FEED THE FUTURE INNOVATION LAB FOR COLLABORATIVE RESEARCH ON AQUACULTURE & FISHERIES (AQUAFISH INNOVATION LAB)

ANNUAL WORK PLAN

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AQUAFISH

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

Cover photo
Bangladesh 2014, photo by Hillary Egna.

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INTRODUCTION

This Work Plan covers the period from 1 October 2015 to 30 September 2016, and includes descriptions of activities covered in detail in the *Implementation Plan 2013–2015* and continuing work will be detailed in the *Implementation Plan 2016 - 2018*.

Phase II of the *Feed the Future Innovation Lab for Collaborative Research on Aquaculture & Fisheries* (AquaFish Innovation Lab) builds on previous successes of earlier CRSP efforts and makes significant global and regional advances in Asia and Africa. Collaborative research focuses on improving sustainable aquaculture productivity through the development and transfer of innovative technologies and management practices that:

- Address health and nutrition needs especially of women and children;
- Consider natural resource management, climate change, and biodiversity issues with targeted programs that protect native fisheries and the integrity of local and regional water systems; and
- Advance market development by linking small producers to markets and training rural stakeholders in food safety and food quality standards.

As part of the Food Security Innovation Center (FSIC), AquaFish falls under the Program for Research on Nutritious and Safe Foods. This Program "addresses undernutrition, especially in women and children, by increasing the availability and access to nutrient dense foods through research on horticulture crops, livestock, fish and dairy, food safety threats such as mycotoxins and other contaminants and on household nutrition and food utilization" (R. Bertram 12/07/12).

AquaFish shares the Feed the Future (FTF) aim of accelerating progress toward meeting the poverty and hunger Millennium Development Goal. AquaFish works towards this goal by accelerating inclusive agriculture sector growth through improved aquacultural productivity, expanded markets and trade, and increased economic resilience in vulnerable rural communities. Improvements in nutritional status are anticipated by increasing availability and access to diverse and high quality animal source foods. The ability to access and utilize food must remain stable and sustained over time. Paying attention to cross cutting themes of gender, environment (climate change), and natural resources management is expected to result in development gains across society.

This work plan focuses on project-level activities. Details of work to be conducted by the Management Team can be found in the Technical Application of Modification 8 of the Leader Award. For a list of project travel during this reporting period, please see Appendix 1. The Monitoring and Evaluation Plan, with FY15 and FY16 FTFMS targets, is provided in Appendix 2.

ANNUAL WORK PLAN OBJECTIVES

I. Project Implementation

Oregon State University (OSU) received a five-year extension from USAID beginning 31 March 2013 and ending 29 March 2018, under the new USAID-approved name *Feed the Future Innovation Lab for Collaborative Research on Aquaculture & Fisheries* (AquaFish Innovation Lab). The AquaFish team at OSU is implementing a global research program that is composed of competitively awarded projects that are regionally and thematically linked to the needs and interests of USAID, Host Country institutions, the US university community, policy makers, practitioners, and end-users. The first year of operations revolved heavily around the competitive awards process. Plans were based on broad experience managing numerous competitive awards processes. They were also based on several innovative strategies to keep costs down, support Host Country institutions and researchers while the competitive process was underway, and increase the opportunity for delivering intermediate results by the third year.

AquaFish 2013-2015 Implementation Plan
In 2013, a streamlined RFP was designed for continuation proposals from existing Lead Projects at University of Michigan, North Carolina State University, and University of Connecticut for work in Asia, and from Auburn University and Purdue University for work in Africa. The RFP was vetted at USAID (with the AOR and OAA) as part of the Technical Application and review process. The review process consisted of two types of reviews: technical and programmatic. The *technical reviews* followed an NSF-style peer review process and addressed technical merit as well as collaboration and broader impacts. *Programmatic reviews* represented the final review tier, and were only carried out for proposals with high technical merit. Programmatic reviews were aimed at aligning proposals with AquaFish goals and maintaining portfolio balance. The programmatic review also involved USAID/BFS, especially in regards to country involvement, environmental concerns, gender inclusivity, and FTF alignment.

Lead Project Institutions were funded over a two-year Implementation Plan from 2013-2015 (http://aquafishcrsp.oregonstate.edu/page/implementation-plans), and projects are taking place in the following countries in Asia and Africa: Bangladesh, Nepal, Cambodia, Vietnam, Ghana, Tanzania, Uganda, and Kenya, with additional key project personnel in the Philippines. These Lead Project Institutions further partnered with other universities including University of Hawaii Hilo, University of Arizona, Virginia Tech, University of Arkansas at Pine Bluff, University of Rhode Island, and Alabama A&M. Funded Lead Project Institutions entered into MOUs with partnering institutions, ensuring, among other things, that Host Country investigators and institutions are treated as full and equal partners in the funded project.

