AQUANEWS

Sustainable Aquaculture and Fisheries for a Secure Future

Feed the Future Innovation Lab for Collaborative Research on Aquaculture & Fisheries

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Development of *Pangasius* Catfish Culture Technology in Hyposaline Waters

By M. Lokman Ali[1], Md. Abdul Wahab[2], and Russell Borski[3]

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Catfish harvest from pond with fish farmer (left) and Dr. Lokman Ali (right) (photo courtesy of Dr. Lokman Ali).

AquaFish Innovation Lab researchers working with local farmer cooperators in the Barishal region of coastal Bangladesh demonstrate for the first time that *Pangasius* catfish (*P. hypopthalamus*) can be grown in hyposaline or brackish waters. This is an important discovery, as culture of this species has been limited to freshwater systems along the Mekong delta region of Vietnam and Cambodia, Thailand, and the Central and Northern regions of Bangladesh. "Opportunities exists to expand its culture to coastal regions impacted by seawater incursion and in vulnerable communities impacted by overfishing and

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Feeding the Future Through Aquaculture: Food Security in Asia

By Paris Edwards, AquaFish Innovation Lab

Women and children after pond harvest in Nepal (photo by Hare Ram Devkota).

Nutrition-focused aquaculture research in Asia is breaking new ground on solutions to address hunger and undernutrition, particularly for women and children. Aquaculture is linked to food security and decreased poverty rates in developing nations. Fish and other aquatic organisms currently make up more than half of the animal protein consumed in several Feed the Future focus countries and represent efficient sources of protein, energy, and essential nutrients. This efficiency comes from the low ratio of input to output and the substantial human nutritional benefit from consuming fish. AquaFish is developing innovative fish culture and nutrition education approaches to address food security and nutrition challenges globally. Research and outreach efforts in Nepal and Bangladesh are improving knowledge about and access to nutritious foods, as well as increasing household income for rural communities.

Researchers from the University of

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Goings-On In the Pond...

AquaFish researchers attended World Aquaculture Society's annual meeting in Jeju, South Korea, in May 2015, and presented three posters on snakehead aquaculture research:

- Ha, N.T.N., T.T.M. Thu, and T.T.T. Hien. 2015. *Effects of storage temperatures, adding sticky rice wine, and glycerol on chemical, microbial, and sensory attributes of dried snakehead fish* (Channa striata).
- Hien, T.T.T., T.L.C. Tu, N.V. Tien, N.B. Trung, T.M. Phu, and D. Bengtson. 2015. *Effects of replacing fishmeal with soy protein concentrate on growth, feed efficiency, and digestibility in diets for snakehead* (Channa striata).
- Thu, T.T.M., L.T. Diem, N.T.H. Ha, T.L.C. Tu, and T.T.T. Hien. 2015. *Development of techniques for processing of salty fermented fish product from commercial snakehead fish*.

Josiah Ani and Kenneth Rono, AquaFish-supported students, and Julius Manyala, AquaFish HC Co-PI from Auburn University, all attended the University of Eldoret Annual Conference in June 2015. Kenneth Rono presented his Bachelor's research on: *The effect of stocking density on growth and survival of Nile tilapia* (Oreochromis niloticus) *fry reared in an aquaponic system.*

Narriman Jiddawi, AquaFish HC Co-PI from the Institute of Marine Sciences, University of Dar Es Salaam, and Maria Haws, AquaFish US Co-PI from University of Hawai'i at Hilo, held a women's shellfish workshop in Zanzibar, Tanzania on 29-30 July 2015.

AquaFish HC Lead Project PI, So Nam visited the Management Team at Oregon State University while he was in the U.S. for the American Fisheries Society's Annual Meeting in Portland, Oregon in August 2015. During his visit to OSU, So Nam was also able to visit nearby hatchery facilities.

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inadequate food security," says Professor Lokman Ali of Patuakhali Science and Technology University, the lead investigator for these studies. The coastal areas along the Ganges and Mekong Deltas of Bangladesh and Vietnam respectively, are already experiencing salinization along inland coastal areas, a trend that is expected to continue with rising sea levels. Moreover, the Southern regions of Bangladesh have traditionally relied on fishing or aquaculture of marine species (e.g., shrimp) for their economic livelihoods.

