MALI PROJECT FINAL REPORT

AQUAFISH CRSP • 2007-2010

AQUACULTURE & FISHERIES
COLLABORATIVE RESEARCH SUPPORT PROGRAM

MALI PROJECT FINAL REPORT

Aquatic Resource Use and Conservation for Sustainable Freshwater Aquaculture and Fisheries in Mali
October 1, 2007 – December 31, 2010

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AQUAFISH COLLABORATIVE RESEARCH SUPPORT PROGRAM

Oregon State University OSU

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Cover Photos:

Front Center: A sample of fish from the first crop in the first pond constructed by the *Jigiya Association*, Kayo, Mali, in November 2009.

Front Left: A farm worker using a cast net to sample for fish growth at a fish farm near Bamako in February 2009.

Front Right: A Lake Sélingué fisherman holds up a large Nile Perch (*Lates niloticus*) caught in the lake in February 2009.

Back Cover: Lake Sélingué fishers (men) deliver their catch to marketers (women) at the shore near the Carrière landing beach, Lake Sélingué, Mali.

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AquaFish CRSP
Oregon State University
418 Snell Hall
Corvallis, Oregon 97331-1643 USA
http://aquafishcrsp.oregonstate.edu
Email: aquafish@oregonstate.edu

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EXECUTIVE SUMMARY

Introduction

The AquaFish CRSP *Mali Project*, "Aquatic Resource Use and Conservation for Sustainable Freshwater Aquaculture and Fisheries in Mali," was funded through an award received from USAID/Mali under the "Leader with Associates" (LWA) award that established the AquaFish CRSP in 2006. The project spanned a period of 39 months (1 October 2007 through 31 December 2010), including a 3-month no-cost extension approved on 15 September, 2010. The no-cost extension allowed the project to complete a final fisheries planning training activity and prepare this final report.

The overall goal of the Mali Project has been to increase the productivity and income of fish producers (farmers and fishers) in targeted areas of Mali. To achieve this, the project has focused its efforts on these three thematic areas:

- Pond Culture—Advancing Sustainable Freshwater Aquaculture Practices and Technologies (Theme Leaders Charles Ngugi, Héry Coulibaly, and Boureima Traoré)
- Rice-Fish—Promoting Sustainable Rice-Fish Aquaculture in Irrigated Systems (Theme Leaders Liu Liping, Héry Coulibaly, and Alhassane dit Sandy Touré)
- Fisheries Planning—Building Community and Consensus towards a Fisheries Management Plan (Theme Leaders Nancy Gitonga, Héry Coulibaly, and Soumaïla Diarra)

More specific goals of the project have been 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
- Help establish linkages useful for further development of aquaculture and fisheries in Mali

The Mali Project has taken a South-South approach to development by bringing the scientific expertise and practical experience of CRSP partners from host countries with more fully developed aquaculture industries to bear on the three primary theme areas of the project in Mali.

Collaborating Institutions

The primary institutions involved in this project have included the following:

- AquaFish CRSP, Oregon State University, Corvallis, Oregon, USA (Lead US Institution)
- Direction Nationale de la Pêche, Bamako, Mali (Lead Mali Institution)
- Ministère de l'Élevage et de la Pêche, Bamako, Mali
- Moi University, Kenya (Theme I Lead Institution through 2009)
- Kenyatta University, Kenya (Theme I Lead Institution beginning 2010)
- Shanghai Ocean University, Shanghai, China (Theme II Lead Institution)
- FishAfrica, Nairobi, Kenya (Theme III Lead Institution)

Results Achieved

In keeping with the project's primary goal of making improved technologies available to our selected target audiences, a total of 20 workshops were conducted across our three theme areas during the thirty-nine month project period. These workshops covered a wide-range of aquaculture and fisheries topics, including pond site selection, pond construction, pond management, up-to-date techniques for rice-fish culture, fish transportation, catfish propagation and care of fry, best management practices, post-harvest technologies, and lake survey techniques, and also included 3 stakeholders workshops to discuss the results of the Lake Sélingué frame survey (see below) and begin developing a plan for co-management of that lake. A total of 358 participants took part in these workshops.

Field testing and demonstrations were also conducted to complement workshop activities and provide guided, hands-on experience to farmers. Two sets of on-farm trials were conducted by the pond culture team and one set of rice-fish demonstration plots were set up and run under the supervision of the rice-fish team. Through the application of improved management practices and supervision by project leaders, farmers participating in the on-farm trials realized yields of up to 9000 kg/ha in a six-month period (18,000 kg/ha/yr), a substantial increase over the estimated average productivity of ponds at the beginning of the project (1500 kg/ha/yr). In the rice-fish demonstrations, after approximately four months of culture one farmer harvested 115 kg of fish from a rice paddy just 840 m^2 in area (equivalent to 1369 kg/ha), bringing in welcome additional income for the family.

Several activities not specified in the work plan were catalyzed by this project and are worth noting. Upon completion of the first and second sets of on-farm trials, it was decided to run a third set, beginning near the original end-date of the project and to be completed after the project end-date under the supervision of DNP technical staff. One of our pond culture trainees, who speaks neither French nor English, has been instrumental in setting up catfish hatching systems in at least three locations and is now producing catfish fingerlings and selling them to other farmers. In addition, he has himself become a trainer, having led at least four pond construction training sessions for 90 people in Bougouni, Segou, Sanankoroba, and Gao during the final year of the project. He is also in demand as a consultant, having received over 120 people seeking fish farming advice at his farm, with 16 of these having started to build ponds of their own. After observing the results of the project's rice-fish demonstrations, at least 22 new farmers in the Baguineda area decided to modify their fields to include fish during the 2010 growing season.

Our fisheries planning activities included conducting the first ever frame survey of Lake Sélingué, preceded by two workshops to train those who would be conducting the survey. This not only produced a valuable baseline dataset for evaluating the fishing capacity of the lake, but also resulted in the creation of a cadre of individuals trained in the survey techniques used, so that they now have the capacity to conduct future surveys on this lake or others. Following analysis of the survey data, two stakeholders' workshops were held to discuss the results of the survey and the implications of those results for future fishery management. The project's final fisheries planning activities were a study tour for four Malians conducted at Lake Victoria, Kenya, to observe how co-management (participation of both government and local stakeholders in developing and carrying out management plans), is being successfully practiced at this lake,

followed by a final workshop with Lake Sélingué stakeholders to discuss the findings of the Lake Victoria study tour and continue the management planning process for the lake.

Summary

The work of the AquaFish CRSP Mali Project has thus set the stage for further development of the aquaculture and fisheries sectors in Mali. Fish farmers have received previously unavailable technical information that will enable them to expand the area under aquaculture production as well as increase their productivity per unit area. Fishers in Lake Sélingué have been brought into the management planning process, and technical staff of the Direction Nationale de la Pêche now have the skills needed for conducting additional frame surveys in the future, whether at Lake Sélingué or elsewhere. Rice farmers in Baguineda and other areas have seen how irrigated rice fields can be modified to accommodate a crop of fish, which many of them are now doing. Both rice farmers and fish farmers have learned how to produce more fish in their respective areas, thus bringing in added food and income to support their families.

INTRODUCTION

The AquaFish CRSP *Mali Project*, "Aquatic Resource Use and Conservation for Sustainable Freshwater Aquaculture and Fisheries in Mali," was funded through an award received from USAID/Mali under the "Leader with Associates" (LWA) award that established the AquaFish CRSP in 2006. The project spanned a period of three years (1 October 2007 through 30 September 2010), but was approved for a 3-month no-cost extension (NCE) at the end of the fourth quarter (on 15 September 2010). The NCE allowed the project to complete a final training in fisheries management and prepare this final report.

The overall goal of the project has been to increase the productivity and income of fish producers (farmers and fishers) in targeted areas of Mali. To achieve this, the project has focused its efforts on 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
- 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 included work in these thematic areas:

- *Pond Culture—Advancing Sustainable Freshwater Aquaculture Practices and Technologies* (Theme Leaders Charles Ngugi, Héry Coulibaly, and Boureima Traoré)
- *Rice-Fish—Promoting Sustainable Rice-Fish Aquaculture in Irrigated Systems* (Theme Leaders Liu Liping, Héry Coulibaly, and Alhassane dit Sandy Touré)
- *Fisheries Planning—Building Community and Consensus towards a Fisheries Management Plan* (Theme Leaders Nancy Gitonga, Héry Coulibaly, and Soumaïla Diarra)

Theme I worked to identify, develop, and promote appropriate pond culture systems for implementation in Mali. Based on experience in China, Theme II introduced appropriate adaptations of proven rice-fish systems into irrigated rice production areas in Mali's Niger River Delta, and Theme III engaged local stakeholders in the process of developing sound fisheries management plans (co-management), working initially at Lake Sélingué.

South-South Approach: The *Mali Project* has taken a South-South approach to development by bringing the scientific expertise and practical experience of CRSP partners from host countries with more fully developed aquaculture industries to bear on the three primary theme areas of the project in Mali.

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

Direction Nationale de la Pêche, Ministère de l'Élevage et de la Pêche, Bamako, Mali
(Lead Mali Institution)
Héry Coulibaly, Principal Investigator and Theme Leader for Themes I, II, & III (Pond Culture, Rice-Fish, & Fisheries Management), Direction Nationale de la Pêche
Boureima Traoré, Collaborator, Theme I
Madi M. Keita, Collaborator for Theme II
Alhassane dit Sandy Touré, Collaborator for Theme II
Soumaïla Diarra, Collaborator for Theme III

Ministère de l'Élevage et de la Pêche, Bamako, Mali
Mme Diallo Madeleine BA, Minister

Moi University, Kenya (Theme I Lead Institution *through 2009)*
Charles Ngugi, Theme Leader, Theme I

Kenyatta University, Kenya (Theme I Lead Institution *beginning 2010)*
Charles Ngugi, Theme Leader, Theme I

Shanghai Ocean University, Shanghai, China (Theme II Lead Institution)
Yang Yi, Theme Leader, Theme II, through July 2009
Liu Liping, Theme Leader, Theme II, since July 2009
Sun Tao, Assistant Workshop Leader, November 2009
Tang Jianye, Assistant Workshop Leader, January 2010

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

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

Fisheries Department, Government of Kenya, Nairobi, Kenya
Peter Nzungi, Frame Survey collaborator, Theme III

Mwea Aquafish Farm, Kenya
Charles Ngugi, Theme Leader, Theme I
James Mugo, Assistant Trainer, Theme I

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

PROGRESS MADE AND RESULTS ACHIEVED

Pond Culture

Workshops

The first Theme I workshop was held by Charles Ngugi, with logistical support from the Director of Fisheries Mali (DNP) and his technical staff. The training included 24 participants, including 4 from the Regional Fisheries Directorates (Bamako and Koulikoro) and 3 fish farmers who decided to take part in the workshop at their own expense. Workshop topics included aquaculture planning, selecting a good pond site, integrating fish in a farm, suitable fish species for culture, polyculture of tilapia and catfish, hatchery management, water quality management, fertilizer application rates, pond record keeping, fish farming economics, and marketing. Charles Ngugi did all the teaching but was assisted by James Mugo of Mwea Aquafish Farm and by resource persons from the DNP, whose main roles were to provide logistical support and help with translation and interpretation. It was a successful training, with some trainees already starting to refurbish their ponds only two weeks after the training.