AquaFish 2016-2018 Implementation Plan
As planned by AquaFish and approved by USAID, existing projects will undergo a mid-term review in FY16, and work that builds on and adds value to previous AquaFish work will be continued. AquaFish has also initiated the planning for undertaking an impact assessment project to evaluate long-term training strategies.

II. Planned Work and Locations

Investigation titles and project descriptions are provided below and are expanded upon in the AquaFish Innovation Lab's *Implementation Plan 2013–2015* and addenda.

ASIA PROJECT: BANGLADESH

Enhancing Aquaculture Production Efficiency, Sustainability, and Adaptive Measures to Climate Change Impacts in Bangladesh

US Institutions: North Carolina State University (Lead)
Host Country Institutions: Bangladesh Agricultural University, Khulna University, University of Dhaka, Hajee Mohammed Danesh Science Technology University, Patuakhali Science and Technology University (Bangladesh)
Other Collaborations and Linkages: Southeast Asian Development Center, Central Luzon State University (Philippines)

Investigations
Economic and Environmental Benefits of Reduced Feed Inputs in the Polyculture of Tilapia and Major Indian Carps (13SFT04NC)

Pulsed Feeding Strategies to Improve Growth Performance, Gastrointestinal Nutrient Absorption Efficiency, and Establishment of Beneficial Gut Flora for Tilapia Pond Culture (13SFT05NC)

Novel Approach for the Semi-Intensive Polyculture of Indigenous Air-Breathing Fish With Carp for Increasing Income and Dietary Nutrition While Reducing Negative Environmental Impacts (13MNE01NC)

The Culture Potential of Pangasius Catfish in Brackish (Hyposaline) Waters of the Greater Barisal Regions in Southern Bangladesh (13BMA02NC)

Integrated Mola Fish and Gher/Freshwater Prawn Farming with Dyke Cropping to Increase Household Nutrition and Earnings for Rural Farmers in Southwest Bangladesh (13HHI03NC)

Production of Nutrient-rich Small Fish Mola and Freshwater Prawn Using Integrated Cage-Pond Carp Polyculture for Northwest Bangladesh (13BMA03NC)

Improving Nutritional Status and Livelihoods for Marginalized Women Households in Southwest Bangladesh through Aquaculture and Value Chain Analysis (13MER04NC)

Project Description
Bangladesh is the most densely populated country in the world, with 40% of the population living in abject poverty. Fifty percent of women are malnourished, with over 40% of children under the age of five showing moderate to severe stunting. Finfish are an important source of nutrition, comprising > 60% of the dietary protein for most people. Accordingly, aquaculture in Bangladesh is considered a high food security priority for enhancing dietary nutrition and improving the economic livelihoods for its poorest citizens. Aquaculture production in Bangladesh faces significant problems which directly threaten the lives and economic livelihoods of local farmers, including: limited production of nutrient-rich foods

available for direct consumption, poor productivity and high mortality rates in marine shrimp (cash crop), excessive and costly feed inputs leading to poor economic return, poor pond management leading to low water quality and environmental degradation, limited diversification of aquaculture products, and a poor understanding of the value chain for seafood products. This project will address these problems, including those centered in the high priority regions of Southwest Bangladesh.

Feed is the most costly aspect of fish farming, representing over half of the total production cost for tilapia, and is even higher in the farming of indigenous, air-breathing fishes (Shing and Koi) currently produced by monoculture. This project will incorporate reduced-feeding protocols, in combination with polyculture production of popular Indian carp species, into current practices of tilapia, Shing, and Koi farming. Technologies promoting a more cost-effective and sustainable method of Shing/Koi farming, fishes rich in iron and other minerals, will contribute toward alleviating malnutrition common in rural women and young children, such as iron-deficient anemia. This project will also investigate novel metagenomic approaches to identify gut microbial communities linked to enhanced feed conversion of tilapia, to lay the framework toward development of probiotic supplements for improving fish growth.