Professor Ali, along with his collaborators at Bangladesh Agricultural University and North Carolina State University, selected farmers in the Patuakhali district in the greater Barisal region to carry out a study to assess the potential for expanding culture of *Pangasius* in hyposaline waters endemic along the coastal inland regions of Southern Bangladesh. Fish were raised in six replicate ponds at three different salinity ranges: 0.0-0.5 ppt (freshwater), 5-7 ppt, and 10-12 ppt (about one third of full-strength seawater). Household members were trained on all aspects of the study, including data collection, fish feeding, pond maintenance, sampling, and harvesting. The research results show that fish raised at the higher salinities exhibited similar survival rates (96.1 – 96.8%), weight gain (677-680 g), growth rates (2.87 % weight gain/day), feed conversion efficiency (1.61-1.63), and overall performance as those reared in freshwater over the four-month trial. The benefit-cost ratio (1.31-1.32) was similar for fish under the different treatments, and water quality parameters were well within the range suitable for *Pangasius* culture. There also appeared to be fewer incidences of disease in animals that were raised at the higher salinities.

"This is a great opportunity for my family and community - we can make more income and the Pangasius *are delicious", says one farmer.*

A participating household in the catfish culture project (photo courtesy of Dr. Lokman Ali).

These findings demonstrate that *Pangasius* can be cultured in salinities as high as 12 ppt, and were presented at the World Aquaculture Meeting in Jeju, South Korea, 26-30 May 2015. The participating farmers are very excited by the results. The technology of hyposaline culture of *Pangasius* catfish has received considerable media coverage, and drawn the attention of many local farmers, government officials, and NGOs.

Adoption of *Pangasius* culture in coastal regions in the Southwest and Southern districts of Bangladesh has opened up the potential for mass-scale culture and production of *Pangasius* catfish as an alternative livelihood and nutrition for communities. As overfishing, increased frequency of natural calamities, and disease outbreaks in shrimp culture continue to impact the impoverished communities of coastal Bangladesh, sustainable intensification of aquaculture is critical. Considering that 60% of animal protein consumed in Bangladesh comes from the fisheries sector and more than half a million fishers live in severe poverty in the Barisal region alone, promotion of *Pangasius* culture, particularly in regions underutilized for agriculture, livestock production, or aquaculture, can greatly contribute to an improved economic and nutritional status for these communities.

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Michigan and the Agriculture and Forestry University (AFU) in Nepal are working with primary schools in the Chitwan and Nawalparasi districts in Nepal to educate communities about nutrition and expand the practice of household fish cultivation. Classes cover aquaculture techniques for freshwater finfish, such as carp and tilapia, throughout the growout process. The school pond program builds upon previous AquaFish Collaborative Research Support Program (CRSP) research that found households with fish ponds in these districts consumed significantly more fish than those without ponds, regardless of income.

Current work is helping to spread the practice of household aquaculture in the region through the development of on-site school ponds and aquaculture curricula. Students are learning a broad set of skills, including fish pond construction, pond depth maintenance, species options, water quality management, pond fertilization, harvest techniques, and general nutritional benefits of consuming fish. In coordination with the school pond program, women's groups, comprised of school parents and interested community members, are learning about the nutritional benefits of fish consumption, as well as preparation and cooking techniques, and post-harvest practices. This hands-on, community-focused aquaculture and nutrition education in Nepal represents an innovative approach to addressing food security challenges.

Nutrient-dense mola fish (photo courtesy of the AquaFish Innovation Lab).

Aquaculture also plays a critical role in food security and nutrition in Bangladesh. AquaFish researchers from North Carolina State University and Bangladesh Agriculture University are leading work with freshwater prawn farmers in the rural Khulna District to enhance production and income through polyculture and gardens composed of a mixture of ponds and vegetables. Initial results indicate that polyculture of the highly nutritious mola with prawns, or prawns and carp, allows farmers to generate more income and increases their consumption of mola and carp without impacting prawn productivity. Mola are small, indigenous fish commonly eaten whole and are rich in essential fatty acids, vitamins, and minerals. To further enhance nutrition access for households, soil fertilization and vegetable gardening techniques are combined with fish cultivation. Vine spinach, an important leafy green vegetable, is being planted for cultivation. Pond mud is used to fertilize the existing, underutilized space along pond dikes and will be tested according to whether or not added nutrient value is brought to the soil. This highly integrated approach to fish polyculture and integrated gardening is helping communities in rural Bangladesh solve obstacles to food security by increasing food quality, maximizing production, and improving income generation.

These two examples demonstrate the innovative, cross-discipline nutrition-focused aquaculture research and information dissemination efforts that are underway by AquaFish researchers to address global food security and malnutrition.