In April 2009, four Malians, including two DNP technician and two fish farmers, travelled to Kenya to receive short-term training in pond culture techniques, including pond management, catfish propagation, tilapia sex reversal techniques, pond record keeping and development of business plans for aquaculture. Held at the Sagana Aquaculture Centre of the Government of Kenya Fisheries Department, the training commenced with their arrival on 6 April and ended on 17 April 2009. The training was primarily practical but included some lecture sessions and a field trip.

At Sagana Aquaculture Centre in Kenya, the visiting Malian team learned about all aspects of pond management, but focused especially on hatchery management and the propagation of African catfish.

The third Theme I training course, which was focused mainly on hatchery management and propagation of catfish, took place in Mali from 21 June to 3 July 2009. There were a total of 22 participants that included 15 fish farmers, 3 Regional Fisheries Directors (Bamako and Koulikoro) and 4 technicians. This training took two weeks and included both lecture sessions and practicals, with the practicals taking over 70% of the training time. Charles

Ngugi led this training, assisted by James Mugo of Mwea Aquafish Farm. The four Malians, including two DNP technicians and two fish farmers, who had travelled to Kenya to receive short-term training in pond culture techniques, participated as resource persons as well.

On their return to Mali from Kenya, the Malian team assisted with subsequent training courses by demonstrating the principles and techniques that they had learned to fellow fish farmers and government technicians.

The first set of on-farm trials was preceded by two workshops, held on 29 and 30 June, to prepare both the farmers and those who would be supervising their efforts for the trials, and in particular to discuss and agree on fish stocking strategies (choice of species and stocking densities), management options (fertilization, feeding), and monitoring protocols (sampling for fish growth) that were to be used.

Charles Ngugi travelled to Bamako on 10 January 2010, to lead two workshops supporting the first set of on-farm trials. The first was a one-day workshop held to evaluate the success of technologies and practices adopted by farmers in the trials, which had been run from July 2009 to January 2010, and the second was another one-day workshop to set up the second set of on-farm trials, which ran from January to June, 2010. Farmer's registration and training for the on-farm trials Evaluation Workshop took place on Monday 11 January 2010. Farmers selected for participation in the evaluation workshop included those that were involved in the first on-farm trials plus an additional three farmers. During the evaluation, it was noted that stocking of the ponds, which had been scheduled for 15 July through 31 July 2009, had been delayed because the irrigation canal whose water the farmers depend on for filling their ponds was under repair. However, DNP staff reported that 6 farmers were able to successfully stock their ponds in time to run a full crop cycle, and harvesting of these ponds began in early January 2010. All farmers who were in the first on-farm trials had harvested their fish by February 2010.

Tanks originally constructed for other purposes can be used for fish production, as practiced by farmer Mafa Fofana.

One of the keys to successful fish farming is having a steady supply of water. The OPIB-administered irrigation system near Baguineda provides enough water to support both irrigated rice farming and fish culture.

Charles Ngugi again traveled to Bamako on 9 May 2010, to conduct two more workshops. The first was a one-day workshop on 10 May for DNP technical staff, to train them on how to conduct a third set of on-farm trials. The second was a workshop on record keeping, business plan development, and marketing of farmed fish, using models previously developed under AquaFish programs in Kenya and Ghana but modified and translated for the Mali project. A wrap-up meeting was held at the end of the workshop on Friday, 14 May, to talk about the third set of on-farm trials and future projections for pond culture in Mali.

Table 1 shows a summary of workshops conducted under our Pond Culture theme (next page).

On-Farm Trials

Two sets of on-farm trials were planned as part of the project's *Pond Culture* theme during the course of the project. The first set of trials was begun in mid-July 2009, and ran until mid-January 2010. Six farmers participated in these trials. Ponds involved in the trials were monitored and sampled monthly by DNP personnel and our student participant Ahmadou Nouh Sow, from the Institut Polytechnique Rural de Formation et de Recherche Appliquée (IPR/IFRA) (Rural Polytechnic Institute for Training & Applied research), Katibougou. Harvesting took place in January and February 2010. Sample and harvest data were summarized for the evaluation carried out at the Bamako workshop in January. Presentation of the harvest data was done by Boureima Traoré, with other technical staff also providing input on data that they had been responsible for collecting. Production from these trials ranged from 1,352 to 9,090 kg for a 6-month crop, which extrapolates to 2,704 to 18,180 kg/ha/yr. These results show that for these 6 farmers there has been a tremendous increase in production per unit area, improving on the baseline production of 1,500 kg/ha/yr estimated at the beginning of the project to a high of 9,090 kg/ha/6 months (just over 18,000 kg/ha/yr) recorded during the trials.

Table 1. Workshops conducted by the Pond Culture team during the course of the project. A total of 9 workshops were conducted, involving 110 trainees in all.

Event Name	Country	Start Date	End Date	# of Trainees	# of Women
First Pond Culture Workshop in Mali	Mali	02 Feb 2009	06 Feb 2009	24	3
First Pond Culture Workshop in Kenya - Catfish propagation and hatchery management	Kenya	06 Apr 2009	17 Apr 2009	4	1
Second Pond Culture Workshop in Mali - Catfish propagation and hatchery management	Mali	21 Jun 2009	03 Jul 2009	22	2
Pre-On-farm Trials workshop for technical staff/supervisors	Mali	29 Jun 2009	29 Jun 2009	5	0
Pre-On-farm Trials workshop for supervisors and participating farmers	Mali	30 Jun 2009	30 Jun 2009	15	1
Post-On-farm Trials #1 evaluation workshop for supervisors and participating farmers	Mali	11 Jan 2010	11 Jan 2010	14	2
#2 Pre-On-farm Trials workshop for supervisors	Mali	12 Jan 2010	12 Jan 2010	6	1
2nd On-farm Trials Eval and 3rd On-Farm Trials Prep workshop	Mali	10 May 2010	10 May 2010	6	1
Third Pond Culture Workshop in Mali	Mali	11 May 2010	14 May 2010	14	3
Total number of workshops: 9				**110**	**14**

During the first set of on-farm trials, Mamadou Kane, a dedicated DNP extension officer who was one of the four who had been trained in Kenya in 2009, died and so his farmers experienced a setback in their trials.

The second set of fwas initiated in January 2010, with stocking of the ponds occurring in February. Samplings for fish growth were scheduled for approximately one-month intervals in March, April, May, and June. Following the May workshops in Bamako, Charles Ngugi, Boureima Traoré, and other DNP staff visited two of the participating sites—the *Jigiya Association* ponds in Kayo-Somono and Mofa Fofana's farm near Baguineda—to assess fish stocking and growth. It was observed that the pond sizes in this set of on-farm trials ranged

from 49.50 m^2 to 6,300 m^2. At Kayo, where fish were stocked on 24 February, sampling revealed average lengths of 15 to 16 cm and weights of over 80 g. At Mafa Fofana's farm, where the fish were stocked in January, including 5,000 catfish in a 320 m^2 pond and about 5 MT of fish in a tilapia pond. Catfish sampled ranged from 28 to 33 cm and tilapia sampled ranged from 15 to 23 cm. In June a fourth sampling of the ponds in this set of trials was carried out and all ponds were harvested. In this set of on-farm trials, the two farmers with the best results achieved extrapolated adult fish (average weights of 200-300 g) yields in the range of approximately 5,000-10,000 kg/ha over a 6-month period.

This pond was selected for the second set of *on-farm trials* and stocked with African catfish (*Clarias gariepinus*).

One of the larger fish sampled from Mafa Fofana's rearing tanks near Baguineda.

Spin-off Activities

Since his initial training under this project in Kenya and Mali, Seydou Toé served as a resource person in the subsequent trainings and was instrumental in the construction of the hatchery at the Sotuba training center. He also constructed a small hatchery facility at his own farm in Banco and began producing catfish fingerlings for sale. To date he has sold all the fingerlings he has produced, earning a significant income for the family. Seydou has also conducted a number of other trainings around the country, starting with the training of 10 young people in Bougouni (approximately 160 km south of Bamako) in the techniques of pond construction and management in early November 2009. Other trainings he has conducted include the following:

- Training of 40 producers in pond construction in Ségou in January 2010
- Training of 35 producers in pond management in Sanankoroba in February 2010
- Training of 5 leading producers in pond construction in Gao in May 2010

In late 2010, he built two new ponds for other farmers, one in Sénou and the other in Sirakoro Méguetana. Additional information about Mr. Toé is provided in the "SUCCESS STORIES" section of this report.

During the course of our Pond Culture work, a number of training materials (modules and fact sheets) were developed and translated into French for use during the workshops. We also made our trainees aware of the SARNISSA website (http://www.sarnissa.org/) and five of them have joined SARNISSA as members.

Following the wrap-up of the first set of on-farm trials in January 2010, the Malian and Kenyan theme leaders decided to set up and run a third set of trials. The ponds for those trials were selected in June 2010, with actual stocking and initiation of the trials occurring near the end of the planned project period (August/September 2010). The trials will continue beyond the project period, but will be monitored and evaluated by DNP staff after harvest in December 2010 or January 2011.

The DNP reported that two new Koulikoro farmers had taken up fish farming during the fourth quarter of FY 10.

In some cases, irrigated rice fields can be converted to dedicated fish ponds, adding a crop of fish and bringing in extra income for the farmer.