The coastal plain regions of South and Southwest Bangladesh are particularly impoverished and therefore are areas of high priority for the Feed the Future initiative. Three investigations (4-5, 7) are specifically targeted to benefit the economic livelihoods of rural farming communities in these regions. Shrimp farming and fisheries were once the economic mainstays for coastal peoples, but these industries are not environmentally sustainable and appear to be rapidly declining. This project will also test a novel polyculture/land-farming strategy, whereby Mola (*Amblypharyngodon mola*), a small indigenous fish with high vitamin A content, is cultured with prawns and pond muds are used as fertilizer to grow fresh vegetables on unflooded gher-dykes. Currently, 38% of rural children in Bangladesh suffer from chronic vitamin A deficiency. For many women-led households in coastal Bangladesh, the sale of mudcrab (*Scylla serrata*) constitute their sole economic livelihood. Currently, the economics of mud-crab culture are not understood, and local communities and government support may advance the production and marketing methods through better participation. This project will conduct a value-chain analysis on mud-crab farming by women in coastal Bangladesh to identify how this industry can be further developed for their benefit.

ASIA PROJECT: CAMBODIA & VIETNAM

Improving Food Security, Household Nutrition, and Trade Through Sustainable Aquaculture and Aquatic Resource Management in Cambodia and Vietnam

US Institutions: University of Connecticut- Avery Point (Lead), University of Rhode Island
Host Country Institutions: Inland Fisheries Research and Development Institute (Cambodia), Can Tho University (Vietnam)

Investigations
Impacts of Climate Change on Fish Value Chains in the Lower Mekong Basin of Cambodia and Vietnam (13MER03UC)

Alternative Feeds and Processing for Freshwater Aquaculture Species (13SFT03UC)

Sustainable Snakehead Aquaculture Development in the Lower Mekong River Basin of Cambodia (13IND02UC)

Estimating Carrying Capacity for Aquaculture in Cambodia (13WIZ01UC)

Enhancing Food Security and Household Nutrition of Women and Children with a Focus on Nutrient Dense Commonly Consumed Fish from Capture Fisheries and Aquaculture in Cambodia (13HHI02UC)

Policy Recommendations to Improve Food Security and Household Nutrition through Sustainable Aquaculture and Aquatic Resource Management in Cambodia and Vietnam (13PDV01UC)

Project Description
This project focuses on poverty alleviation and food security improvement through sustainable aquaculture development and aquatic resources management in Cambodia and Vietnam; especially in the context of climate and non-climate drivers of change. The work undertaken through this project will be sustained after the life of the project by the partners in Cambodia and Vietnam and with a number of partner organizations and projects.

In Cambodia, freshwater aquaculture production has increased rapidly over the last two decades, with an annual average growth rate of about 20 percent. In 2010, aquaculture represented 12 percent of total inland fisheries production. In Vietnam, the annual growth of aquaculture has been about 10-13 percent during the last decade. The Mekong Delta region of Vietnam often contributes about 55-60% of the total aquatic production and more than 60% of total aquatic production for export of the whole country. Any adverse impacts to the fisheries and aquaculture sector in the region will therefore have implications for the region's economic development, for poverty reduction, and for global as well as regional food security. Importantly, it must be recognized that these two countries are highly vulnerable to climate change because of their low capacity to respond and adapt. Climate change is likely to have negative impacts on capture fisheries systems already stressed by overexploitation and pollution and also likely to impact the productivity and viability of aquaculture operations.

Past studies of AquaFish CRSP produced a number of outcomes, including development of a plant based feed for snakehead fish, recommendations to government and the private sector for a sustainable snakehead aquaculture industry, value-added products from small-sized/low value fish such as fish paste and fish sauce, extension/outreach technologies, recommendations for improvements in the marketing system for both capture and culture fish in the region, and recommended policies to improve management of small-sized/low value fish in the Mekong area. These outcomes have impacted or are impacting both the private and public sectors through improvements in technologies, commercialization of new products, sustainable aquatic resource management practices, and policies for aquaculture and capture fisheries. The vision of this project is poverty alleviation and food security improvement through sustainable aquaculture development and aquatic resources management in Cambodia and Vietnam; especially in the context of climate and non-climate drivers of change. This vision takes into account the need to address under-nutrition, especially in women and children, by increasing the availability and access to nutrient dense foods through research on fish.

This project will address this issue through six separate but complementary investigations on fish value chains, development of feeds and feeding strategies and processed products, sustainable snakehead aquaculture systems, estimating carrying capacity for aquaculture, food and nutrition security vulnerability of women, and policy and outreach. The research to be undertaken through this project has been identified as high priority by the Cambodian government. It is expected that the government, through IFREDI and FiA, will continue to fund these research areas and seek additional donor funding.

