Second Annual Report
AquaFish CRSP Mali Project

Aquatic Resource Use and Conservation for Sustainable Freshwater Aquaculture and Fisheries in Mali

October 1, 2008 – September 30, 2009

Cooperative Agreement # 688-A-00-07-00044-00
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Introduction

The *Mali Project*, "Aquatic Resource Use and Conservation for Sustainable Freshwater Aquaculture and Fisheries in Mali," operates through an award received from USAID/Mali under the "Leader with Associates" (LWA) award that established the AquaFish CRSP in 2006. The project, which has a planned span of three years (1 October 2007 through 30 September 2010), has the overall goal of "improving the productivity and income of producers in targeted areas of Mali through facilitation of access to technologies and building the capacity of stakeholders involved in freshwater fish farming and capture fisheries management." It is working in three thematic areas to:

- Facilitate access and adoption of improved aquaculture production technologies in targeted areas to increase and diversify the incomes of farmers,
- Build the capacity of the Government of Mali to develop and disseminate relevant technologies,
- Identify appropriate strategies for the implementation of integrated rice and fish farming in target areas,
- Help develop an appropriate fisheries management plan to ensure long-term viability and sustainability of capture fisheries in the target area, and
- Help establish linkages useful for further development of aquaculture and fisheries in Mali.

The Mali Project's Three Thematic Areas: The Project's three-pronged approach towards facilitating the development of sustainable aquaculture and good fisheries management in Mali is being applied through work in these thematic areas:

- Theme I: *Pond Culture—Advancing Sustainable Freshwater Aquaculture Practices and Technologies* (Theme Leaders Dr. Héry Coulibaly and Dr. Charles Ngugi)
- Theme II: *Rice-Fish—Promoting Sustainable Rice-Fish Aquaculture in Irrigated Systems* (Theme Leaders Dr. Héry Coulibaly and Drs. Yang Yi* and Liu Liping)
- Theme III: *Fisheries Planning—Building Community and Consensus towards a Fisheries Management Plan* (Theme Leaders Mr. Soumaila Diarra and Mrs. Nancy Gitonga)

Theme I is working to identify, develop, and promote appropriate pond culture systems for implementation in Mali. Theme II is working to introduce appropriate adaptations of proven rice-fish systems, based on experience in China, into irrigated systems of the Niger River delta in

Mali, and Theme III is seeking to encourage local involvement (ownership) in the development of sound fisheries management plans, working initially in the Lake Sélingué area.

South-South Approach: The *Mali Project* takes a South-South approach to development, in which scientific expertise and practical applications are drawn from the experiences of the Aquaculture and AquaFish CRSPs and the global aquaculture community and brought to bear on our three theme areas through two African institutions (Moi University and FishAfrica, Kenya) and one Asian institution (Shanghai Ocean University, China).

Collaborating Institutions and Personnel:

AquaFish CRSP, Oregon State University, Corvallis, Oregon, USA
(Lead US Institution)
Hillary Egna, Principal Investigator
James Bowman, Project Coordinator
Dwight Brimley, Business Manager
Lisa Reifke, Graduate Research Assistant
Stephanie Misola, undergraduate assistant

Direction Nationale de la Pêche, Ministère de l'Élevage et de la Pêche, Bamako, Mali
(Lead Mali Institution)
Héry Coulibaly, Principal Investigator and Mali Theme Leader for Themes I & II (Pond Culture and Rice-Fish)
Soumaila Diarra, Mali Theme Leader for Theme III (Fisheries Management)
Madi M. Kheita, Collaborator for Theme II
Alhassane Abdou Sidy Toure, Collaborator for Theme II
Boureima Traore, Collaborator, Theme III

Moi University, Eldoret, Kenya (Theme I Lead Institution)
Charles Ngugi, PhD, Theme Leader, Theme I
Mr. Manyala, Collaborator for Theme III

Shanghai Ocean University, Shanghai, China (Theme II Lead Institution)
Yang Yi, Theme Leader, Theme II (Through July 2009)
Liping Liu, Assistant Theme Leader, Theme II (Since July 2009)

Network of Aquaculture Centres in Asia-Pacific (NACA)
Derun Yuan, Assistant Theme Leader, Theme II

FishAfrica, Nairobi, Kenya (Theme III Lead Institution)
Nancy Gitonga, Theme Leader, Theme III