Rice-Fish Culture

Workshops

In order to strengthen the technical capacity of our Malian partners, a training course on rice fish culture was organized for two Malian fisheries officers at Shanghai Ocean University (SOU), China, from 16 to 21 September 2008. This activity had originally been planned for Year 3 of the project, but was brought forward following discussions among team leaders in mid-2008. Alhassane Touré, the regional fisheries director of Koulikoro region, and Tiéman Traoré, the fisheries service officer of Kati, Ministère de l'Elevage et de la Pêche, attended and successfully completed the training course. The decision to hold this training early in the project rather than later was a good one, as these two participants were then able to make valuable contributions to project activities and to the dissemination of rice-fish information in Mali following their training.

Building on experience gained during their short course in China in September 2008, Touré and Traoré formed a group in the Baguineda irrigation area and presented techniques on rice-fish culture to potential participants in a demonstration activity on 8 and 9 June 2009. In late June Liu Liping and Wu Zongwen, representing Theme II leader Yang Yi, visited Mali, where they met with Touré and Traoré, DNP leaders, OPIB officials, and farmers interested in rice-fish technologies to discuss arrangements for the rice-fish demonstrations. Preparation

for the rice-fish demonstrations included a workshop on "Up-to-date Techniques for Rice-Fish Culture in China," which was conducted in Baguineda on 26 June 2009. Touré and Traoré subsequently selected four farmers' rice fields for use as demonstration sites, helped them build fish sumps in the fields to adapt them for rearing fish, and initiated the demonstrations by stocking catfish and tilapia fingerlings. The first rice-fish demonstration was planned to last through November 2009.

Three rice-fish related workshops were held in FY 10. Two of these were held in November 2009 and the third in January 2010. Theme leader Liu Liping, along with Yuan Derun and Sun Tao, visited Mali in November to conduct two workshops as well as to harvest the four Baguineda area Rice-Fish Demonstration plots that had been set up in July 2009.

The first workshop, "Workshop on Appropriate Aquaculture Post-harvest Technologies," was held in Baguineda on 13 and 14 November. There were 24 participants in this workshop, including fishers, fish farmers, fish traders/marketers, fish processors, government officers responsible for aquatic food quality and safety, and researchers. The objectives of the workshop were to examine the current status of post-harvest processing practices, review the technologies available, identify constraints and problems in post-harvest processing, and recommend appropriate technologies for small post-harvest businesses. Yuan Derun reviewed aquaculture post-harvest technology and its roles in aquaculture development, poverty alleviation, food security, safety and aquaculture trade, and this was followed by Sun Tao's presentation covering the details of post-harvest technologies, including cooling, drying and salting, and smoking fish. Alhassane Touré reviewed current practices of aquaculture post-harvest processing in Mali. After that, Liu Liping introduced live fish and fish larvae transportation techniques. All the participants then discussed the issues and constraints related to rice-fish culture in Mali. The workshop leaders gave useful technical solutions to the workshop attendees.

The second workshop, "Workshop on Training and Extension Capacity for Rice-Fish Culture," followed immediately after the first from 16 to 20 November. There were 27 participants in this workshop (including 7 government officials), which aimed to build training and extension capacity for government extension officers, university teachers, and others working to develop rice-fish culture techniques. The topics covered history, relevance, status, development trends of rice-fish culture, and rice-fish culture systems (including physical structure and construction, the fish component, species choices, seed production, grow-out in rice fields, and feeds and feeding). Training and extension methods were also presented to help build training and extension capacity.

The third short-course conducted in FY 10 was a four-day stakeholder workshop on "Best Aquaculture Practices (BMPs) and Aquaculture Policy in Mali," organized by the DNP for approximately 20 participants, including fishers, fish farmers, middlemen, fish traders, government officers responsible for aquatic food quality and safety, and researchers, from 31 January to 3 February 2010. The objective of the workshop was to generate recommendations regarding development and implementation of BMPs for Mali aquaculture through careful review of the current status of aquaculture practices and policies in Mali, critical examination of the existing guidelines and standards, and consultation with multiple

stakeholders and experts. The workshop was led by Theme leaders Liu Liping (Shanghai Ocean University) and Alhassane Touré (Direction Nationale de la Pêche), with assistance from Tang Jianye (SOU). The workshop covered international principles for responsible aquaculture practice, aquaculture status, practice and future development trends in Mali, current policy and regulations on aquaculture in Mali, code of quality and safety management for aquaculture in China, guidelines for drug use in aquaculture, tolerance for residue of drugs in seafood, integrated pest management, and tilapia culture and practices. It was followed by group discussion and brainstorming on aquaculture in Mali. Jeff Dorsey, who works in the Niono area and had contacted the team during the previous quarter, attended the workshop and talked about rice-fish culture in Mali. Finally, a French translation of a document on fisheries standards in use in China, *Le standard industriel de la poissonnerie dans la République populaire de Chine*, was discussed and recommended for submission to the DNP as a reference for work in Mali. That document was included as Item 3 in Appendix 1 of our report for the 2nd quarter (FY 10).

A summary of the workshops conducted under the Rice-Fish theme is provided in Table 2 (next page).

Rice-Fish Demonstrations

The project's demonstrations of rice-fish culture were conducted in the Baguineda irrigation area between July and November 2009. Four farmers were selected for participation in late June and field preparations began 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. On 19 November 2009, the fish were harvested from the first rice field, that of Mamadou Samaké. Mr. Samaké's harvest was observed by the participants of the Theme II training workshop and Mme Diallo Madeleine BA, Minister of the Ministère de l'Élevage et de la Pêche. In addition to his rice harvest of 305 kg (3640 kg/ha), 115 kg of fish were harvested from his field of approximately 840 m^2 (0.084 ha) in area. The harvest of 115 kg extrapolates to over 1360 kg per hectare. The extra income that Mr. Samaké made through fish sales was approximately CFA 60,720 ($121), which was very appealing to him. His results have also generated a great deal of interest among other rice producers in the Baguineda area, a large number of whom began to make plans for going into rice-fish culture after restoration of the water supply following irrigation system renovations that were undertaken between November 2009 and June 2010. The other three demonstration sites were harvested between 19 and 22 November. Students Fadima Keita and Bocary Diarra continued to assist with the rice-fish demonstrations right through the harvests.

Table 2. Workshops conducted by the Rice-Fish team during the course of the project. Five workshops were conducted, involving a total of 92 trainees.

Event Name	Country	Start Date	End Date	# of Trainees	# of Women
Training Course on Rice-Fish Culture	China	16 Sep 2008	21 Sep 2008	2	0
Up-to-date techniques for rice-fish culture in China	Mali	26 Jun 2009	26 Jun 2009	21	1
Workshop on Appropriate Aquaculture Post Harvest Technologies	Mali	13 Nov 2009	14 Nov 2009	24	9
Workshop on training and extension capacity building for rice-fish culture	Mali	16 Nov 2009	20 Nov 2009	27	0
Workshop on BMPs - the Issues and Challenges	Mali	01 Feb 2010	04 Feb 2010	18	2
Total number of workshops: 5				**92**	**12**

Preparing for rice-fish culture in Baguineda begins with the excavation of a fish sump in one corner of the rice field.

After modification of the rice field for fish and rice seedling transplantation, fingerlings are released into the sump in one corner of a Baguineda rice fish demonstration field.

Spin-Off Activities

After seeing rice farmer Mamadou Samaké's success in the rice-fish demonstrations, at least 22 new Baguineda-area rice farmers chose to adapt their rice fields for fish production during the rice production season beginning in June 2010. This is a 5x increase over the four farmers who volunteered to participate in our first set of rice-fish demonstrations. With guidance from DNP technical officers, some of these new farmers chose to try several designs for the layout of fish sumps and access channels in the fields. The DNP monitored the preparation and stocking of their fields and, with assistance from the OPIB, rice was planted into all of

these fields in late June and July. Fish were then stocked and harvesting is planned for December 2010 or January 2011. CRSP trainee Alhassane "Sandy" Touré has been and continues to be a leader for the DNP in this work. The rice-fish farmers of the Baguineda area have also formed a cooperative to better organize themselves for sharing and spreading this new technology.

Two additional farmers in the Mopti area also took up this technology in FY 10, bringing the total number of rice-fish farmers adopting this technology during the project period to 28.

The DNP has been collaborating with other organizations, such as USAID'S *Integrated Initiatives for Economic Growth in Mali* program (IICEM) and the *Farmer-to-Farmer (FTF) Program*, to share information and set up training and demonstrations in additional areas such as Mopti. The trainees benefitting from these activities were producers, technical staff in Mopti, and NGOs who are involved in the Tombouctou and Gao regions.

Two of the new field layouts tested for rice-fish culture in the Baguineda area in 2010.

Fisheries Planning

Lake Sélingué Frame Survey

The work plan for our Fisheries Planning component called for a frame survey of Lake Sélingué, in the Sikasso Region. A frame survey is used to determine the types of fishing gear used and the fishing effort expended on a body of water so that its fishing capacity can be assessed prior to developing a management plan.

To prepare for this survey, two training sessions were held in February 2009 to train those who would be conducting the survey, including a 2-day session for survey supervisors (9-10 February) and a 1-day session for enumerators (11-12 February). A total of 31 participants were trained in these two sessions (see Table 3 below).

The frame survey itself was carried out by the survey team from 16 to 19 February. Two major fish landing sites were selected for the survey: the Carrière landing site on the eastern side of the lake and the Faraba landing site on the western side of the lake, with two days spent at each site. A database system was developed for storing and managing the survey

data in early April 2009, the data were analyzed, and a report on the survey results (*Report on Lake Sélingué Frame Survey of February 2009*) was submitted to the DNP in May. 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 per year, 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 the development of improved plans for the sustainable management of the lake fisheries. Assessing the fishing capacity through frame survey is the first step.

Recommendations based on the Lake Sélingué frame survey included:

- A frame survey of the lake should be carried out every two years to assess the impact of management measures taken to ensure sustainable fisheries.
- The DNP should also use the survey capacity built to carry out surveys on other fisheries lakes and reservoirs in Mali, for example on Lake Manantali.
- 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 DNP 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.

To achieve the maximum benefit to stakeholders and to Mali, and with co-management of the lake to conserve its fishery resources as the goal, the results and implications of the frame survey needed to be shared and discussed with all stakeholders. Two stakeholders' workshops were therefore planned as a part of overall Theme III activities, and these workshops were conducted in FY 10.

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

Frame survey data collection at Lake Sélingué in February 2009.