ASIA PROJECT: NEPAL

Development of More Efficient and Environmentally Sustainable Aquaculture Systems for Nepal

US Institution: University of Michigan (Lead)

Host Country Institutions: Agriculture and Forestry University (Nepal)
Other Collaborations and Linkages: Institute of Agriculture and Animal Science, Directorate of Fisheries Development (Nepal)

Investigations
Reproduction and Seed Production of Sahar (*Tor putitora*) in Chitwan, Nepal (13QSD02UM)

Production of Periphyton to Enhance Yield in Polyculture Ponds with Carps and Small Indigenous Species (13SFT08UM)

Household Fish Ponds in Nepal: Their Impact on Fish Consumption and Health of Women and Children and Their Constraints Determined by Value Chain Analysis (13MER06UM)

Two Small Indigenous Species to Improve Sustainability in Typical Polyculture Systems in Nepal (13IND04UM)

Demonstrating the Value of Tilapia and Sahar production in Polyculture Ponds Using Government Farm and On-Farm Trials (13BMA06UM)

Establishing School Ponds for Fish Farming and Education to Improve Health and Nutrition of Women and Children in Rural Nepal (13HHI04UM)

Project Description
Nepal is a poor country; most residents are at best educated at the level of primary schooling, and many are undernourished or even malnourished. As a result of this poverty, most planning documents produced by the government, as well as outside organizations, concentrate on human health and nutrition as the main focus for future development of aquaculture. This focus is long standing. In 1976, Rana and Rajbanshi developed a National Plan for Development of Aquaculture in Nepal, which focused on increasing production of household ponds and other systems that would provide nutrition to poor households as the main concept. Subsequent plans in Nepal, including the Fisheries Perspective Plan (GoN 2000), the Strategic Vision of Aquaculture Research (NARC 2010), and evaluations by FAO (2013) all maintain nutrition for poor families as the main focus. Throughout the poorer countries of Asia, small indigenous species of fish (SIS) are promoted as a means to provide health benefits for poor consumers. The benefits of their consumption include increased intake of calcium and vitamins (such as vitamin A) because the fish are generally consumed whole. In addition, these fish, when cultured or captured, are generally consumed in the home rather than sent to market, so they provide direct nutrition. While SIS can be caught from natural waters, they have not been well incorporated into aquaculture production systems. For example, the polyculture systems, which are the mainstay of commercial aquaculture in Nepal, largely use 5-7 carp species, all targeted on large carp species sold to market. While SIS could be incorporated into these polyculture systems — possibly without any loss of yield for the large carp species — this has seldom been done, and there is no research basis to indicate whether such incorporation would be helpful or damaging to overall production. Over the first two years of this grant, our project will focus on this incorporation of SIS into polyculture systems to determine if it is a viable means to increase food production for poorer households.

Since the 1970s aquaculture development in Nepal has focused on utilizing marginal agricultural lands, such as gholes (flooded areas with marginal agricultural potential), to serve as aquaculture sites for poor households. As a result of outreach conducted in the Terai (the low elevation plains area of Nepal), numerous household ponds have been built in these marginal agricultural areas, and the management of those ponds with cages has been promoted as a means to substantially improve nutrition of poor households. Such outreach to extend aquaculture into gholes has been promoted in all of the aquaculture

plans for Nepal, and yet the success of these systems and their effects on household nutrition remain uncertain. This is the project's second main focus; to evaluate the success of household ponds in increasing fish consumption by women and children in poor households, and to then determine if this increased consumption leads to improvements in health as measured by World Health Organization standards of nutritional status for children.

A third area of focus for this project is the enhanced production of native species, particularly sahar, a cool water species indigenous to Nepal. Again, all of the aquaculture planning documents described above had a focus on fish production in colder regions of the country. While these plans generally called for trout culture, sahar may be a more successful alternative because it is a native species, valued by local inhabitants, and important as a target of restoration. This project will incorporate sahar in on-farm trials, as well as to expand sahar seed production to other regions of the country. In addition to sahar, this project will work to establish aquaculture systems for another indigenous species, the stinging catfish.

AFRICA PROJECT: KENYA & UGANDA

Aquaculture Development in Kenya and Uganda: Advancing Cost-Effective Technology, Market Assessment, and End-User Engagement

US Institutions: Auburn University (Lead), Alabama A&M University, University of Arizona
Host Country Institutions: Makerere University (Uganda), University of Eldoret (Kenya)
Other Collaborations and Linkages: NaFiRRI (Uganda), Ministry of Fisheries Development (Kenya)

Investigations
Development of Low-Cost Captive Breeding and Hatching Technologies for two African Lungfish (*Protopterus aethiopicus and P. amphibius*) to Improve Livelihoods, Nutrition, and Income for Vulnerable Communities in Uganda (13IND03AU)