Fisheries Department, Government of Kenya, Nairobi, Kenya
Peter Nzungi, Frame Survey consultant and trainer, Theme III

Sichuan Aquacultural Engineering and Technology Research Center, China
Wu Zongwen, Collaborator, Theme II

Progress Made and Results Achieved

Short-Term Training

The *Mali Project* is largely a training project, utilizing short-term training, on-farm trials, and in-field demonstrations to reach its targeted audiences in the three theme areas. Overall, short-term training events have occurred mainly in Mali, but some training has also been done in China and Kenya. During FY 09 seven short-term training activities were conducted in Mali and one course was put on in Kenya, as follows:

- *Pond construction and management training* (Theme I), 2-6 February; Sotuba Centre de Formation Pratique en Elevage, Bamako; 24 trainees
- *Frame Survey training* for supervisors (Theme III), 9-10 February; ODRS (Office de Developpement Rural de Sélingué), Lake Sélingué, 11 trainees
- *Frame Survey training* for enumerators (Theme III), 11-12 February; ODRS, Lake Sélingué; 20 trainees
- *Catfish propagation and hatchery management training* (Theme I), 6-17 April; Sagana Aquaculture Centre, Kenya; 4 trainees
- *Catfish propagation and hatchery management training* (Theme I), 21 June-3 July; Sotuba Centre de Formation Pratique en Elevage, Bamako; 22 trainees
- *Pre-On-Farm Trials workshop for supervisors* (Theme I), 29 June; Sotuba Centre de Formation Pratique en Elevage, Bamako; 5 trainees
- *Pre-On-Farm Trials workshop for supervisors and farmers* (Theme I), 30 June; Sotuba Centre de Formation Pratique en Elevage, Bamako; 15 trainees
- *Workshop on Up-to-Date Techniques for rice-fish culture in China* (Theme II), 26 June; OPIB (Office du Perimetre Irrigue de Baguineda), Baguineda; 21 trainees

The total number of trainees involved in these 2009 short-term events was 122.

Theme I Leader Charles Ngugi provided training on pond site selection and pond construction, including the use of practicable survey methhods, during the February 2009 short course at the *Centre de Formation Pratique en Elevage* in Bamako.

The four Malians who were trained in catfish propagation and hatchery management at Sagana Aquaculture Centre in Kenya assisted the trainers with demonstrations of artificial propagation techniques during the June 2009 short course at Sotuba.

Long-Term Training

Although long-term training is not a major component of our current project, three students from the Institut Polytechnique Rural de Formation et de Recherche Appliquée (IPR/IFRA) (Rural Polytechnic Institute for Training & Applied research), in Katibougou, received partial support for participation in project activities this year. These include Ahmadou Nouh Sow, who is associated with Theme I (Pond Culture) activities, and Fadima Keita and Bocary Diarra, who are both associated with Theme II (Rice-Fish) activities. Ahmadou Nouh Sow has been involved in pond management and fingerling production activities at the Centre Piscicole Molodo near Niono, has assisted with the transportation of fingerlings from Molodo to sites of the Theme I On-Farm Trials, and has helped with pond monitoring at those sites. Fadima Keita and Bocary Diarra have participated in similar ways in the activities of Theme II (Rice-Fish).

On-Farm Trials

Two sets of On-Farm Trials are planned as part of Theme I (Pond Culture) during the course of the project. The first set of trials was begun in mid-July, 2009, and will run until mid-January, 2010. In June ten farmers were selected to participate in these trials. The trials themselves were preceded by two workshops, held on June 29 and 30 (see short-term training, above), to prepare both the farmers and those who would be supervising their efforts for the trials, and in particular to discuss and agree on the fish stocking (species and stocking densities), management options (fertilization, feeding), and monitoring protocols (sampling for fish growth) that would be used. The ten ponds selected were stocked with fish in mid July; however; due to water shortages and/or pond soils that would not retain sufficient water to maintain the crop through a complete culture cycle, four ponds were dropped from the trials, leaving six participating farmers. The trials are being conducted under supervision of regional directors of the Direction Nationale de la Pêche as well as by one of the students who are partially supported by the project. This supervision includes regular (monthly) visits to the ponds to assess their status and detailed record-keeping, by date, of fish stocked, weights of fish in samples taken at monthly intervals, and amounts and costs of inputs. These ponds are expected to be harvested in January, at which final data on fish survival, growth, yield, and gross and net income will be recorded. When all ponds have been harvested a wrap-up workshop will be held to compare and discuss the results from each pond.