Stakeholders' Workshops

Two Lake Sélingué stakeholders' workshops were conducted in May 2010 to discuss the findings of the frame survey and the implications of those findings for lake management. The two workshops included one in Bamako for the DNP fisheries management team and another

for Lake Sélingué fishers, held at the ODRS offices in Sélingué. A PowerPoint presentation for reporting on the frame survey at these workshops was prepared by the workshop leader in Kenya prior to traveling to Mali in May. This presentation touched on the Lake Sélingué fisheries database and how it operates, the results of the 2009 Frame Survey, and recommendations for the sustainable management of the resources of the lake, based on the survey results. The agendas for the stakeholders' workshops was drawn up through e-mail consultations between frame survey specialist Peter Nzungi, Theme III leader Nancy Gitonga, and DNP Director Héry Coulibaly.

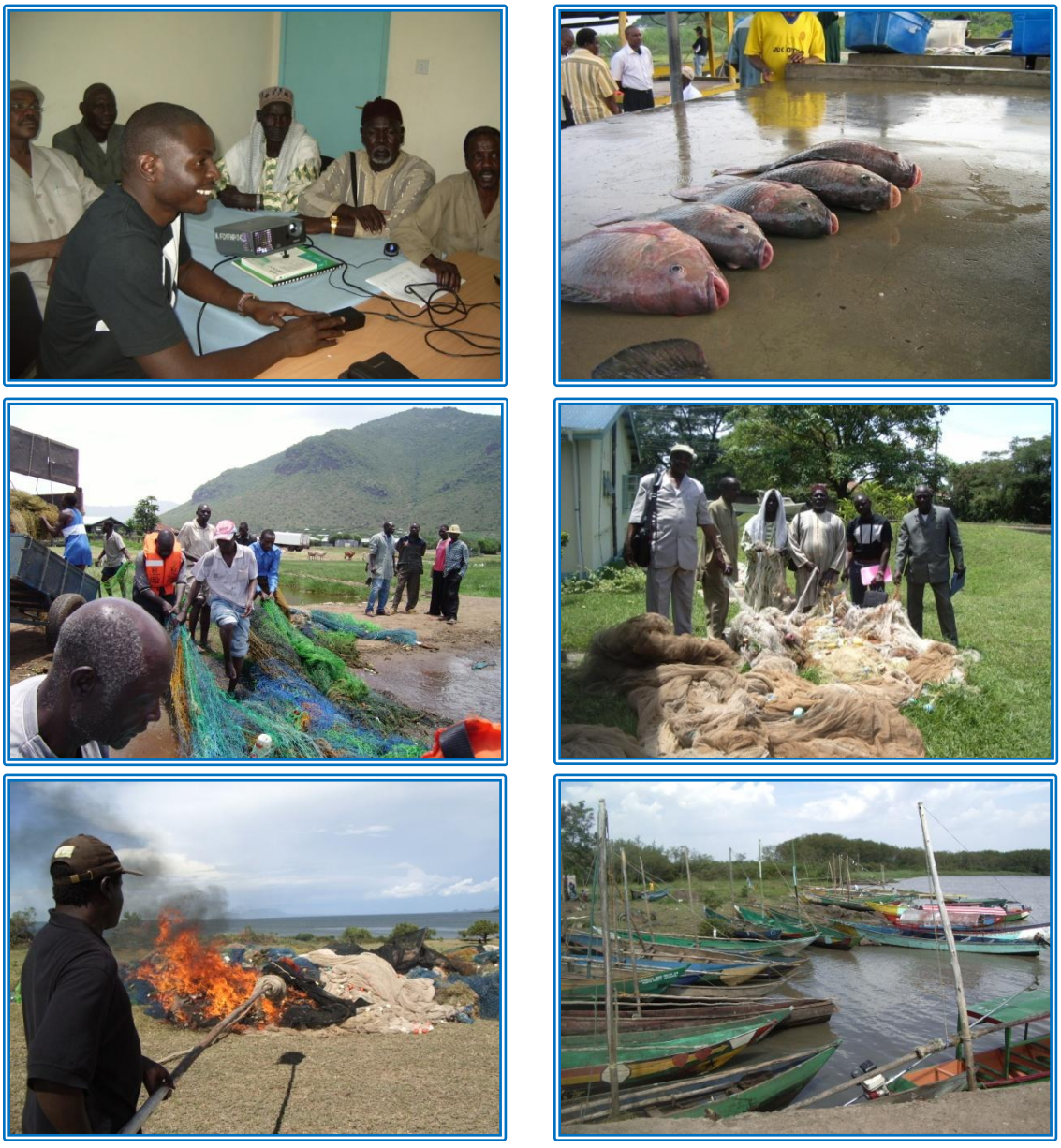
Stakeholders Workshop for the DNP Fisheries Management Team
Two days (10-11 May 2010) were given to the stakeholders' workshop for the DNP fisheries management team held at the DNP offices. During the two days the frame survey specialist presented the results of the frame survey, the Lake Sélingué fisheries database and how it operates, and draft recommendations on sustainable management of the resources of the lake based on the frame survey results for discussion. This was done through an interpreter. Lively discussions ensued and the participants were happy with the results. They came up with several other recommendations which were included in the final survey report.

Stakeholders Workshop for Lake Sélingué Fishers
Another two days (12-13 May 2010) were given for the stakeholders workshop held at the ODRS offices in Sélingué for Lake Sélingué Fishers. During the workshop the frame survey specialist again presented the results of the frame survey and draft recommendations on sustainable management of the resources of the lake based on the frame survey results as well as additional ones suggested by DNP management. Again this was done through an interpreter. Just like the meeting with the DNP fisheries management team, a lively discussion followed the presentations and again the participants of this workshop were happy with the results. They also came up with several other recommendations which have been included in the final survey report. There were 33 participants in this second workshop.

Lake Fisheries Co-Management Training
On evaluation of the activities conducted under this project through FY 09, DNP Director Héry Coulibaly requested that an additional training course in *Fisheries Planning* be substituted for the third planned *Pond Culture* training session in Kenya, which had not yet been held. At the team leaders meeting following the AquaFish CRSP Annual Meeting in San Diego, it was agreed that it would be in the best interest of the project and of fisheries development in Mali to respond favorably to the DNP director's request, and USAID agreed the project could substitute the refocused training.

The focus of this new training was on how fisheries management, and specifically co-management, has been successfully applied at Lake Victoria, Kenya. The training, conducted out of Kisumu, on the shore of Lake Victoria, thus took the form of a study tour, looking at 1) fisheries co-management, 2) monitoring, control, and surveillance systems, and 3) the formation and roles of Beach Management Units at Lake Victoria, Kenya. Through the addition of two extra days, it was also possible to expand the training in Nairobi to include the use of computer software for data storage, management, and analysis.

The DNP, FishAfrica, and the OSU Management Office put considerable effort into planning this revised training course during the 3rd and 4th quarters of FY 10, with dates for the training eventually set for 27 September through 3 October. To maximize the benefits of this effort for Mali, four participants were sent rather than two. The four participants departed Mali on 26 September, arriving in Kenya on 27 September, and returned to Mali on 4 October.



During their study tour at Lake Victoria, Kenya, the Malian team spent some time in the classroom listening to presentations about western Kenya, the lake, and co-management of the lake's fisheries, but more time was spent at the lake itself, visiting landing sites, observing the types of fishing gear and boats in use and fish species caught, learning about monitoring and control practices, and visiting with fishermen and to discuss and understand how co-management of Lake Victoria's fishery resources is practiced.

Final Stakeholders' Workshop

The results of this study tour, along with documentation collected during the trip, were presented to stakeholders in a workshop held in Sélingué on 11 December, 2010. Participants in this workshop included executives of the ODRS, Prefects and Sub-prefects of the communities of Bougouni and Yanfolila, mayors and chiefs of the villages bordering Lake Sélingué, representatives of the fishing communities of Carrière and Faraba, representatives of the police, the hydroelectric station, and the health services of Sélingué, and wholesale fish merchants. On the whole 76 stakeholders participated in the workshop.

The aim of the workshop was not only to review the findings of the Lake Victoria study tour, but also to outline a strategy for sustainable management of Lake Sélingué's fisheries. Agreement was reached on the following proposals for developing a good management strategy for Lake Sélingué:

- A proposal to establish catch quotas for the lake, and especially for juvenile fish
- A proposal to set up new working groups for preparing and implementing co-management of Lake Sélingué
- A proposal to ensure the inclusion of town councilors along with the usual managers in the management of the Lake's fisheries

The main conclusions and recommendations of the workshop included:

- A plan establishing co-administration and management conventions for Lake Sélingué's fishery resources should be put into place to begin in 2011
- Approved management conventions for Lake Sélingué should be brought up to date with respect to legality
- Support for the lake's monitoring services (human, material, and financial) should be increased
- Diversification of the activities of the professional fishermen working on the lake should be sought

A summary of the workshops conducted under the Fisheries Planning activity is provided in Table 3.

Table 3. Workshops conducted by the Fisheries Planning team during the course of the project. Six workshops were conducted, involving a total of 156 trainees.

Event Name	Country	Start Date	End Date	# of Trainees	# of Women
1st Fisheries Management Workshop (frame survey training for supervisors)	Mali	9 Feb 2009	10 Feb 2009	11	0
1st Fisheries Management Workshop (frame survey training for enumerators)	Mali	11 Feb 2009	12 Feb 2009	20	0
Stakeholders' Workshop I	Mali	10 May 2010	11 May 2010	12	0
Stakeholders' Workshop II	Mali	12 May 2010	13 May 2010	33	3
Fisheries Training Workshop in Kenya	Kenya	27 Sep 2010	3 Oct 2010	4	0
Stakeholders Workshop to Review the Findings of the Lake Victoria Study Tour	Mali	11 Dec 2010	11 Dec 2010	76	5
Total number of workshops: 6				**156**	**8**

OSU Management Office Activities

Coordination of Annual Project Meetings and Attendance at Conferences

During the three years of the project, team meetings were planned to coincide with AquaFish Annual Meetings and large international aquaculture conferences. For our Malian partners, these conferences and meetings provided excellent opportunities to meet many of the participants in the wider AquaFish Program, both from the US and from participating Host Countries, and to learn how the AquaFish CRSP functions. Participation in the World Aquaculture meetings also brought them into contact with the global aquaculture community, providing examples and models of what aquaculture can and does do in other countries and regions, and giving them many ideas to bring home to Mali.

