attributes will be essential.

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Potential for Open-Air Fish Market Outlets for Tilapia in Honduras

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Honduran tilapia farmers face several problems regarding product size and export-quota requirements. One major obstacle is the significant production of undersized fish not suitable for the export market. Domestic markets would provide stability by offering additional market alternatives, thereby reducing risks associated with having only one target market. The goal of this project is to assess the domestic market as an alternative tilapia outlet. While the overall study includes analyses of open-air fish market, supermarket, and restaurant market outlets, this document will focus on open-air fish markets. A random sample of all open-air fish market vendors in the major urban areas and census of the fish market vendors in the small towns in the country resulted in 66 completed fish market questionnaires. The survey showed that tilapia is a well-known product in Honduran open-air markets. Overall, 70% of open-air market vendors sold tilapia, and over half of the open-air market vendors not currently selling tilapia responded that they were very likely to sell tilapia the next year. Approximately 25% of tilapia sold was from Lake Nicaragua. However, lack of demand, high wholesale prices, and off-flavor were mentioned as primary reasons for not selling or not continuing to sell the product. Results indicated relatively stable tilapia sales in recent years; however, inconsistency in supply was a major obstacle for further market growth. The survey results appeared to indicate potential to increase tilapia sales if a consistent supply can be maintained. Nevertheless, careful attention needs to be paid to the costs of production of farm-raised fish versus wholesale prices of wild-caught tilapia. Wholesale prices of tilapia ranged from US$0.20 to $0.61 lb^{-1} and averaged $0.51 lb^{-1}. It is unlikely that many tilapia farms

would be able to produce and transport tilapia to open-air markets at these wholesale prices. Open-air markets do not appear to represent a profitable market outlet for farm-raised tilapia.

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Potential for Open-Air Fish Market Outlets for Tilapia in Nicaragua

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Nicaraguan tilapia farmers face considerable market risk in attempting to develop export markets for their products. Domestic markets would provide stability by offering additional market alternatives, thereby reducing risks associated with having only one target market. The goal of this project was to assess the domestic market as an alternative tilapia outlet. A complete census of open-air markets was conducted in the major urban and rural population centers. The survey results indicated that tilapia was a common product in Nicaragua, with over 65% of fish market vendors selling tilapia. On average, vendors had been selling tilapia for more than ten years. Tilapia were sold most commonly by vendors with larger stands and those with slightly higher education levels. Inconsistent supplies and insufficient quantities of tilapia have resulted in decreasing sales of tilapia. Sales of freshwater fish in Nicaragua are hampered by fears on the part of consumers over contamination of Lake Managua and the safety of fish supplies as a result. Fear of contamination was the major reason why vendors had either stopped selling or never sold tilapia. Wholesale prices paid by vendors for tilapia are likely to be lower than the price levels that will be necessary to cover production costs of farm-raised tilapia.

In memoriam

We are very sorry to note the recent passing of Dr. Niall Bromage. Dr. Bromage was a professor in Reproductive Physiology and Endocrinology and Assistant Director for Research at Stirling University, Scotland.

Much of Dr. Bromage's research centered on the endocrine and environmental control of reproduction and smoltification of fish especially with regard to the provision of all-year-round supplies of eggs, larvae, and smolts for fish farming. He is remembered fondly by those who knew him.

Graduate's Corner

Congratulations to Elizabeth Trejos-Castillo on the successful defense of her M.S. thesis this spring at Auburn University, Alabama. Trejos' advisor was Joseph Molnar, a long-time Aquaculture CRSP Principal Investigator.

Income, Food Security, and Poverty Reduction: Case Studies of Small-Scale Aquaculture Producers in Santa Barbara, Honduras

(abstract of Elizabeth Trejos-Castillo's M.S. thesis)

With very few exceptions, rural aquaculture in the Central American region is not properly integrated into government structure and policy frameworks. Studies suggest that small-scale aquaculture projects in Central America have had some success, although it has been limited. Structural policies have reduced the governments' capacity to promote and develop aquaculture oriented towards the production of cheap products for the poor. In Honduras, poverty represents one of the major problems of the rural areas where individuals suffer from the lack of access to land titles, credit, and appropriate technology for their livelihood improvement. The adoption of aquaculture practices have been a long-term process in which socio-cultural as well as economic and political factors have played a determinant role. Major difficulties encountered in promoting aquaculture in the country are not linked to existing physical resources, but mainly to institutional factors, as well as to research and entrepreneurial capacity. The purpose of this study is to identify socio-economic factors leading to the successful adoption of tilapia culture by subsistence farmers and small tilapia producers at Santa Barbara, Honduras. Subsistence and small farmers' reasons for initiating, continuing, or stopping tilapia culture as well as the advantages or disadvantages of the enterprise are evaluated in the study. Results suggest that the extended relationship with a local non-governmental organization is clearly one of the reasons for the sustain practice of fish culture at the study communities. Farmers also rely on the NGO to provide technical support and seed supply. Role of women in aquaculture development programs and research at the rural areas is also an important fact to be evaluated. Women play determinant roles at almost any all the stages of the adoption of the aquaculture innovation throughout the maintenance of the enterprise. The role of public sector, non-government organizations and donor support in promotion of small-scale aquaculture is determinant for the adoption of aquaculture enterprises among the poor. Mainly due to the lack of coordination and unification of such organizations, the rate of adoption of aquaculture has been lower than expected in Honduras.