Left: Members of the *Jigiya Association*, Kayo, sampling their new pond by cast net during the first cycle of On-Farm Trials, July 2009 – January 2010.

Tilapia sampled from the *Jigiya Association's* pond in Kayo part way through the first On-Farm Trial period.

Rice-Fish Demonstrations

Four farmers were selected to participate in demonstrations of rice-fish culture in their fields in the Baguineda irrigation area. Participating farmers were selected in late June and field preparations were begun immediately thereafter. Preparations involved excavation of a fish sump in one corner of each rice field being used, excavation of water channels leading through the rice field to the fish sump, and using the excavated soil to raise the surrounding embankments to ensure that fish would not escape. As with the Theme I On-Farm Trials, the fish culture part of these demonstrations was begun with the stocking of fish in mid-July. These demonstration fields are also being regularly monitored by the regional directors of the DNP, with periodic (monthly) sampling and complete record keeping. The demonstration plots will be harvested in mid-November, when the Baguineda irrigation system is expected to be shut down for repairs to the main channel. Data collected throughout the demonstration period and at harvest, including fish and rice yields, total costs, and gross and net returns, will be analyzed. The results will be reported as soon as possible after harvest and analysis.

Preparing for rice-fish culture in Baguineda: Beginning to construct a fish sump in one corner of a rice field.

Releasing fingerlings into the fish sump in a Baguineda rice field.

This Baguineda rice field has been prepared for rice-fish culture by constructing water channels leading through and around the field into a sump in one corner that provides refuge for the fish.

A Baguineda rice field during the rice-fish production period; the fish sump is shown in the near corner of the field. The four demonstration sites will be harvested in the first quarter of FY 10.

Frame Survey, Lake Sélingué

The Frame Survey of Lake Sélingué was conducted from 16-19 February, 2009, immediately following the training of supervisors and enumerators (see "Short-Term Training," above). The survey team started the survey exercise at the Carrière landing site on the eastern side of the lake on 16th February 2009. Completed questionnaires from the eastern side were collected and verified on the 17th February 2009. The exercise was moved to the Faraba landing site on the western side of the lake on 18th February 2009, and completed questionnaires from the western side were collected and verified on the 19th of February 2009.

Frame survey enumerators were awarded certificates following the training session in February 2009.

Frame survey data collection at Lake Sélingué.

A database system was developed for storing and managing the survey data and personnel from the Fisheries Department, Nairobi, Kenya were trained on its use and entered the survey data in early April 2009. After completion of data entry, the database was then queried for the required information and the results were exported to an MS Excel spreadsheet for further processing and analysis.

The survey results were submitted in the document *Report on Lake Sélingué Frame Survey of February 2009*, by frame survey expert Peter Nzungi, on 4 May 2009. A summary table containing results for the survey organized by Administrative Communes was produced. Bar graphs and pie charts were also prepared from the summary table to facilitate comparisons between Communes. From the results some recommendations were made to guide planning for management of the Lake Sélingué fishery. An electronic version of the report, the survey database, and photos taken during the survey participants training workshops and during the survey exercise itself were submitted along with the written report. The office of the Director, Direction Nationale de la Pêche, translated the report into French and the French version became available in early September, 2009.

The 2009 Lake Sélingué Frame Survey and report were the first of this kind ever conducted on this lake. Lake Sélingué, whose average fish production is 4,000 tons, contributes significantly to the national economy through food security support, income generation, and job creation. The results of this survey are therefore expected to assist in improving management of the lake fisheries for sustainability; assessing the fishing capacity through frame survey is the first step.

Recommendations based on the Frame Survey included the following points:

- A frame survey of Lake Sélingué should be carried out every two years to assess the impact of management measures taken to ensure sustainable fisheries.
- The DPN should also use the survey capacity built to carry out surveys in other fisheries lakes and reservoirs in Mali.
- The use of the data software in future will require that the data experts build Malian capacity, through training on the use, data entry, and analysis.
- There is need for DPN to carry out stock assessment of Lake Sélingué so that the entire lake status (fish stocks and fishing capacity) can be known for the development of an effective fisheries management plan.