World Aquaculture 2008

An important initial project planning meeting was held in Busan, Korea, following the AquaFish CRSP Annual Meeting (18-19 May) and World Aquaculture Society conference (19-22 May) held there. Team members Héry Coulibaly, Charles Ngugi, Yang Yi, and Nancy Gitonga, together with USAID/Mali CTO Gaoussou Traore and OSU PIs Hillary Egna and Jim Bowman, met there on 22 May 2008. Although several members of the team (Coulibaly, Ngugi, Gitonga, Traore) had met in Mali in late 2007, this was the first opportunity for the full team to meet, get acquainted, and to have a chance to work on the project Work Plan together, including revising the schedule of activities for each theme and adjusting targets for the selected impact indicators, and to discuss issues related to language and the translation of workshop and other materials into French. It was noted at this meeting that MOUs and Subcontracts remained to be developed and that this process is typically somewhat time-consuming. The Mali Project team gave a presentation introducing the project to the full Aquafish CRSP membership during their Annual meeting.

Aquaculture America 2009

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, again 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.

Aquaculture 2010

In 2010 the project team again had an opportunity to meet to discuss project issues, this time following the AquaFish CRSP Annual Meeting and the *"Aquaculture 2010"* conference (World Aquaculture Society) in San Diego, California, from 1-5 March 2010. DNP Director Héry Coulibaly was joined by Theme Leaders Nancy Gitonga, Liu Liping, and Charles Ngugi, and by Oregon State University PIs Hillary Egna and Jim Bowman for this meeting. USAID/Mali's AOTR Gaoussou Traore was unable to attend the meeting due to a schedule conflict, although CRSP AOTR Harry Rea attended. This was a very productive meeting, providing an opportunity for the team to thoroughly review progress made and plan for the remainder of the project period, adjust the activity schedules of the three theme areas, and discuss potential activities for the future. And as reported above, an important part of the discussion focused on the idea of converting and replacing a planned *Pond Culture* workshop with one focused on *Fisheries Planning*.

At this meeting CRSP Director Hillary Egna invited Héry Coulibaly to serve as leader for the CRSP West Africa Regional Center of Excellence (RCE), working with Charles Ngugi, who is the RCE for South and Eastern Africa. This will further connect Mali into the CRSP framework while providing a way for Héry to bring his own networks in as well. In the entire AquaFish CRSP membership of 300 participants, there are only 4 RCE leaders, including Héry, so his role as RCE leader will be an important one. This recognition and role is projected beyond the life of the current Mali Project.

<u>Coordination of Project Activities</u>

During the first year, the Management Office spent considerable effort developing Memoranda of Understanding and Subcontracts between the various institutions that are involved in the project (Direction Nationale de la Pêche (DNP), Shanghai Ocean University (SOU), and FishAfrica (FA)). Several aspects of this project are different than typical past AquaFish CRSP projects, and these differences complicated the development of these important documents. Amendments to these subcontracts were put into place at the beginning of each new fiscal year, extending the agreement periods and providing additional funding for the activities of each partner. Four additional amendments were later agreed on due to budget adjustments that needed to be made for the new fisheries planning workshop at Lake Victoria in Kenya.

The writing and submission of quarterly and annual reports was coordinated through the OSU Management Office, which submitted 12 quarterly reports and 3 annual reports to USAID/Mali over the life of the project. Mali Project annual reports were also included in AquaFish CRSP annual reports submitted to USAID/Washington. We also submitted data for annual indicator reports, both in the USAID/Mali Excel format and through the GFSR M&E system. During the course of the project the Management Office set up a number of conference calls between Héry Coulibaly (DNP), Gaoussou Traore, Karen Ramsey, and Yacouba Santara (USAID/Mali), and Jim Bowman (OSU), and we have had numerous SKYPE discussions with Héry Coulibaly and other team members.

The Management Office prepared two posters about the Mali Project for display at the *Aquaculture America 2009* and *Aquaculture 2010* conferences (Appendix). The posters covered the goals of our project, the approaches taken to achieve those goals, and progress made to date. We also prepared two French-language copies of the *Aquaculture 2010* posters and for Héry Coulibaly to take back to Mali. The French version was updated in May and five copies were printed and taken to Mali by Jim Bowman when he visited for the USAID All-Partners Meeting in June. Mini versions of the posters are included in the Appendix. In preparation for the December 2009 All-Partners Meeting in Mali, the Management Office prepared a brochure and a fact sheet (Appendix) about the project along with PowerPoint material for the presentation made at the meeting by Héry Coulibaly. These are included in the Appendix of this report. We have also been developing a Mali Page on the AquaFish website, where project documents such as MOUs, subcontracts, and quarterly and annual reports are posted and where team members can log in and record indicator data such as numbers of short-term training events held and numbers of participants attending.

Jim Bowman visited Mali in November 2009 and in June 2010, and Hillary Egna visited in August 2010. Both were able to visit some of the *on-farm trial* and *rice-fish demonstration* sites and the ponds of several farmers and farmer associations. Each also visited the Practical Aquaculture Training Center of Molodo (Niono, Segou area); the Office de Developpement Rural de Sélingué (ODRS), the ODRS hatchery, and the Carrière fish landing beach in Sélingué; and the hatchery and ponds of the Practical Training Center for Breeding at Sotuba. Both also had several opportunities to meet with the project's DNP and USAID partners, as reported in quarterly reports throughout the year. For his November 2009 trip to Mali Jim Bowman was fortunate to be able to pass through Kenya for an opportunity to meet with Theme Leaders Nancy Gitonga and Charles Ngugi to discuss project progress and problems, activity schedules, and indicator reporting. The meeting was hosted by Nancy Gitonga in her office at OAU headquarters in Nairobi.

The Management Office was intensively involved in planning and coordinating arrangements for the Lake Victoria co-management workshop, including the preparation of supplemental subcontract amendments for the DNP and FishAfrica, the two subcontracting institutions most closely involved in this training.

The Management Office requested a three-month no-cost extension (NCE) for the project and developed and submitted two proposals for future collaborative work to be led by the AquaFish CRSP. The request for an NCE was subsequently granted by USAID/Mali,

extending our operating time through December 31, 2010. No feedback on the proposals has been officially received although there had earlier been some indication of possible interest in continuation beyond the current project end date.

Other Project Activities

Activities of the Direction Nationale de la Pêche (DNP)

The DNP has taken an active role in the project including participating in all work plan activities as well as conducting follow-up/complementary activities for the three project themes and carrying out some supplemental new activities. Throughout the project period they have worked closely with the Ministry of Livestock and Fisheries to keep them informed of our activities and to involve them in them when appropriate. The Minister, Mme Diallo Madeleine BA, opened the first project workshop in February of 2009 and also visited our rice-fish demonstration sites on the day of the first harvest. These activities were covered by national radio and television of Mali. Examples of follow-up work related to our themes are the initiation of a third set of on-farm trials (Pond Culture) and providing advice to Baguineda farmers leading to at least 21 new rice farmers investing in rice-fish technology during the 2010 crop season (Rice-Fish). In addition, the DNP has engaged a local studio to videotape many of the field and classroom events and will be producing several short videos to promote the aquaculture and fisheries activities that we have been involved in. The DNP has also taken responsibility for getting "signage" in place at our sites to show USAID sponsorship of our work. For this 4 big signs and 10 smaller ones have been produced and placed at project activity sites. The Project Management Office assisted the DNP by creating the design for the signs using appropriate logos. The DNP has also produced and printed two vertical banner-style posters, one each on pond culture and rice-fish culture, and 1500 copies of flyers on fingerling production, pond culture, and rice-fish production. The DNP has also been collaborating with other organizations in Mali that have interest in aquaculture and fisheries development, and especially with USAID partners such as the IICEM, who have a particular interest in rice-fish systems, and the Peace Corps. Throughout, the DNP has ensured that our activities have received good press coverage, including a number of articles about the work of each of our three themes—pond culture, rice-fish culture, and fisheries management planning—in publications such as *L' Essor*.

Participation in USAID/Mali All-Partners Meetings

December 2009

The purpose of this meeting was to provide a venue for USAID/Mali/AEG to describe the components of its economic growth portfolio to its partners and for the partners to share what they are doing with each other. DNP Director Héry Coulibaly represented the project at these meetings, making a presentation in which he outlined the project's three theme areas and highlighted the activities undertaken and results achieved to date. No other project team members were able to attend this meeting due to schedule conflicts at the time.

June 2010

In this meeting USAID/Mali/AEG sought input from its partners to help it prioritize potential economic growth programs for support under the *Feed the Future* initiative, with the Government of Mali's *National Priority Investment Plan* for 2011-2015 as the starting point. It also provided opportunity for brainstorming with regard to scaling up those program areas

considered to be most important for Mali's economic growth. Participants were asked to take a broad view with regard to commodity prioritization and not to favor their own areas of interest. Boureima Traoré (DNP) and Jim Bowman (OSU) attended this meeting on behalf of the project team. This two day meeting provided a great opportunity to meet representatives of the many other USAID/Mali partners and to learn about other value chains and their importance to the Malian economy; unfortunately there was not much time for in-depth discussions with those other partners.

Summary of Short- and Long-Term Training

One of the major constraints to the development of aquaculture in Mali has been a lack of good technical information to guide the work of farmers, prospective farmers, extension agents, and others interested in farming fish. An important aspect of the Mali Project is its strong training component, in which short-term training and workshops are utilized to reach its targeted audiences in the three theme areas. The project's capacity building efforts benefit local stakeholders through technology transfer, the introduction of best management practices, and increased economic opportunities.

Short-Term Training

The Mali Aquaculture and Fisheries Project utilized on-farm trials, field demonstrations, and short-term training to test, adapt, and transfer appropriate aquaculture and fisheries technologies to its targeted audiences in the three theme areas. Training activities reached a wide audience of participants, including fishers, fish farmers, middlemen, fish traders, processors, government officers, and researchers. Most of the project's short-term training events occurred in Mali, but some training was conducted in third countries, specifically China and Kenya. During the project, 17 short-term training activities were conducted in Mali, one course was held in China, and two courses were conducted in Kenya, as summarized in Table 4.

Table 4. A summary of all short-term training conducted during the course of the project. Twenty workshops were conducted, involving a total of 358 trainees.