AquaFish Student Corner

Graduate Student Profile: Moureen Matuha

By Morgan Chow, AquaFish Innovation Lab

Cell phones are changing the way markets interact, and have been widely recognized as a powerful tool in food production. In aquaculture, technical guidance, product assembly, and price discovery are just three of the many practical applications of using cell phones to advance communication in markets and improve aquaculture productivity and profitability. A Ugandan study found that market participation rises with increased access to mobile phones. In Kenya, the Marine Fisheries Service is developing an SMS-based system to provide accurate, updated data on fish landings. Other applications could include providing numbers of available fingerlings for distribution, placing orders for seed stock, and coordinating stocking and harvesting locations and times. Since aquaculture plays an increasingly important role in income generation and improved nutrition in rural Uganda, developing ways to overcome barriers in markets is a crucial component of AquaFish research and the future of the industry.

Moureen Matuha understands that the use of cell phones as a means of disseminating aquaculture and market information can also lead to more available market information, increased efficiency in moving goods, and increased income. Her Master's research as an AquaFish-supported student at Auburn University, aims to promote aquaculture development through cell phone network development in Uganda. The first steps of Moureen's research were to collect baseline data and to assess fish farmers' needs and interests for cell

Moureen Matuha at Aquaculture America 2015 (photo courtesy of Moureen Matuha).

phones as a source of information and technical guidance. These data will be used in collaboration with researchers, government staff, and cellular providers to advance aquacultural development in Uganda.

Originally from Buikwe district, Uganda, Moureen graduated with her Bachelors in Environmental Science Technology and Management from Kyambogo University. Before Moureen began her Master's, she volunteered in the Water Environment Section of the National Fisheries Resources Research Institute (NaFIRRI), where she participated in a number of research projects. Moureen was especially moved by her interactions with women who owned farms because Moureen grew up thinking fish farming was only for men. It was these interactions that motivated her to get more involved in aquaculture and go back to school for her Master's in aquaculture.

Under the advisory of Joseph Molnar, AquaFish US Lead Project PI, Moureen is pursuing a Masters in Fisheries and Allied Aquaculture at Auburn University. Moureen and her fellow researchers

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AquaFish Student Corner

Moureen interacting with one of Uganda's prominent fish farmers (photo courtesy of Moureen Matuha).

hope that this study will expand the already existing cell-based system that was developed by Grameen Foundation in Uganda by providing a better understanding of the current challenges in aquaculture. The findings show that information on pond construction and management, marketing, water quality management, quality feeds, feeding procedures, hatchery management, disease management, and stocking and harvesting are all needed by Ugandan fish farmers. The next step is to identify potential fish farmers and village agents at each sub-county in Uganda to be trained on cell phone-based aquaculture market operations such as communicating with buyers, asserting bargaining power, and accessing new market information and financial services.

Moureen says that the most enjoyable part of her work is interacting directly with fish farmers so that she can better understand the day-to-day challenges they face. She looks forward to future collaboration with AquaFish researchers and other aquaculture research institutions, as well as the Ugandan government and the Ministry of Fisheries. Outreach is very important to Moureen, and she plans to continue to lead trainings throughout Uganda with fish farmer associations. One day, she too hopes to have her own farm.

PONDerings...

Although you hide in the ebb and flow

Of the pale tide when the moon has set,

The people of coming days will know

About the casting out of my net,

And how you have leaped times out of mind

Over the little silver cords,

And think that you were hard and unkind,

And blame you with many bitter words.

-William Butler Yeats

AquaFish Management moves again...

After four moves in less than four years, AquaFish Management is finally secured in the recently earthquake-retrofitted Strand Hall, where Oregon State University's College of Agricultural Sciences now resides.

What Improved Feeds Can Bring to the Pond

By Morgan Chow, AquaFish Innovation Lab

Choosing the right feed is one of the most important production decisions farmers must make. In aquaculture, feed can amount to more than 80% of total production costs for farmers globally, and poses a significant barrier to small- and medium-scale aquaculture growth. Reductions in feed usage can significantly improve farmers' incomes, while improved feed quality can contribute to higher quality fish while also reducing negative impacts on the surrounding environment. AquaFish researchers have been conducting research on improved feeds with aims to increase productivity for commercially valuable fish species for aquaculture.

Farmers in Bangladesh carry recently harvested fish (photo courtesy of Dr. Lokman Ali).

In Kenya, AquaFish researchers are formulating a higher quality pelleted feed for tilapia aquaculture for easy consumption, minimizing food waste, and improving overall food quality. In Vietnam, AquaFish is working to replace costly and resource-intensive fishmeal with soy-based protein for carnivorous freshwater snakehead aquaculture.