Mali Project Meeting during "Aquaculture America 2009," Washington, February 19-23

Project team members in attendance at the Annual Meeting of the AquaFish CRSP and the *"Aquaculture America 2009"* conference (World Aquaculture Society) in Seattle, Washington, from 15-18 February, 2009, took the opportunity to meet to discuss project issues. Malians Héry Coulibaly (Direction Nationale de la Pêche) and Gaoussou Traore (USAID/AEG/Mali) were joined by Theme Leaders Charles Ngugi and Yang Yi and Oregon State University's Hillary Egna and Jim Bowman for these meetings. This meeting provided a chance to review problems encountered to date and approaches taken to solve them, to discuss the format and content of annual reports, and to review and adjust the schedules of activities for the work in the three theme areas.

For our Malian partners this also provided another opportunity to interact with participants in the wider AquaFish Program, both from the US and from participating Host Countries. Participation in the *Aquaculture America* conference brought them once again into contact with the global aquaculture community, providing examples and models of what aquaculture can and does do in other countries and regions.

Progress toward Benchmarks, Intermediate Results, and Indicators

Significant progress was made this year with respect to project impact indicators and targets, as shown in Table 1 (next page). The table consists of two sections, one for the five indicators required in the Work Plan and another for additional indicators that are being tracked to the extent possible. We have already met or exceeded our targets for some indicators, even though some related activities are scheduled for completion in FY '10.

Table 1. Impact indicators being tracked under the AquaFish CRSP Mali Project.

Required Indicators (Work Plan, p. 31):

Indicator	***Project Target***	***Previous Total***	***New This Year***	***New Total***
New technologies under field testing	*12*	*0*	*2*[1]	*2*[1]
New technologies made available	*4*	*0*	*6*	*6*
Individuals receiving short-term training[2]	*155 (79/76)*	*2 (2/0)*	*122 (114/8)*	*124 (116/8)*
Farmers who adopted new practices[2]	*16 (8/8)*	*0*	*17 (17/0)*	*17 (17/0)*
Fish processors who adopted new practices[2, 3]	*4 (2/2)*	*0*	*0*	*0*

Additional Indicators (Work Plan, pp. 32-33 and/or Tables 1-3):

Indicator	***Project Target***	***Previous Total***	***New This Year***	***New Total***
Number of Malians who attend international aquaculture meetings[2]	*3*	*2 (2/0)*	*2 (2/0)*	*4 (4/0)*
Number of students trained or mentored in Mali[2]	*3*	*0*	*3 (2/1)*	*3 (2/1)*
Number of participants trained outside of Mali[2]	*8*	*2 (2/0)*	*4 (3/1)*	*6 (5/1)*[2]
Additional aquaculture production area resulting from project efforts (either number of additional ponds or rice paddies or additional area in hectares)	*1.4 ha*	*Not yet determined*	*Not yet determined*	*Not yet determined*
Estimated increase in fish productivity in ponds or rice-fish systems in targeted areas (kg/ha/yr or percent)	*1500 kg/ha/yr*	*Not yet determined*	*Not yet determined*	*Not yet determined*
Estimated increase in income for fish farmers in targeted areas (CFA/ha/yr or percent)	*Not yet determined*	*Not yet determined*	*Not yet determined*	*Not yet determined*
Number of extension publications developed	*10*	*0*	*12*	*12*
Number of frame surveys conducted for lake fisheries	*1*	*0*	*1*	*1*
Estimated increase in income for fishermen in targeted areas (CFA/ha/yr or percent)	*Not yet determined*	*Not yet determined*	*Not yet determined*	*Not yet determined*

[1] Previously reported as 4 technologies; now re-defined as 2: Pond Culture and Rice-Fish Culture.

[2] The total number of individuals is followed in parentheses by the number of men/number of women. For example, an entry of 9 (5/4) would indicate a total of nine individuals, of which 5 were men and 4 were women.

[3] Impacts related to processors are not expected to begin until FY10.