Event Name	Theme	Country	Start Date	End Date	# of Trainees	# of Women
Training Course on Rice-Fish Culture	Rice-Fish	China	16 Sep 2008	21 Sep 2008	2	0
First Pond Culture Workshop in Mali	Pond Culture	Mali	02 Feb 2009	06 Feb 2009	24	3
Frame survey training for supervisors)	Fisheries Planning	Mali	09 Feb 2009	10 Feb 2009	11	0
Frame survey training for enumerators	Fisheries Planning	Mali	11 Feb 2009	12 Feb 2009	20	0
Catfish propagation and hatchery management	Pond Culture	Kenya	06 Apr 2009	17 Apr 2009	4	1
Catfish propagation and hatchery management	Pond Culture	Mali	21 Jun 2009	03 Jul 2009	22	2
Up-to-date techniques for rice-fish culture in China	Rice-Fish	Mali	26 Jun 2009	26 Jun 2009	21	1
Pre-On-farm Trials workshop for technical staff/supervisors	Pond Culture	Mali	29 Jun 2009	29 Jun 2009	5	0
Pre-On-farm Trials workshop for supervisors and participating farmers	Pond Culture	Mali	30 Jun 2009	30 Jun 2009	15	1
Workshop on Appropriate Aquaculture Post Harvest Technologies	Rice-Fish	Mali	13 Nov 2009	14 Nov 2009	24	9
Workshop on training and extension capacity building for rice-fish culture	Rice-Fish	Mali	16 Nov 2009	20 Nov 2009	27	0
Post-On-farm Trials #1 evaluation workshop for supervisors and participating farmers	Pond Culture	Mali	11 Jan 2010	11 Jan 2010	14	2
#2 Pre-On-farm Trials workshop for supervisors	Pond Culture	Mali	12 Jan 2010	12 Jan 2010	6	1
Workshop on BMPs - the Issues and Challenges	Rice-Fish	Mali	01 Feb 2010	04 Feb 2010	18	2
2nd On-farm Trials Eval and 3rd On-farm Trials Prep workshop	Pond Culture	Mali	10 May 2010	10 May 2010	6	1

Stakeholders' Workshop I	Fisheries Planning	Mali	10 May 2010	11 May 2010	12	0
Stakeholders' Workshop II	Fisheries Planning	Mali	12 May 2010	13 May 2010	33	3
Third Pond Culture Workshop in Mali	Pond Culture	Mali	11 May 2010	14 May 2010	14	3
Fisheries Training Workshop in Kenya	Fisheries Planning	Kenya	27 Sep 2010	03 Oct 2010	4	0
Stakeholders' Workshop to Review the Findings of the Lake Victoria Study Tour	Fisheries Planning	Mali	11 Dec 2010	11 Dec 2010	76	5
Total number of workshops: 20					**358**	**34**

Involving an equal number of women in project training events has been a challenge throughout the project period. Some of this has been due to role distinctions inherent in Mali culture but some could have been due to less entrenched reasons. The Management Office is gearing up for enhancing outreach towards women beneficiaries, possibly with additional funds dedicated to women's involvement in the next project. Given the de novo nature of aquaculture in Mali, there could be lower barriers for women entrants but land and water rights, access to resources (info, credit, inputs), and perceptions of risk (vs. known low-risk outputs from labor) conspire almost everywhere in Africa to keep women from profiting. However, in Mali our experience with involving women was more segmented than in our other Africa activities. Fundamentally, two years is an inadequate period of time to bring in underrepresented groups, but with more time, funds, and up-front dedication, we think we can make a difference.

Theme II leaders awarded certificates to the participants attending the November 2009 Workshop on Post-harvest Technologies in Baguineda.

Technical staff and farmers during the Theme I *on-farm trials* workshop held in January 2010 in Bamako.

Long-Term Training

Although long-term training was not a major component of the project, three students from the Institut Polytechnique Rural de Formation et de Recherche Appliquée (IPR/IFRA) (Rural Polytechnic Institute for Training & Applied research), Katibougou, received partial support for participation in project activities during its second and third years. Student Ahmadou Nouh Sow was associated with Theme I (Pond Culture) activities, while Fadima Keita and Bocary Diarra were both associated with Theme II (Rice-Fish). All of these students assisted with workshop organization, fish transportation, and setting up, monitoring, monthly sampling, and harvesting of on-farm trials ponds (Theme I) and rice-fish demonstrations (Theme II).

Chronological Summary of Project Activities, 2007-2010

Year 1: October 1 2007 through September 30 2008

- ✓ ***Nov 2007 to Dec 2008:*** In Mali, ALL: Planning design & review with Mali counterparts
- ✓ ***May to September, 2008:*** Theme II: Planning for Rice-Fish Demonstration and Workshop on Training and Extension Capacity for Rice-Fish Culture
- ✓ ***September 2008:*** In China, Theme II: Training on Rice Fish Culture plus Capacity Building for Effective Skills Transfer
- ✓ ***Continuous:*** ALL: monitoring, evaluating, and impact reporting

Year 2: October 1 2008 through September 30 2009

- ✓ ***Feb2-6, 2009:*** In Mali, Theme I: Mali Pond Culture Workshop #1
- ✓ ***Feb 9-13, 2009:*** In Mali, Theme III: Frame Survey Training
- ✓ ***Feb 16-20, 2009:*** Frame Survey, Lake Sélingué (two Theme III activities end-to-end)
- ✓ ***Apr 6-17, 2009:*** In Kenya, Theme I: Kenya Pond Culture Workshops #1+2[1]
- ✓ ***Jun 21-Jul 3, 2009:*** In Mali, Theme I: Mali Pond Culture Workshop #2
- ✓ ***Jul 15, 2009:*** In Mali, Theme I: Start of Pond Culture On-Farm Trials #1 (immediately following the Pond Culture Workshop)
- ✓ ***Jun 26-Jul 15, 2009:*** In Mali, Theme II: Rice-fish demonstration set-up, first rice crop (at beginning of rice season)
- ✓ ***Continuous:*** ALL: monitoring, evaluating, and impact reporting

Year 3: October 1 2009 through December 30 2010

- ✓ ***Nov 12-14, 2009:*** In Mali, Theme II: Workshop on Appropriate Aquaculture Post Harvest Technologies
- ✓ ***Nov 16-20, 2009:*** In Mali, Theme II: Workshop on Training and Extension Capacity Building for Rice-Fish Culture (just before harvest)
- ✓ ***Jan 9-12, 2010:*** In Mali, Theme I: Set up and start Pond Culture On-Farm Trials #2
- ✓ ***Feb 1-4, 2010:*** In Mali, Theme II: Workshop on BMPs - the Issues and Challenges
- ✓ ***May 10, 2010:*** In Mali, Theme I: Evaluation and Wrap-Up, On-Farm Trials #1
- ✓ ***May 10, 2010:*** In Mali, Theme III: Stakeholders Workshop #1
- ✓ ***May 11-14, 2010:*** In Mali, Theme I: Mali Pond Culture Workshop #3
- ✓ ***May 12, 2010:*** In Mali, Theme III: Stakeholders' Workshop #2
- ✓ ***Sep 27-Oct 4, 2010:*** In Kenya, Theme III: Lake Management Training, Lake Victoria[2]
- ✓ ***Dec 11, 2010:*** In Mali, Theme III: Final Stakeholders' Workshop, Lake Sélingué
- ✓ ***September to December 2010:*** ALL: Final Reporting; Lessons Learned

Key:

Theme I - Pond Culture
Theme II - Rice-Fish
Theme III - Fisheries Planning
All

[1] Two of the original three sessions (planned for 2 trainees each) combined into a single session with 4 trainees.
[2] The third planned pond culture training session was converted to this fisheries planning course at Lake Victoria.

Progress towards Impact Indicator Targets

Significant progress was made with respect to reaching the project's impact indicator targets, as shown in Table 5 (next page). The table consists of two sections, one for the five indicators required in the Work Plan and another for additional indicators that were tracked to the extent possible. Note that we have exceeded our targets for most indicators.

New technologies *under field testing* during the project included:

1. Pond culture
2. Rice-fish culture.

New technologies *made available for transfer* during the project period included:

1. Pond construction
2. Pond culture
3. Rice field modification for growing fish
4. Rice-fish culture.
5. Catfish hatchery construction
6. Catfish propagation
7. Fish feed preparation
8. Fingerling transportation
9. Fish smoking
10. Fish drying

Table 5. AquaFish CRSP Mali Project Impact Indicator Targets and Achievements.

Required Indicators:

Indicator	***Project Target***	***Results end of FY 2009***	***Results in FY 2010***[1]	***New Total***
New technologies under field testing	*12*	*2*[2]	*0*	*2*
New technologies made available	*4*	*6*	*4*	*10*
Individuals receiving short-term training[3]	*155 (79/76)*	*124 (116/8)*	*234 (208/26)*	*358 (324/34)*
Farmers or organizations who adopted new practices[3]	*16 (8/8)*	*17 (17/0)*	*48*	*65*
Fish processors who adopted new practices[4]	*4 (2/2)*	*0*	*6 (0/6)*	*6 (0/6)*

Optional Indicators:

Indicator	***Project Target***	***Results end of FY 2009***	***Results in FY 2010***	***New Total***
Number of Malians who attend international aquaculture meetings[3]	*3*	*4 (4/0)*	*1 (1/0)*	*5 (5/0)*
Number of students trained or mentored in Mali[3]	*3*	*3 (2/1)*	*0 (0/0)*	*3 (2/1)*
Number of participants trained outside of Mali[3]	*8*	*6 (5/1)*	*4 (4/0)*	*10 (9/1)*
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*	*Over 200 new ponds and 27 rice-fish paddies*	*Over 200 new ponds and 27 rice-fish paddies*
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*	*2,700 to 18,000 kg/ha/yr*[5]	*2,700 to 18,000 kg/ha/yr*[5]
Estimated increase in income for fish farmers in targeted areas (CFA/ha/yr or percent)	*Not yet determined*	*Not yet determined*	*180 to 1,200%*[5]	*180 to 1,200%*[5]
Number of extension publications developed	*10*	*12*	*10*[6]	*22*[6]
Number of frame surveys conducted for lake fisheries	*1*	*1*	*0*	*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 Including the no-cost extension period, 1 Oct – 31 Dec 2010.
2 Previously reported as 4 technologies; now re-defined as 2: Pond Culture and Rice-Fish Culture.
3 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.
4 Impacts related to processors are not expected to be apparent until late 2010.
5 In ponds of farmers participating in the first set of Theme I on-farm trials.
6 Includes PowerPoint teaching modules.

SUCCESS STORIES

Improved Pond Management and Increases in Fishpond Productivity

One of the major goals of the project has been to help fish farmers improve their practices to increase productivity. Following their training experiences, many farmers have indeed returned home to apply their new knowledge to improve their pond management and productivity. Results coming out of our on-farm trials have shown exactly the kind of increases we are looking for. Among the ponds of the six farmers who completed the first set of trials, production ranged from 1,352 to 9,090 kg for a six-month crop cycle, which extrapolates to between 2,704 and 18,180 kg/ha/yr, with the best farmers in the second set of trials having similar results. This is a 2- to 11-fold increase in production per unit area over the 1,500 kg/ha/yr baseline estimated at the beginning of this project, and it shows the positive effect that occurs when farmers apply improved management practices provided to them through training and education.