Not only do improved feeds positively impact aquaculture productivity, but different feeding strategies also play a role in enhanced aquaculture production. Previous AquaFish research has shown that Nile tilapia and milkfish can be grown to market size with significant cost savings if alternate-day feeding is applied instead of daily feeding. Reduced feeding can also promote foraging on primary production within ponds, resulting in a diversified diet.

AquaFish researchers at Bangladesh Agricultural University (BAU) and North Carolina State University are studying the effect of pulsed feeding strategies on the growth performance, gastrointestinal nutrient absorption efficiency, and the establishment of beneficial gut flora in tilapia pond culture. Preliminary results of BAU's pulsed feeding strategy research show that the optimal benefit-cost ratio for tilapia production in fertilized ponds occurs when fish are fed on alternate days. This means that high production can be achieved with 50-65% less feeds.

In addition to reducing costs while retaining high productivity, this work goes further to better understand factors associated with nutrient uptake efficiency and absorption in tilapia, such as amino acid and lipid transporters in the intestine, and attempts to characterize changes in gut microbial communities in response to pulse-feeding. Previous research has shown that probiotic maintenance of beneficial gut flora in farmed finfish can promote growth, greater nutrient availability, and positive impacts on human health. Alternate feeding practices could further benefit farmers in Bangladesh if they are found to influence tilapia nutrient uptake efficiency and gut flora composition.

The AquaFish feeds research in Kenya and Bangladesh exemplify the importance of improving feeds for increased productivity in aquaculture, higher quality fish, and potentially greater nutrient availability for human consumption.

Notices of Publication

Notices of Publication announce recently published peer-reviewed work carried out with AquaFish support. To receive a full copy of a publication, please contact the author(s) directly. All past and present Notices of Publication can be found on the AquaFish website at: aquafish.oregonstate.edu/nop.php

Impact of the adoption of BMPs on social welfare: A case study of commercial floating feeds for pond culture of tilapia in Ghana (15-342).

Yaw B. Ansah and Emmanuel A. Frimpong.

Best management practices (BMPs) are the most cost-effective means of mitigating negative impacts of pond aquaculture on the environment. The impacts of BMPs and other innovations on fish farm profits have been studied widely. This study estimates impacts of BMP adoption on social welfare. We employed the economic surplus model to determine net present value (NPV) of adopting the more expensive but less polluting commercial floating fish feed in the pond culture of Nile tilapia (*Oreochromis niloticus*) in Ghana. We also conducted a sensitivity analysis to determine which variables had the greatest influence on mean NPV. Our results indicate an NPV of US$ 11 million from the adoption of commercial floating feed in pond farming alone in Ghana. The variables with the biggest impacts on NPV were level of change in tilapia yield, and level of change in production costs, with the adoption of the new feed type. We conclude that adoption of yield-enhancing BMPs and innovations in Ghana will result in significant social welfare benefits. We recommend that credit programs and other financial packages be set up by governments or nongovernmental organizations to help farmers meet the increased cost of fish feed and to accelerate diffusion of commercial fish feed in pond farming.

This abstract was excerpted from the original paper, which was published in Cogent Food & Agriculture (2015), 1: 1048579.

Using model-based inference to select a predictive growth curve for farmed tilapia (15-343).

Yaw B. Ansah and Emmanuel A. Frimpong.

Aquaculture presents a unique challenge to the modeling of fish growth, because the main objective is to accelerate growth for profit. Growth patterns of captive fish in wellfed conditions will diverge from that found in wild fish. For a fish-farming enterprise, overestimating growth will lead to expectations for revenue and profit that will not be realized. Underestimating growth will lead to planning for later harvest than is optimal and the unnecessary additional cost of feeding. We evaluated the performance of four candidate models—Gompertz, logistic, quadratic, and von Bertalanffy—in predicting the growth of Nile Tilapia *Oreochromis niloticus*. Each model was fitted to 20 weight-at-age data sets collected from five demonstration farms in Ghana over a 5-month period. We used the Akaike information criterion adjusted for small sample size and model weights to assess model fit. We also assessed predictive performance by comparing predicted to actual growth observed over the last month of the experiment. The logistic growth model performed best for both model fitting and prediction. For a 1-month period approximately between day 121 and day 152 all but the logistic model overpredicted growth with corresponding SEs as follows: Gompertz (14.9 ± 3.8 g, mean ± SE), von Bertalanffy (21.0 ± 3.9 g), and quadratic (34.0 ± 3.6 g). The logistic model (–0.5 ± 3.8) did not significantly over- or underpredict growth, and is recommended for predicting future growth of Nile Tilapia under pond culture conditions in applications such as the construction of enterprise budgets to assess profitability of tilapia farms. The default fitting of the von Bertalanffy growth model to farmed tilapia data is not supported by this study.