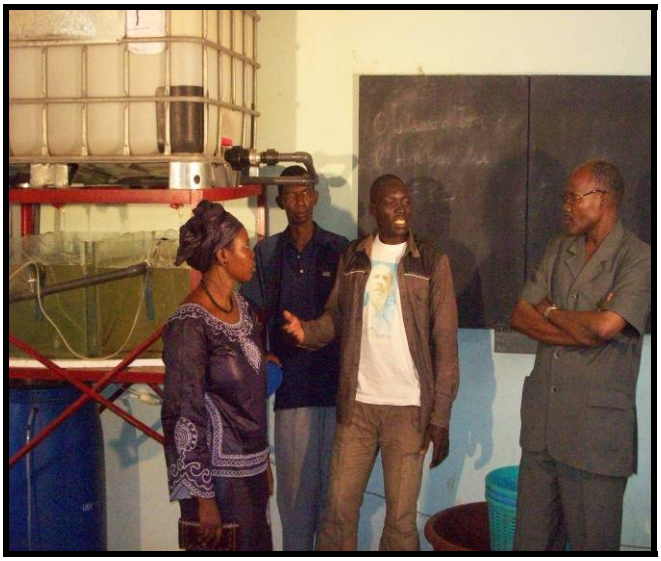
Success Stories

Fish Farmer Seydou Toé

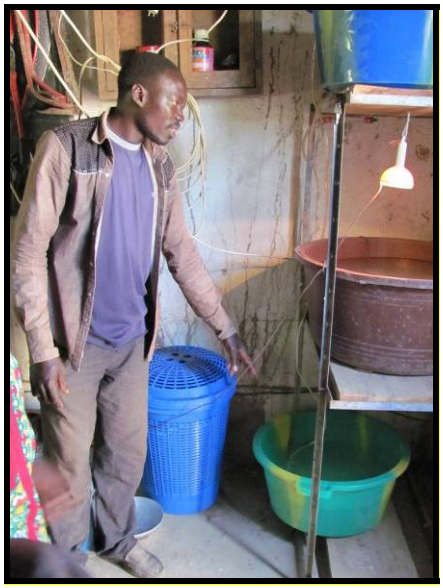
Mr Toé is an agricultural producer who has been practicing fish culture since 2006. His farm, operated in partnership with his brother Richard Toé, is at the edge of an arm of the Niger River in Banco, approximately 30 km from Bamako. With respect to fish farming, he has had problems related to the construction of his ponds, good feeds for the fish, management of the farm, access to fingerlings, and also with high soil permeability, which results in leaky ponds. Seydou speaks neither French nor English, but speaks Bambara and writes N'Ko. He is a founding member of the Association des Pisciculteurs et Aquaculteurs du Mali (APAM).

With respect to the activities of the USAID/AquaFish CRSP *Mali Project*, Seydou was selected by APAM to participate in the Theme I (Pond Culture) training workshops in Bamako and Sagana, Kenya, in February and April 2009, respectively. The February workshop in Bamako focused on pond construction and management, whereas the course held in Kenya specialized on the propagation of *Clarias* (African catfish) and the rearing of *Clarias* fry in the hatchery.

On his return from the Kenya training course, Seydou prepared a list of materials to purchase for the construction of a hatchery for the artificial propagation of *Clarias*. The project financed the purchase of materials and Seydou, with the support of his other colleagues, built and tested a hatchery at the Centre de Formation Pratique en Elevage in Bamako. Participants in the subsequent Theme I training course held at the center (June 2009—see "Short-Term Training" above) used this hatchery to hatch catfish eggs that they produced during the course, which focused on *Clarias* breeding and hatchery management. Seydou provided valuable assistance during this training by explaining the construction and use of the hatchery and demonstrating the catfish culture skills he had learned while in Kenya. The hatchery continues to be operated by APAM to produce *Clarias* fry. .



The team members who were trained in the artificial propa agation of *Clarias* (African catfish)at Sagana Aquaculture Centre in Kenya; from left to right: Rokia Coulibaly, Mamadou Kane, Seydou Toé, and Bouréima Traore.



Seydou Toé explaining the construction and operation of the *Clarias* (catfish) hatchery that he now uses at his farm in Banco.

Using local materials Seydou has also built another hatchery at his own farm. By year's end, thanks to training and assistance from this project and for the first time in Mali, Seydou has produced more than 8,000 fingerlings and marketed at least 4,000 of them locally to other farmers. His fingerling sales serve as an important source of income, enabling him to face the various expenses of fish pond operation to provide for their needs. Moreover, Seydou has found a method of protecting small fish against predation by larger fish by putting old vehicle tires in the pond to provide refuge for the smaller fish.