New Fishpond Construction

Following participation in Theme I training sessions, trainees went home to construct new ponds based on what they learned about selecting suitable pond sites and using appropriate construction methods. As of the end of FY 10, the project team is reporting that over 200 new fish ponds have been built.

Fish Farmer Seydou Toé

We reported on Mr. Toé's initial successes in quarterly and annual reports throughout the project, but his story continues to be remarkable. Mr. Toé is a farmer engaged in the production of poultry, livestock, fruits, vegetables, and other food crops 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 southwest of Bamako. 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, founded with 80 members in 2007; now with 200 members and offices in Ségou and Mopti) and has participated in four of this project's training courses.

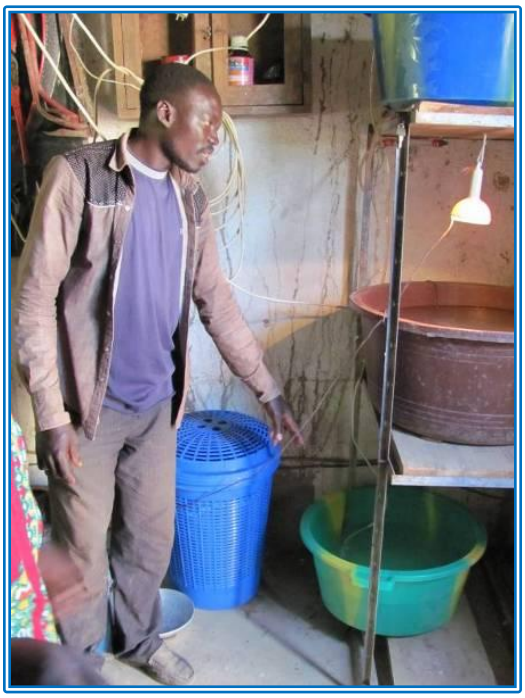
Prior to the beginning of this project, Seydou had been having problems related to poor construction of his ponds, lack of good feeds for the fish, lack of pond management information, and limited access to fingerlings. Some of his pond construction issues were related to high soil permeability, resulting in poor water retention in the ponds. This type of problem may point to a lack of good technical information in prior years, particularly information about selecting good sites for ponds.

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. In these workshops he learned about pond construction and management and the propagation of *Clarias* (African catfish), including spawning, hatching, and the care of catfish fry in the hatchery.

On their return from the Kenya training course in 2009, Seydou and his fellow trainees constructed and tested a hatchery at the Centre de Formation Pratique en Elevage at Sotuba. This hatchery has been used to hatch African catfish (*Clarias gariepinus)* eggs produced during

subsequent training courses on catfish propagation and continues to be operated by APAM to produce catfish fry.

The team members who were trained in the artificial propagation of *Clarias* (African catfish) at Sagana Aquaculture Centre in Kenya; from left to right: Rokia Coulibaly, Mamadou Kane, Seydou Toé, and Bouréima Traoré. In the left rear is the hatchery that they constructed at the Sotuba training center following their return from Kenya.



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

Using locally available materials, Seydou also built a hatchery at his own farm in Banco in 2009. By the end of 2009, thanks to training and assistance from this project and for the first time in Mali, Seydou had produced more than 8,000 fingerlings and marketed at least 4,000 of them locally to other farmers. In 2010 he produced more than 12,000 more catfish fingerlings and marketed at least 7,000 of them to other farmers. His fingerling sales serve as an important source of income, enabling him to meet the various operating expenses of his fish farm. 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. He has also acquired additional land, with soils more suitable for pond construction, where he plans to expand his fish farming operation, and he has trained a 15-person work team that helps him both on his own farm and in the trainings that he leads.

Seydou serves as the best kind of model for promoting fish farming in Mali, and through him we are now seeing tremendous multiplier effects from the work done by this project. In addition to the improvements he has made in his own fish farming work, Seydou's services as a consultant and pond construction trainer are in high demand throughout Mali. In 2010 more than 120 people have visited his farm seeking advice, and from these 16 have started to build their own ponds. The fact that people are willing to pay him for his services is an indication that farmers see fish culture as a sustainable enterprise and understand that positive economic benefits can be gained from it.

The training Seydou has received under the AquaFish CRSP Mali Project, financed by USAID/Mali, has enabled him to identify good sites for pond construction, improve pond management at his farm, and produce fingerlings for sale to other fish farmers. Seydou now also contributes to the dissemination of the information he has received and technologies he has learned by training and advising other producers. As an example, the APAM chose him to go to Bougouni, approximately 200 km from Bamako, to train 10 young people in fish culture in November 2009. During 2010 he has been involved in additional trainings that have included at least 80 trainees in Segou, Sanankoroba, and Gao.

Stimulation of the Association des Pisciculteurs et Aquaculteurs du Mali (APAM)
Following the first Theme I training course in February 2009, APAM organized meetings and other 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.

Catfish Fry Producer Rokia Coulibaly
Rokia Coulibaly, another one of the trainees who went to Kenya in 2009, installed a catfish hatching system similar to that of Seydou Toé on her property in June 2010, and successfully hatched her first batch of catfish larvae in July. Since then she has produced 15,000 fingerlings, of which she sold 1,000. The significance of the innovation of these simple hatching systems is that they are inexpensive, easy to construct, and easy to operate, so that many farmers or fingerling suppliers should be able to put them into operation. As more of these practical systems come into operation around the country, catfish fingerlings should become much more readily available for purchase by farmers who want to produce catfish for home consumption or for the market.

Left: Rokia Coulibaly shows her newly completed catfish hatching system.

Below: Rokia is using a hapa net and shading by banana leaves to nurse and protect newly-hatched catfish larvae.

Formation of the Jigiya Association, Kayo

Following participation in the first Theme I training course in February 2009, trainee Moussa Ballo returned to Kayo, near Koulikoro, to form the Jigiya ("Hope") Association. This is an 11-member group of former fishers who are working together to build livelihoods based on fish farming rather than fishing. Together they are building ponds and growing fish in Kayo. They are among those who have participated in on-farm fish culture trials conducted under Theme I of the project, achieving yields far in excess of the estimated yields obtained from typical ponds prior to the efforts of this project.

Rice-Fish Farming in the Baguineda Area

Mamadou Samaké is a rice producer in the Baguineda irrigation area, approximately 40 km from Bamako. He was one of the first rice farmers in this area to try growing fish in a rice field, through his participation in the project's rice-fish demonstrations. His successful endeavor was instrumental in encouraging other farmers to integrate fish into their rice production. He took part in the informational meetings on rice-fish culture presented by Liu Liping, Wu Zongwen, Alhassane ("Sandy")Touré, and Tiéman Traoré in June and July 2009, and volunteered to participate in the project's demonstration of rice-fish culture techniques.

The design was laid out in Mr. Samaké'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. Samaké maintained his field and cared for his fish well, even bringing termites for their food.

Mr. Samaké 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 Mme Diallo Madeleine BA, of the Ministère de l'Élevage et de la Pêche, on November 19, 2009, when his fish were harvested.

In addition to his rice harvest of 3640 kg, 115 kg of fish were harvested from his field at the end of demonstration period, which was very appealing to him because of the extra income that was generated. His results have generated a great deal of interest among other rice producers in the Baguineda area and a large number of them began thinking about going into rice-fish culture as soon as supply water was restored following repairs to the irrigation system.

The significance of Mr. Samaké's initial success is the multiplier effect it has had among other rice farmers in Mali, not only in the Baguineda irrigation area, but elsewhere in the country as well. As an example, at least 22 new rice farmers in the Baguineda area modified their fields for rice-fish farming in the 2010 season. In anticipation of the opening of the renovated irrigation system, the new fields were modified in May and June, rice was transplanted in June, and the fish were stocked in July. New farmers are using not only the original design used by Mr. Samaké, but are also trying out new field configurations. We eagerly await the results of these new undertakings in terms of fish production, income generation, and the comparative performance of the new field designs that are being tested.

Mme Diallo Madeleine BA, Minister of the Ministry of Livestock and Fisheries, visiting the farm of Mamadou Samaké on harvest day.

Over 100 kg of fish were harvested from the rice-fish field of Mamadou Samaké in November 2009.

One of the new rice-fish field designs, seen in early August, after rice transplantation and over a month of cultivation.

Another of the new rice-fish field designs, seen well after rice transplantation and significant rice growth.

Capacity Building for Sustainable Fisheries Management

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 properly managing 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. In addition, it is crucial to have stakeholders involved in the process to ensure long-term success and community buy-in. A major constraint in past fisheries management has been the failure to involve local stakeholders in management planning processes.

The project conducted a *Frame Survey* of Lake Sélingué to provide baseline information about its fisheries 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 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 allowed the *Fisheries Planning* team to develop recommendations to guide the development of management plans for the Lake Sélingué fishery.

Lake Sélingué stakeholders participated in two workshops to consider the implications of the 2009 frame survey and to begin to work together on plans for future management of the lake. For the first time ever, in 2010 no citations were given to Carrière fishermen by Lake Sélingué fisheries authorities.

In addition, four Malian stakeholders participated in a study tour of Lake Victoria, Kenya, where they visited fishing communities and members of *Beach Management Units* (BMUs), learning about Kenya's experiences in co-management of fisheries resources and how management responsibilities are shared between local stakeholders and the responsible government agencies.

Through completion of Lake Sélingué's frame survey, the formulation of management recommendations, participation in stakeholders' workshops, and exposure to how fisheries co-management is practiced in a major African lake, Lake Sélingué stakeholders are ready to work on developing a new management plan for the lake. On 11 December 2010 another stakeholders' workshop was held at Sélingué to summarize the findings and recommendations from all project activities to date and continue the process of management planning with full participation of all stakeholders. In addition, Malians now have the capacity to conduct regular frame surveys at Lake Sélingué or other important Malian water bodies, analyze the results, and design good management strategies for those bodies of water.

Third-Country Training Activities—China and Kenya

Some of our best successes originated in trainings conducted outside of Mali, including rice-fish training conducted in Shanghai, China, pond culture training conducted in Kenya, and lake co-management training conducted at Lake Victoria, Kenya.