New Approaches to Inform, Motivate, and Advance Small and Medium-Scale Fish Farmers: Building Industry Capacity through Cell Phone Networks, Training, and Market Participation (13BMA04AU)

Assessment of Market Opportunities for Small-Scale Fishers and Farmers in Central Uganda (13MER05AU)

Assessment of Growth Performance of Monosex Nile Tilapia (*Oreochromis niloticus*) in Cages Using Low-Cost, Locally Produced Supplemental Feeds and Training Fish Farmers on Best Management Practices in Kenya (13SFT06AU)

Formulation and Manufacture of Practical Feeds for Western Kenya (13SFT07AU)

Development of Low-Cost Aquaponics Systems for Kenya (13BMA05AU)

Project Description
This project endeavors to solve or clarify some bottleneck or unknown dimension that limits the advance of fish culture in Uganda and Kenya. Whether it be the reproductive control and managed grow out of a new species such as lungfish, the established practice of tilapia culture under diverse and changing local circumstance, or new insights on how to reach and engage fish farmers with practical information through their cellphones, this project is committed to practical, tangible results.

Ensuring the supply of quality fingerlings for local farms is a fundamental task in both Uganda and Kenya. Training, research, and outreach focused on growing a spatially balanced distribution of seed

stock producer clusters will foster the development of the tilapia industry. Readily available quality fingerlings will facilitate producer motivation for timely restocking for increased production and enhance availability of supply. Developing and stimulating the network of fingerling producers also will foster peer-to-peer technical support, market development, and other forms of mutual support.

Aquaculture development is building in Uganda as at least one large commercial farm is using cage culture to produce daily truckloads of tilapia destined for export to Congo. The medium and small-scale sector is advancing through the endeavors of project-developed and supported Annual Fish Farmer Conference and Trade Show that has become a focal event for the industry. Project-trained trainers continue to hold events and work with producers throughout the country. Tilapia remains a readily marketed and popular consumer item, particularly in locales away from Lake Victoria and other large water bodies. Yet serious deficiencies in production practice, value chain development, and species alternative remain. Research is needed to demonstrate and clarify optimal timing and strategies for producing tilapia and clarius for food and baitfish. New cell-phone based systems for market development, management guidance, and seedstock coordination present real possibilities for augmenting the value captured by producers in the marketing chain. New species, particularly lungfish, offer the advantages of known consumer acceptability associated with a popular indigenous species, yet can only be expanded through research that unlocks the reproductive process to foster seedstock development for the species and identifies viable cage culture production regimes.

In Kenya, national policies have promoted fish culture through the subsidized distribution of fingerlings and the coordination of feed supplies. The government has also promoted creation of thousands of small farm ponds so that many new farmers have access to ponds and need technical guidance. This project will contribute to capacity building of university and extension to train these new farmers.

AFRICA PROJECT: GHANA & TANZANIA

Aquaculture Development and the Impact on Food Supply, Nutrition and Health in Ghana and Tanzania

US Institutions: Purdue University (Lead), Virginia Polytechnic Institute & State University, University of Arkansas at Pine Bluff, University of Hawaii at Hilo
Host Country Institutions: Kwame Nkrumah University of Science & Technology; University for Development Studies, Nyankpala Campus (Ghana); Sokoine University of Agriculture; University of Dar es Salaam (Tanzania)
Other Collaborations and Linkages: Western Indian Ocean Marine Sciences Association (Tanzania), Farmer Line (Ghana)

Investigations
Assessing the Nutritional Impact of Aquaculture Policy in Fish Farming Districts in Tanzania and Ghana (13HHI01PU)

Development of a Cell-Phone Based Seafood Market Information System (SMIS) in Ghana: Application to Tilapia (13MER01PU)

Value Chain Analysis of Farmed Nile Tilapia (*Oreochromis niloticus*) and African Catfish (*Clarias gariepinus*) in Tanzania (13MER02PU)

Spat Collection and Nursery Methods for Shellfish Culture by Women (13QSD01PU)

Coastal Women's Shellfish Aquaculture Development Workshop (13BMA01PU)

Identifying Local Strains of Nile Tilapia (*Oreochromis niloticus*) that are Adapted to Future Climate Conditions (13IND01PU)

Evaluation of Invertebrates as Protein Sources in Nile Tilapia (*Oreochromis niloticus*) Diets (13SFT01PU)

Enhancing the Nutritional Value of Tilapia for Human Health (13SFT02PU)

Project Description

African governments acknowledge in National Development Plans that urgent poverty reduction measures are needed to achieve the UN Millennium Development Goals, with governments most focusing on national poverty eradication strategies and improvements in food nutrition and security. Fish has always been an important part of the diet of the people of the continent but until recently fish has been largely harvested from the wild. Total fish output in some African nations such as Nigeria and Egypt continue to grow at accelerating rates and fish cultivation has become part of many rural agricultural enterprises. This has been encouraged by expansion of NGO developmental activities on aquaculture, improved aquaculture production technologies, recognition of over exploitation of natural fisheries, and increased nutritional requirement of a rapidly growing population. These factors combine to make aquaculture an economically attractive agricultural production alternative in sub-Saharan Africa.