The activities of the AquaFish CRSP Mali Project, financed by USAID/Mali, have brought out Seydou's resourcefulness and ingenuity and allowed him to develop them to the benefit of his own farm as well as the efforts of other Malian fish farmers. The training he has received has enabled him to producer fingerlings for sale to other fish farmers, and Seydou now also contributes to the dissemination of the information he has received and technologies he has learned by leading and advising other producers with regard to fish culture. As an example, the APAM has chosen him to go to Bougouni, approximately 200 km from Bamako, to train ten young people in fish culture in November.

Rice Farmer Mamadou Samake

Mr SAMAKE is a rice producer in the Baguineda irrigation area, approximately 40 km from Bamako. He took part in the informational meetings on rice-fish culture presented by Liu Liping, Wu Zongwen, Alassane Toure ("Sandy"), and Tiéma Traoré in June and July, 2009, and volunteered to participate in the project's demonstration of rice-fish culture techniques by integrating fish into his rice production activities.

The design was laid out in Mr. Samake's rice field and he personally did all the alteration work needed to excavate the trenches and the sump to provide a place of refuge for the fish. Fish stocking took place in August and the fish harvest was planned for November 2009. Mr Samake maintained his field and cared for his fish well, even bringing termites for their food. He received the support of the project for the prepared food of fish.

Mme Diallo Madeleine BA, Minister of the Ministry of Livestock and Fisheries, visiting the farm of Mamadou Samake.

Fish caught from the rice-fish field of Mamadou Samake.

Mr. Samake was visited by members of the Direction Nationale de la Pêche and USAID personnel in September 2009, by the participants of the Theme II training workshop in

November, and by Minister Mrs. Diallo Madeleine BA, of the Ministère de l'Élevage et de la Pêche, on November 19th, 2009.

The harvest of fish from Mr. Samake's rice field also took place on November 19th, and more than 106 kg of fish were harvested. The harvest data are currently being analyzed. This result is very appealing to Mr. Samake because of the income that was generated, and his results have generated a great deal of interest among other rice producers in the Baguineda area and a large number of them are planning to go into rice-fish culture as soon as the water supply is restored.

Frame Survey of Lake Sélingué

Lake Sélingué is the largest capture fisheries water body in Mali, which is why it was chosen for fishery status evaluation through a Frame Survey. The importance of management of a common fisheries resource cannot be overstated, but in order to put proper and effective fisheries management plans that involve the users and key players into place, it is important to have necessary information about the fishery. The fisheries status is not easy to measure since physical census of fish may not be possible. Other parameters are therefore used to evaluate the status of a fishery. The exercise that was carried out in Lake Sélingué in February 2009 provided the baseline information from which the impact of management measures can be evaluated and improved management plans can be formulated.

The overall objective of conducting the Frame Survey was to determine the existing fisheries situation with respect to the facilities and service providers at the landing sites in Lake Sélingué as well as the composition, magnitude, and distribution of fishing effort. The Frame Survey provided information on the number of fish landing sites; the facilities available at the fish landing sites to service the sector, including accessibility to the landing sites; the service providers especially fishermen cooperatives/associations; the number of fishers; the number and types of fishing canoes and their modes of propulsion; the types and sizes of fishing gear used on the lake and the mode of operation for gillnets. This information will guide the development and management of the Lake Sélingué fishery.

The Frame Survey allowed the Theme III team to develop recommendations on the best approach to manage the lake based on the information gathered. The major observation was that the way the fish stocks are exploited needs to be controlled, especially with regard to the use some destructive types of gear found in the lake and fishing methods such as the use of barriers/fences. There is also a need to establish and protect breeding grounds during breeding times to ensure that healthy fish populations are sustained through recruitment. It was also recommended that the lake should be surveyed again in two years to evaluate the effects of management measures taken following this initial survey.

Through the successful training provided through this project and the completion of Lake Sélingué's first frame survey, Mali now has essential data on the lake fisheries as well as a cadre of capable frame survey supervisors and enumerators. It is now in a position to conduct regular frame surveys at Lake Sélingué as well as on other important water bodies in Mali.