This abstract was excerpted from the original paper, which was published in North American Journal of Aquaculture (2015), 77: 281-288.

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Development of formulated diets for snakehead (*Channa striata* and *Channa micropeltes*): Can phytase and taurine supplementation increase use of soybean meal to replace fish meal? (15-344).

Tran Thi Thanh Hien, Tran Thi Be, Chong M. Lee, and David A. Bengtson.

Culture of snakehead species is limited in Vietnam and banned in Cambodia because of the reliance of the industry on feeding them "small-size" fish (sometimes called trash fish or low-value fish), many of which are juveniles of commercially important species. In an effort to find substitutes for small-size fish, we conducted a series of experiments to test formulated diets with several levels of soybean meal (SBM) replacement of fish meal. Feeding trials lasted eight weeks, after which survival, growth, food conversion ratio and protein efficiency ratio were compared. In the first two experiments, with *Channa striata*, we substituted SBM, either with or without supplementation of phytase (20 mg/kg) (Experiment 1) or taurine (1 g/kg) (Experiment 2), for 0, 20, 30, 40, or 50% of the fish meal. Experiment 1 demonstrated that SBM can replace 30% of the fish meal without, and 40% of the fish meal with, phytase supplementation. Experiment 2 showed again that SBM can replace 30% of the fish meal without, and 40% of the fish meal with, taurine supplementation. The third experiment, with *Channa micropeltes*, which was done only with phytase supplementation, showed that 40% of fish meal can be replaced by SBM. In all the SBM diets, the essential amino acids (EAA) lysine, methionine and threonine were also added to make their dietary levels equal to those in the fish meal control diet. Use of the SBM replacement diets, in addition to conserving the small-size fish in the wild, would result in economic savings (cost/kg of fish produced) of about 11% compared to diets based on fish meal alone.

This abstract was excerpted from the original paper, which was published in Aquaculture (2015), 448: 334-340.

Application of Porter's Framework to assess aquaculture value chain in Kenya (15-345).

L.Z.B. Ndanga, K. Quagrainie, C.C. Ngugi, and J. Amadiva.

Aquaculture (fish farming) is an agricultural as well as fisheries activity, competing with other agricultural enterprises and artisanal fisheries for the same basic inputs. Therefore, aquaculture is subject to the same basic resource constraints that traditional agricultural activities face. The literature suggests that competition within a value chain is between chains and not individual actors. This study examined the aquaculture value chain in Kenya, assessing the entire value chain, and determining the appropriate points to participate in economically sustainable ways. The competition analysis assessed attractiveness at each stage of the chain by reviewing the rivalry in terms of five competitive forces within the Kenyan aquaculture industry; competitive rivalry, the threat of new entrants, bargaining power of suppliers, threat of substitutes and bargaining power of buyers. The aquaculture industry in Kenya is assessed using Porter's model with marketing mix (Ps) and factor evaluation matrix (FEM). Input supply is found to be the most difficult value chain function in which to participate because it requires relatively large initial capital outlays and additional operating funds. Although fish farming is the driving function of the entire value chain, the significant capital investments required could be a barrier to entry. Fish farming has largely benefited from the support of government, NGOs and other regional development initiatives. The study established that the easiest sector to enter (in terms of low barriers to entry and exit and low labour requirements) is the fish marketing sector. This chain function provides the most flexibility and liquidity to participants, whether as full-time or part-time occupation. Overall, participation in the Kenya aquaculture value chain will depend on the prospective entrant's level of experience, time, capital commitment and financial goal (long term stability versus liquidity). Aquaculture requires a long term commitment and high capital outlays, as

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well as persistence, and should therefore be considered by those looking for long term stability and not short term benefits. Established fish farmers may consider diversifying into input supply and value addition as well.

This abstract was excerpted from the original paper, which was published in African Journal of Food, Agriculture, Nutrition, and Development (2015), 15(3): 10118-10137.

Inferring invasion history of red swamp crayfish (*Procambarus clarkii*) in China from mitochondrial control region and nuclear intron sequences (15-346).

Yanhe Li, Xianwu Guo, Liping Chen, Xiaohui Bai1, Xinlan Wei, Xiaoyun Zhou, Songqian Huang, and Weimin Wang.