Previous AquaFish CRSP work has focused on a broad range of issues targeting poverty reduction and increased productivity. In Tanzania, for example, lower costs feed alternatives were identified from leguminous tree species to replace the more costly soybean meal used in tilapia diets. Through training in hatchery techniques and management, Kenya farmers now have an additional aquaculture enterprise of raising catfish fingerlings and selling as bait to the longline fishing industry on Lake Victoria. Traders in baitfish from natural catches are now engaged in fish farming that has enabled year-round supply of baitfish. Training in supply chain management has enabled the development of new market opportunities for foodfish producers in Kenya and Ghana as well as new markets for baitfish producers in Kenya. Farmers have acquired knowledge about the environmental effects of their activities and are therefore implementing broadly focused environmental BMPs on their farms, especially in Ghana and Kenya. Studies that analyzed tilapia value chain provided valuable information needed for the improvement of tilapia trade through market intelligence. Similarly, consumer preference studies for farmed fish provided information for the development of consumer-driven aquaculture production in Ghana and Kenya.

The vision of this project is to build on previous work to enhance the profitability of the aquaculture industry in sub-Saharan Africa through physical and human capacity development; enhanced market information sharing and trading; improved nutritional qualities of fish and consequently human nutrition; growth of a whole chain of activities from farm to the consumer; better management of native fish and shellfish species. Results from the various investigations will help to achieve the goals of improving human nutrition, efficiency in the value chain, increased incomes for producers and traders of aquaculture products, diversified production systems, enhanced nutrient, and reduction in postharvest losses through efficient market information sharing mechanisms.

This project involves knowledge generation and physical and human capacity development. Student participation in research activities is designed to create a framework such that all additional materials and investment by this project are viewed as part of quality improvement of the Aquaculture Sciences program. Involvement of students means involving a set of other faculties such as graduate committee members. This will facilitate joint planning and management of additional investments and also create continuity, as other students outside the program will continue to use the additional facilities.

III. Travel

New travel identified in Appendix 1 is for trips needed to attend meetings in Africa and Asia. These meetings require broad participation from US and HC institutions and include:

- AquaFish Annual Meeting and hosted Technical Session, Indonesia, FY16

Appendix 1 also includes trips already approved via the AquaFish Phase II proposal and previous Annual Work Plans. Trips have been identified based on the best available information and new trips are submitted in this document for written approval from the AOR, where needed.

APPENDIX 1: TRAVEL

Table A-1 lists international trips that will be taken in FY 2016 for the AquaFish Innovation Lab CA/LWA No. EPP-A-00-06-00012-00. Some trips listed are already approved via the AquaFish Phase II proposal and previous Annual Work Plans. Table A-1 provides information in compliance with ADS 303.M17, and includes: "the number of trips, the number of individuals per trip, and the origin and destination countries or regions." The Management Office, through an online monitoring system, formally tracks international travel.

Destination Country or Region	Origin Country or Region	Number of Trips	Number of Travelers per trip	FY
Indonesia or other AquaFish 2016 Annual Meeting and Technical Session location	Bangladesh	1	5	2016
	Cambodia	1	5	2016
	Ghana	1	4	2016
	Kenya	1	4	2016
	Nepal	1	5	2016
	Philippines	1	3	2016
	Tanzania	1	4	2016
	Uganda	1	4	2016
	USA	1	20	2016
	Vietnam	1	5	2016
Brazil	USA	1	1	2016
Burma	USA	1	2	2016
Thailand	USA	1	3	2016
China	USA	1	1	2016
Scotland	USA	1	1	2016
Senegal and Ghana	USA	1	2	2016
Zambia or Africa Region	USA	1	2	2016
Vietnam and Cambodia	USA	1	2	2016
Bangladesh	USA	1	1	2016
Uganda	Kenya	1	1	2016
Vietnam and Cambodia	USA	1	1	2016
USA	Bangladesh	1	1	2016
USA	Ghana	1	1	2016
USA	Kenya	1	1	2016
Bangladesh	USA	1	1	2016
Cambodia	Vietnam	1	1	2016
Kenya	Uganda	1	3	2016
Nepal	USA	1	1	2016
Uganda	USA	1	1	2016
Cambodia	Vietnam	1	1	2016
Vietnam	Cambodia	1	1	2016
Ghana	USA	1	1	2016
Kenya	USA	1	1	2016