Upcoming Conferences

Date	Topic/Title	Event Location	Contact Information
September 22–25, 2003	Asian-Pacific Aquaculture	Bangkok, Thailand	World Aquaculture Conference Management; Fax: 760-432-4275; Email: worldaqua@aol.com; Website: <www.was.org>
October 15–17, 2003	Acquacoltura International 2003	Verona, Italy	Heighway Events; Phone: 44-0-20-7017-4529; Fax: 44-0-20-7017-4537; Email: sue.hill@informa.com; Website: <www.heighwayevents.com>
October 29–31, 2003	Fish Africa 2003	Cape Town, South Africa	Heighway Events; Phone: 44-0-20-7017-4529; Fax: 44-0-20-7017-4537; Email: sue.hill@informa.com; Website: <www.heighwayevents.com>
November 9–15, 2003	Expo Pesca	Lima, Peru	Thais Corporation SAC; Fax: 551-436-3318; Email: thais@amauta.rcp.net.pe; Website: <www.thaiscorp.com>
December 2–3, 2003	Aquaculture Asia-Pacific	Sydney, Australia	David Monaghan; Phone: 44-0-1892-533-813; Fax: 44-0-1892-544-895; Email: david.monaghan@informa.com
December 3–5, 2003	Aquaculture Australia	Sydney, Australia	Heighway Events; Phone: 44-0-20-7017-4529; Fax: 44-0-20-7017-4537; Email: sue.hill@informa.com; Website: <www.heighwayevents.com>
March 1–5, 2004	Aquaculture 2004	Honolulu, Hawaii	Conference Manager; Phone: 760-432-4270; Fax: 760-432-4275; Email: worldaqua@aol.com; Website: <www.was.org>

WAS/Brazil Features Plethora of CRSP Participants

The World Aquaculture Society held its Annual meeting from 19–23 May in Salvador, Brazil. Over 4,000 participants attended the event, including several CRSP participants who presented findings from their CRSP-sponsored research to those assembled. The following researchers were among those who presented:

Alcántara, F.B., P.P. Padilla, S.M. Tello, C.V. Chavez, and L.C. Rodriguez. Pond Culture of *Arapaima gigas* Cuvier in the Peruvian Amazon.

Boyd, C.E. Experiences in Training Shrimp and Fish Farmers on Pond Management.

Boyd, C.E. Site Evaluation for Aquaculture Projects.

Boyd, C.E., J.F. Queiroz, and C.W. Wood. Reaction of Liming Materials in Pond Bottom Soils.

Brown, C.L., R. B. Bolivar, and E.B. Jimenez. Moderation in Feeding—An Economic and Environmentally Friendly Approach to Tilapia Production.

Queiroz, J.F., G.S. Rodrigues, and C. Campanhola. Apoia—New Rural: A Practical Methodology for Environmental Assessment of Aquacultural Systems.

Szyper, J.P. Predicting Water Temperature Regimes in Aquaculture Systems from Nearby Airport Air Temperature Records.

Thunjai, T. and C.E. Boyd. Effects of Pond Age on Bottom Soil Quality.

Trejos-Castillo, E., J. Molnar, P. Martinez, T. Popma, S. Triminio, D. Meyer, W. Tollner, and B. Verma. Socio-Economic Factors for The Successful Adoption of Tilapia Culture by Subsistence Farmers' Clusters in Honduras: Santa Barbara Case Studies.

Yi, Y. C.K. Lin, and J.S. Diana. Recycling Pond Mud Nutrients In Integrated Lotus-Fish Culture.

Yi, Y., W. Saelee, P. Nadtirom, A.A. Mon, and K. Fitzsimmons. Tilapia-Shrimp Polyculture at Low Salinity Water: Stocking Densities of Nile Tilapia and Feeding Strategies.

Zelaya, O., A. Garza, D.B. Rouse, and D.A. Davis. Influence of Indoor Nursery Conditions on Final Pond Production and Size Distribution of *Litopenaeus vannamei*.

Special recognition is due to authors Chris Brown, Med Bolivar, and E.B. Jimenez for "Moderation in Feeding—An Economic and Environmentally Friendly Approach to Tilapia Production," which recently won the fisheries session best paper award at Central Luzon State University.

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