Identifying the dispersal pathways of an invasive species is useful for adopting the appropriate strategies to prevent and control its spread. However, these processes are exceedingly complex. So, it is necessary to apply new technology and collect representative samples for analysis. This study used Approximate Bayesian Computation (ABC) in combination with traditional genetic tools to examine extensive sample data and historical records to infer the invasion history of the red swamp crayfish, *Procambarus clarkii*, in China. The sequences of the mitochondrial control region and the proPOx intron in the nuclear genome of samples from 37 sites (35 in China and one each in Japan and the USA) were analyzed. The results of combined scenarios testing and historical records revealed a much more complex invasion history in China than previously believed. *P. clarkii* was most likely originally introduced into China from Japan from an unsampled source, and the species then expanded its range primarily into the middle and lower reaches and, to a lesser extent, into the upper reaches of the Changjiang River in China. No transfer was observed from the upper reaches to the middle and lower reaches of the Changjiang River. Human-mediated jump dispersal was an important dispersal pathway for *P. clarkii*. The results provide a better understanding of the evolutionary scenarios involved in the rapid invasion of *P. clarkii* in China.

This abstract was excerpted from the original paper, which was published in the International Journal of Molecular Science (2015), 16: 14623-14639.

Induced spawning of the common snook (*Centropomus undecimalis*) in captivity using GnRH-a implants (15-347).

María de Jesús Contreras-Garcia, Wilfrido M. Contreras-Sánchez, Ulises Hernández-Vidal, and Alejandro Mcdonal-Vera.

Culture of *Centropomus undecimalis* shows great potential as this species tolerates handling and adapts easily to captivity. However, the difficulty in achieving spawning in captivity is a major obstacle for the development of commercial scale farming. Spawning of common snook was achieved using GnRH-a implants in single 100 and 200 µg doses per fish; control group specimens received no hormone and did not spawn. Both GnRH-a trial doses resulted in spawning with up to 100% fertilization rates per experimental unit, and a range of 60-75% per treatment, showing no statistical differences ($p < 0.05$). The percentage of hatching rate was between 50-100% and larvae measured between 1.56 ± 0.08 and 1.98 ± 0.05 mm total length after yolk sac absorption.

This abstract was excerpted from the original paper, which was published in Ecosistemas y Recursos Agropecuarios (2015), 2(6): 357-362.

AquaFish Management presented four posters at the American Fisheries Society (AFS) Annual Meeting in Portland, Oregon, USA, 16-20 August 2015:

- Chow, M., and H. Egna. 2015. *Gender dimensions in disaster management: Implications for coastal aquaculture and fishing communities in the Philippines.*
- Ichien,S., J. Borberg, J. Hawkins, and H. Egna. 2015. *The potential role of air-breathing fish in enhancing climate resilience for small-scale fish farmers.*
- Price, C., P. Edwards, J. Borberg, H. Demmin, K. Goetting, and H. Egna. 2015. *Innovative fish feeds and nutrient input systems for small-scale aquaculture in Africa and Asia.*
- Price, C., K. Goetting, H. Demmin, and H. Egna. 2015. *Global experiment central database: The world's largest inventory of standardized pond aquaculture data.*

AquaFish HC Lead Project PI, So Nam, with AquaFish-Supported PhD student Stephanie Ichien at AFS Portland 2015 (photo courtesy of Stephanie Ichien).

Upcoming Meetings and Events...

Aquaculture 2016
22-26 February 2016
Las Vegas, Nevada, USA
https://www.was.org/meetings/default.aspx?code=AQ2016

International Symposium on Tilapia in Aquaculture
26-29 April 2016
Surabaya, Indonesia
http://ag.arizona.edu/azaqua/ista/ISTA11/ISTA11.htm

Asian-Pacific Aquaculture 2016
26-29 April 2016
Surabaya, Indonesia
http://www.marevent.com/APA2016_INDONESIA/APA16%20Reg%20Bro%206-22.pdf

International Institute of Fisheries, Economics, and Trade Conference 2016
12-15 July 2016
Aberdeen, Scotlad
http://www.iifet-2016.org/

11th Asian Fisheries & Aquaculture Forum, Asian Fisheries Society
3-7 August 2016
Bangkok, Thailand
http://www.asianfisheriessociety.org/events.php

6th Global Symposium on Gender in Aquaculture and Fisheries
3-7 August 2016
Bangkok, Thailand
http://genderaquafish.org/

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