Destination Country or Region	Origin Country or Region	Number of Trips	Number of Travelers per trip	FY
Nepal	USA	1	1	2016
Uganda	USA	1	3	2016

APPENDIX 2: MONITORING & EVALUATION PLAN

Submitted 6 September 2013
Approved by AquaFish AOR, USAID 9 September 2013

AquaFish works towards achieving development impacts by meeting key targets, measured as indicators and benchmarks of progress. Benchmarks and milestones provide a means to explore different measures of performance than more quantitative indicators, such as the metrics designed by USAID for reporting under FTFMS (Feed the Future Monitoring System). Formal milestones, benchmarks, and indicators were finalized after review and approval of all subprojects.

A. KEY DEVELOPMENT TARGETS: MILESTONES AND BENCHMARKS

The following conceptual framework helps ensure that targets are adequately addressed across the global portfolio, and for facilitating feedback and continuous learning in order to improve processes and outcomes. The proposed targets, indicators, and milestones are estimated and may change upon subcontract review and award. The AquaFish gender strategy will continue to ensure strong programmatic commitment toward gender inclusion. Gender is both integrated into the four targets and also highlighted independently.

Research Target
Produce end-user aquaculture and fisheries research results that promote sustainable intensification of production systems, enhance food safety and nutrition, increase international trade opportunities, and contribute to responsible aquatic resource management.

Program-wide Research Milestones

(1) Developed and adopted innovative and appropriate technologies that increase profitability and environmental stewardship in aquaculture and fisheries.
(2) Addressed biodiversity conservation issues to ameliorate threats to biodiversity and developed technologies and strategies to protect habitat and populations.
(3) Continuously funded research projects that meet or exceed the expectations of external peer-review panels.
(4) AquaFish activities and outputs improved the availability of and access to nutrient dense foods.
(5) Engaged local stakeholders in research design, implementation, and results reporting through active participation.

Year 1 Benchmarks:

a. Request for Proposals approved by USAID and widely advertised for new projects with submitted proposals externally peer-reviewed.
b. Favorably reviewed proposals have activities initiated in a timely manner.
c. Identified partners for gauging nutrition status and change. With or through the partners, established measurable baselines for the targeted groups for fish production levels, income, and diet.

Years 2-5 Benchmarks:

a. 1 innovative aquaculture and fisheries technology or strategy developed and disseminated throughout each region.
b. AquaFish activities remain locally appropriate by receiving regular input through the Regional Centers of Excellence and Development Theme Advisory Panels.

c. Established baselines and produced measurable increases in farm productivity, farmer incomes, market access, and export value, achieved following adoption of AquaFish recommendations and technologies.
d. Threats to biodiversity resulting from aquaculture activities ameliorated, and biologically significant areas positively impacted.
e. Using baseline information, make positive changes for generally improved household (or targeted group) access to high quality foods.

Capacity Building Target
Focus AquaFish investments on building local capacity in aquaculture and aquatic resource management and ensuring long-term program impacts at local and national levels through strategic informal and formal training opportunities. Integrate items related to gender.

Capacity Building Milestones - Regional
(1) Forged professional and managerial relationships between US and Host Country researchers and institutions.
(2) Established a track record of successful formal long-term training of Host Country and US students and researchers.
(3) Delivered relevant short-term training opportunities that provide positive Host Country societal benefits beyond the life of the AquaFish.
(4) Identified gender issues in aquaculture and fisheries and adopted gender program-wide integration policies.

Year 1 Benchmarks:
a. Gender integration strategies adopted within all sub-awards.
b. Regional Centers of Excellence continued within the AquaFish regions for research activities (i.e., Asia, Africa, and Latin America and the Caribbean).
c. Formal Memoranda of Understanding adopted between all US and Host Country partners.

Years 2-5 Benchmarks:
a. Partnerships strengthened among US and Host Country universities, NGOs, NARS, and USAID Missions through Associate Awards.
b. At least 100 degree seeking men and women enrolled through formal long-term training opportunities in US, Host Country, and Regional universities.
c. Equal numbers of women and men trained through short- and long-term training opportunities.
d. Numerous train-the-trainer workshops convened to provide Host Countries with highly skilled extension specialists.
e. At least 30 workshops convened over the course of this 5-year award and encouraged equal participation from women and men.