Training in China and Kenya

Some of our best successes to date had their beginnings in training conducted outside of Mali. Examples of this are the successes our trainees have been involved in since their return from rice-fish training in China and catfish propagation/hatchery management training in Kenya.

Participants Alassane Toure ("Sandy") and Tieman Traoré went to Shanghai Ocean University, China, in September of 2008 and returned to share what they had learned there with farmers and OPIB officials in the Baguineda irrigation area. This led directly to the setting up this year of four rice-fish demonstration sites in Baguineda and generation of a lot of interest among other Baguineda area rice farmers, many of whom say they will modify their fields and stock fish during their next crop.

Likewise, participants who went to Sagana Aquaculture Centre, Sagana, Kenya, in April of this year returned to construct hatchery facilities at public and private locations, train others in how to build and operate these facilities, and begin producing catfish (*Clarias*) fry and fingerlings on their own. One of these trainees, fish farmer Seydou Toé, has since produced over 8000 fingerlings on his farm, is selling fingerlings to other farmers, and has been independently involved in training of other farmers.

The successes of these external training activities have occurred in spite of the language differences that exist, demonstrating again the value of the active, hands-on approach to training we have used and the extent to which language barriers can be overcome when trainees and trainers alike are excited about the subject matter and believe that they can overcome language differences to communicate effectively and achieve good results.

Problems Encountered

We were saddened to learn, towards the end of May, of the serious illness of our longtime friend and colleague Dr. Yang Yi of Shanghai Ocean University, and of his passing away at the end of July. Dr. Yang Yi was for many years a respected member of the Aquaculture and AquaFish CRSP families and of the global aquaculture community. He will be remembered for his many contributions to aquaculture research and education, but also for his warm spirit, kindness, and friendship. He was instrumental in the planning of activities for the Rice-Fish component of this project and his team was poised to begin the first set of rice-fish demonstrations when he became ill in May. We will miss his presence and his contributions to the project.

The political unrest of early 2008 in Kenya continued to have repercussions for Dr. Charles Ngugi, leader of our Pond Culture theme's activities during the year. During that unrest the Ngugi family lost their home and possessions in western Kenya and fled to the Nairobi area for safety. Dr. Ngugi's work since then has been complicated by an uncertain situation in Eldoret, where Moi University is located, and the long "commutes" between Nairobi and Eldoret (over 300 km each way) that he has had to make to continue his teaching and research there.

While language differences have not presented a major obstacle to communication among members of the project implementing team (members from the DNP, Moi University, Shanghai Ocean University, Fish Africa, and Oregon State University), the physical distances between us do cause difficulties for our work effort in that they do not permit regular face-to-face meetings for activity planning and problem solving. In terms of whole-team meetings, budget concerns have limited us to setting aside time to meet at events such as AquaFish CRSP annual meetings and WAS annual conferences. These meetings are good but are limited in terms of time, and everyone is not always able to attend. For more efficient future work, we may need to find ways to increase the effectiveness of whole-team working opportunities, either through more frequent actual meetings or perhaps by using modern electronic tools, for example having "virtual" meetings using Skype or other technologies.

Lessons Learned

We have learned this year that language barriers have been much less of an obstacle to communication and learning in our training courses than might have been expected. In bringing aquaculture and fisheries expertise from non-Francophone countries (Kenya and China) to Mali, there was some concern that our training success would be hampered by poor communication and limited learning. However, our Theme Leaders' experiences have been that communication and learning have been excellent, both in the training sessions held in Mali and those held in Kenya and China. We attribute this to several factors, including the Malian trainees' very high level of interest in gaining skills in aquaculture and fisheries, our emphasis on hands-on learning, the enthusiasm of our trainers, and the use of competent and interested interpreters in the training sessions. A prime example of where language could have been an issue but was overcome is the example of Seydou Toé, who speaks neither French nor English. Seydou attended the first Theme I training session (pond construction and management) in Mali and then traveled to Kenya to study catfish reproduction and hatchery management. He came back from Kenya with a level of understanding that enabled him to construct a working hatchery at the practical training center in Bamako, demonstrate its use to other Malians, and assist in the next Theme I training course held at the center. He has since gone on to expand and improve operations on his own farm (including construction of his own hatchery) and to become involved in the training of other Malians (see "Success Stories," above).