Information Dissemination Target
Disseminate AquaFish research results to foster broad application of results among local stakeholders within governmental and non-governmental organizations, private sector, as well as for end-users, and the general public.

Information Dissemination Milestones
(1) Successful diffusion of AquaFish research results and technologies between countries within a region having comparable social and environmental conditions.
(2) Increased awareness of local stakeholder constraints and opportunities related to responsible aquaculture and fisheries management.
(3) Applicable extension activities associated with each research project conducted to ensure wide dissemination of research results.

(4) AquaFish results and technologies for farm operations adopted and policies for responsible aquatic resource management created.
(5) AquaFish research published in regional, national, and international peer-reviewed journals.

Year 1 Benchmarks:
a. Dissemination efforts have continued through Aquanews, EdopNet, and the searchable online publication database.
b. The importance of extension evident through integration of at least one outreach activity within each funded project.
c. Research adoption encouraged by prioritizing the use of on- and off-farm trials to conduct research.

Years 2-5 Benchmarks:
a. Intra- and inter-regional diffusion of AquaFish results and technologies accomplished.
b. Training manuals with local and regional scopes published following completion of AquaFish research projects.
c. Continuous academic output of AquaFish data as publications within recognized journals and presentations provided at regional, national, and international forums.

Gender Integration: Cross-Cutting Target
AquaFish is dedicated to improving gender inclusiveness in the aquaculture and fisheries sectors. Gender integration is implicit and interwoven into the above research, capacity building, and information dissemination milestones and benchmarks requested by USAID in its original RFA. Additional explicit guidance, in the form of program-wide gender integration initiatives, is provided below.

Year 1 Initiatives:
a. Require that all funded projects address gender inclusiveness within their planned scope-of-work.
b. Seek out USAID review of projects' gender inclusiveness plans and respond by improving plans prior to project implementation.

Years 2-5 Initiatives:
a. Collect disaggregated gender data from individual research and outreach projects funded by AquaFish.
b. Analyze disaggregated data on an annual basis to gauge gender inclusiveness success and take appropriate action as indicated through data analysis.
c. Involve field projects in monitoring and evaluating gender integration as the program progresses with time. Evaluate the effects of specific projects on gender and ensure that any possible negative effects due to gender bias are mitigated.
d. Focus one component of a lessons learned and synthesis assessment specifically on the social context and impact of AquaFish research and outreach activities on the lives of women.
e. Tailor specific extension and technical services related to sustainable aquaculture and aquatic resource management to women producers.
f. Engage extension specialists who are sensitive to diversity issues and access to resources of underrepresented groups and women will be included as an integral part of their delivery team to ensure women farmers and fishers feel welcome in AquaFish training opportunities.
g. Promote the participation of women in formal and informal education and training opportunities provided through AquaFish. AquaFish has set a 50% benchmark for training women in formal and informal education. In addition, the 50% benchmark applies to attracting and retaining women scientists and administrators in all AquaFish activities, as project researchers, advisory group members, and managers.

B. USAID FEED THE FUTURE INDICATORS AND MONITORING SYSTEM

AquaFish reports under USAID's various impact reporting frameworks to achieve outcomes that have meaning for stakeholders, including Missions, Host Country decision-makers, and end-users. Target and Actual indicator metrics reported through the Feed the Future Monitoring System (FTFMS) for FY15-FY16* are presented in Table 1.

Table 1. AquaFish Feed the Future Monitoring System 4.5.2 Indicator targets for FY15 and FY16*.

Indictor Number	Indicator	2015 Targets	2016 Targets
4.5.2(6)	Number of individuals who have received USG supported long-term agricultural sector productivity or food security training		
	Total	100	90
	Female	50	45
	Male	50	45
4.5.2(7)	Number of individuals who have received USG supported short-term agricultural sector productivity or food security training		
	Total	280	252
	Female	140	126
	Male	140	126
4.5.2(11)	Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBOs) receiving USG assistance		
	Total	70	63
	New	28	25
	Continuing	42	38
4.5.2(39)	Number of new technologies or management practices in one of the following phases of development: (Phase I/II/III)		
	Total	19	17
	Phase 1 Number of new technologies or management practices under research as a result of USG assistance	8	7
	Phase 2 Number of new technologies or management practices under field testing as a result of USG assistance	6	5
	Phase 3 Number of new technologies or management practices made available for transfer as a result of USG assistance	5	5

*FY16 targets reported in this Work Plan represent values on record as of 31 August 2015 and may change with the FY15 FTFMS report due later in the year.