The inclusion of DNP technical staff in our training and planning activities has stimulated more frequent visits to farmers by these staff members. For example, visits to farmers made jointly by theme leaders and DNP staff during the selection of farmers for the Theme I On-Farm Trials allowed them to give constructive criticism while opening their minds to incorrect pond management practices that had been limiting farmers' production.

Other lessons drawn from project activities include the following:

- Our results to date show that the program is an important means for improving the income of the small producers and thus an effective tool in the fight against poverty;
- Fish culture and rice-fish culture are of great interest to impoverished producers; greater support (material support) could positively influence the level of adoption of the technologies that we are making available; women, especially those who are household heads, and the young people would benefit from such an increased level of adoption;

- Financial support for fish farmer organizations (e.g., APAM) would allow a greater diffusion of rice-fish culture technology, methods of pond construction, and management practices for fish farms;
- Further reinforcement of the capacity of the Direction National de la Péche would ensure a better coverage of geographical zones not yet reached, where the need is great and the conditions are favorable;
- Particular technologies that may have potential in Mali but have not yet been addressed include fish culture in floating cages, the production of fish feeds, and the production of fresh water crustaceans (shrimps)
- Activities undertaken by the project to date have by nature focused on male participants; to include more female participants in future activities we will need to develop activities that focus on components of the market chain that are traditionally handled by women, i.e., those such as processing and marketing, which come after fish are landed or harvested.

Outcomes and Impacts

Notable impacts realized this year have included:

- *Stimulation of APAM* (*Association des Pisciculteurs et Aquaculteurs du Mali*): Following the first Theme I training course, February 2009, APAM organized meetings and group activities to evaluate the facilities and practices of member farmers, assess those in light of new information learned in the training, and to begin to adapt to work towards greater and more efficient productivity.

- *Success of farmers* like Seydou Toé: Seydou Toé is a real success story. Following training events both as a trainee and as an assistant to trainers, he has greatly improved his own fish farming efforts, is producing catfish fingerlings for sale, and is training other farmers.

- *Improved management of pre-existing fishponds*: Following training sessions participants have gone home to apply their new knowledge to improve their pond management and productivity

- *Construction of new ponds*: Following participation in training sessions trainees have also gone home to construct new ponds based on what they learned about selecting suitable pond sites and using appropriate construction methods.

- *Application of simple methods for catfish propagation and hatchery management*: A new hatchery facility was installed at the *Sotuba Centre de Formation Pratique en Elevage* by participants returning from training in Sagana, Kenya. This facility was used in a subsequent catfish propagation training course for Malian farmers, and continues to be operated by the APAM to produce catfish fry.

- *Formation of the Jigiya Association*: Following participation in the first Theme I training course in February 2009, Moussa Ballo returned home to form the Jigiya (“Hope”)

Association, an 11-member group that is now building ponds and growing fish together in Kayo, near Koulikoro.

- *Trained cadre of frame survey supervisors and enumerators*: Following training and survey exercises conducted as part of the Theme III (Fisheries Planning) effort this year, Mali now has the capacity to conducted the recommended periodic frame surveys of Lake Sélingué as well as similar surveys on other important lakes in the country.

- *Introduction of rice-fish culture into the Baguineda area*: Four farmers volunteered for participation in the Project's rice-fish demonstrations and produced crops of fish along with their rice. Although analysis of the results has not yet been completed, the participating farmers seem pleased with their results, and many more farmers in the area intend to try rice-fish production when they begin their next crop.

Summary

The Mali Project has made great strides this year, completing eight short-term training activities involving 122 participants, completing the first Frame Survey of Mali's largest inland body of water, Lake Sélingué, demonstrating rice-fish culture in the fields of four collaborating rice farmers, and conducting on-farm trials in the ponds of six fish farmers. Following their experiences in our training courses, participants have gone on to renovate poorly constructed fish ponds, build new ponds, apply improved management practices to their fish ponds, begin small-scale fingerling production, and become involved in training others. Analysis of the results of on-farm trials and rice-fish demonstrations early in the coming year will reveal more about the successes or shortcomings of these activities and suggest ways to do more and better in the future. The project continues to have the potential to make great contributions to Mali and the region, and the project team looks forward to continuing the momentum built this year and reaching or exceeding the remaining goals and targets that were set for the project.