Participants Alhassane Touré ("Sandy") and Tiéman Traoré, who were trained at Shanghai Ocean University, China, in 2008, returned to share what they had learned there with farmers and OPIB officials in the Baguineda irrigation area. They were directly involved in setting up the four rice-fish demonstration sites in Baguineda in 2009. The success of rice farmers who participated in those demonstrations, particularly Samaké, in turn generated so much interest among other Baguineda area rice farmers that at least 21 new farmers adapted their fields for fish production in 2010.

Likewise, participants who were trained at Sagana Aquaculture Centre, Kenya, in 2009 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. Soon after their return, they constructed a catfish hatchery at Sotuba training center and two of them, Seydou Toé and Rokia Coulibaly, have constructed their own catfish egg hatching

facilities on their own properties. Seydou Toé has independently been involved in training of other farmers.

In September 2010 four new participants went to Kenya for training in lake co-management and related topics at Lake Victoria. Initial reactions to the training were very positive and we expect to see good results in terms of the application of what was learned in Kenya to lake management in Mali, initially at Lake Sélingué but ultimately at other lakes and reservoirs as well.

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.

LESSONS LEARNED

- Tools such as *on-farm trials*, *rice-fish demonstrations*, and *stakeholders' workshops* are extremely effective for sharing critical information and providing the kind of hands-on practical experience that is needed for good learning. In our project we have found that participants in these activities were enthusiastic, actively engaged, and excited about the subject matter. Those who participated in stakeholders' workshops understood the importance of being involved in planning processes and were eager to do so.

- *Third-Country Training* can provide exceptionally good benefits for this type of project, as exemplified by the outstanding contributions made in Mali by those trained in China and Kenya in the early stages of the project. The contributions of these individuals, both in the field and in workshops put on by the project, proved to be significant factors in successes achieved by the project and are expected to continue to contribute to the future development of the aquaculture and fisheries sectors in Mali.

- The inclusion of DNP technical staff in our training and planning activities has served to stimulate 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.

- Fish culture and rice-fish culture are of great interest to impoverished producers. Greater support could positively influence the level of adoption of the technologies that we are making available. Women, especially those who are household heads, and young people would immediately be able to benefit from such an increased level of support.

- 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. Additional adaptive research, however, needs to continue to address local constraints to the full adoption of these technologies.

- Further reinforcement of the capacity of the Direction National de la Pêche through technical training for additional members of their staff would ensure better coverage of geographical zones not yet reached, where the need is great and the conditions are favorable.

- To include more women in aquaculture and fisheries activities, a greater focus on components of the market chain that are traditionally handled by women, such as processing and marketing, which occur after fish are landed or harvested, will be required.

- Transferring funds from the US to overseas partners is not always the straightforward and quick process that might be expected. We have found that wire transfers tend not to go directly from our bank to theirs, but instead often have to wend their way through

clearing houses and other banks, sometimes taking two to three weeks to arrive at the recipient bank. This has been problematic in cases where we needed to quickly get funds from OSU to our partners.

- Making arrangements for the international travel necessary for this type of project can be quite complex, due to problems such as long and complicated processes for getting visas for some countries and the need to meet "Fly America" requirements while keeping travel as straightforward and efficient as possible.

- Language barriers have been 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 experience has been that communication and learning have been excellent 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 and dedication of our trainers, the outstanding contributions of Malians who were trained in China and Kenya early in the project, 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 but has achieved so much as a result of the training he received through this project (see "Success Stories," above).

- Political unrest in countries other than the host country can have a significant impact on project progress, particularly in the start-up phase. In the case of this project, political unrest in Kenya in early 2008 had extreme effects on our partners from Kenya, particularly Charles Ngugi, leader of our Theme I effort, whose family lost their home and possessions in Western Kenya and had to flee to the Nairobi area for safety. This upheaval greatly affected Dr. Ngugi's ability to participate in project affairs during that early period of the project. Another tragedy occurred when we lost Dr. Yang Yi, Theme Leader for the rice-fish component, who died suddenly during the 2nd year of the project. Fortunately he had developed a good network on the project and was able to transfer leadership to Liu Liping and Yuan Derun.

- More timely information and feedback from USAID regarding project extensions is required. Until mid-August, we were actually planning a closedown on 30 September 2010. The university and partner agreements were ending and contract officers were beginning layoffs and closedown procedures. While we definitely appreciated the no-cost extension that was granted, it came at the 11th hour and caused higher transaction costs and extra work related to partner arrangements such as MOUs and subcontracts. The organizations involved are large and complex and require greater lead time for actions such as responding to RFPs and negotiating MOUs and subcontracts.

- If a new project is desired by USAID, planning for it would have benefitted from starting in early summer, at the time of the June workshop. The in-person communications that could have occurred at that time, as well as the resulting increase in available time for planning, would have been far more conducive to putting together a solid project that closely integrates gender and nutrition.

RECOMMENDATIONS

The AquaFish CRSP and its partners see many areas for future work that can contribute to development of aquaculture and fisheries sectors in Mali. Our recommendations for future work in these sectors fall into three main categories, as follows:

New Research / Investigations—To Address Critical Constraints to Fisheries and Aquaculture Development:

- Development of fisheries management plans
- Cage culture development – strategies and techniques
- Shrimp production in freshwater (freshwater prawns)
- Manufactured feeds for fish
- Live food production for fry early nursing, focusing on catfish
- Development of appropriate feeds and feeding technologies for small scale aquaculture in Mali
- Conducting frame surveys in natural water bodies in Mali
- Conducting stock assessment surveys in natural water bodies
- Development of improved rice-fish production models
- Investigation of other approaches to integrating fish production with agriculture
- Mosquito/malaria control in fish ponds and rice-fish systems, possibly in collaboration with the IPM CRSP
- Conducting economic analyses of different fish production systems (tanks, earthen ponds, lined ponds, cages, etc)
- Introduction of improved post-harvest technologies

Training—In Support of Proposed Research:

- Capacity building (training of trainers and technicians) in both fisheries and aquaculture to expand to other parts of the country and to develop needed expertise in critical areas such as:
    - Fingerling production technologies
    - Fishery data collection
    - Conducting surveys, recording data, and interpreting results
- Basic training for farmers in principles and techniques for small scale semi-intensive aquaculture
- MS-level degree training for selected DNP staff, either regionally or abroad

Outreach / Communication—To Bring Research Results to Diverse Audiences in Mali and the Region: These audiences can include end-users and stakeholders such as individual producers and producer associations, the GoM, the DNP, the USAID Mission, and industry.

- Organization of field days, trade shows to provide information about pond culture, rice fish production, fishery management, and post-harvest processing for Malian fish producers and processors
- Setting up on-farm demonstration sites for pond culture and rice-fish culture
- Supporting producer organizations such as APAM and Jigiya, especially as regards outreach (extension) activities.
- Communication through visual media (video, documentaries) to provide aquaculture and fisheries information to the people of Mali and west and central Africa
- Briefings to USAID Mission; serve as resource persons for the Mission

Across these three work areas, gender analysis should be used to address the two key questions posed by USAID in its program planning: 1) How will existing differences in gender roles and status affect the work to be done, and 2) How might the project's expected results affect women and men differently?

Possible Partners and/or Linkages for Future Work:

A number of regional and international organizations have expertise and experience that might be included in future collaborative efforts to build on the strong partnerships, excellent initial accomplishments, and momentum created through the AquaFish CRSP Mali Project. Some possible collaborators to consider for future work include:

- The AquaFish CRSP
- FishAfrica, Nairobi, Kenya
- Kenyatta University, Nairobi, Kenya
- Shanghai Ocean University, Shanghai, China
- The Network of Aquaculture Centres in Asia-Pacific (NACA)
- Other CRSPs
- University of Georgia
- Auburn University
- African Union
- NEPAD
- FAO

APPENDIX: EXAMPLES OF POSTERS, BROCHURES, AND FACT SHEETS PRODUCED BY THE PROJECT

The following items are included as examples of some of the project's work in the areas of information dissemination and publicity:

- Conference poster presented at Aquaculture America 2009, Seattle, WA, February 2009: ***Aquatic Resource Use and Conservation for Sustainable Freshwater Aquaculture and Fisheries in Mali***

- Poster for use in training and extension activities in Mali, June 2009: ***Etapes a Suivre Pour la Construction d'un Etang***

- Poster for use in training and extension activities in Mali, June 2009: ***Propagation du Poisson-Chat***

- Mali Project fact sheet developed for USAID/Mali's All-Partners Meeting in Bamako, December 2009: ***Aquatic Resource Use and Conservation for Sustainable Freshwater Aquaculture and Fisheries in Mali***

- French version of Mali Project brochure developed prior to USAID/Mali's All-Partners Meeting in Bamako, December 2009: ***Utilization et Conservation des Ressources Aquatiques Pour un Système Durable de Pêche et d'Aquaculture en Eau Douce au Mali***

- English version of Mali Project brochure developed prior to USAID/Mali's All-Partners Meeting in Bamako, December 2009: ***Aquatic Resource Use and Conservation for Sustainable Freshwater Aquaculture and Fisheries in Mali***

- English version of conference poster presented at Aquaculture America 2009, San Diego, CA, March 2010: ***Towards the Development of Sustainable Freshwater Aquaculture and Fisheries Management in Mali: Collaborative Work Under The Aquafish CRSP***

- French version of conference poster presented at Aquaculture America 2009, updated for use in Mali, June 2010: ***Vers le Développement d'un Système Durable de Gestion des Pêches et d'Aquaculture en Eau Douce au Mali : Travaux de Collaboration Dans le Cadre du Projet AquaFish CRSP***

- Banner produced by the Direction Nationale de la Pêche, June 2010: ***Pisciculture***

- Banner produced by the Direction Nationale de la Pêche, June 2010: ***Rizipisciculture de Baguineda***

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

James Bowman[1], Héry Coulibaly[2], Charles Ngugi[3], Yang Yi[4], Nancy Gitonga[5], Lisa Reifke[1], and Hillary Egna[1]

[1]Oregon State University, Corvallis, Oregon USA, [2]Direction Nationale de la Pêche, Mali, [3]Moi University, Kenya, [4]Shanghai Ocean University, Shanghai, China, [5]FishAfrica, Kenya

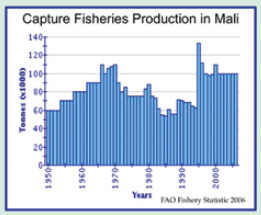
Introduction

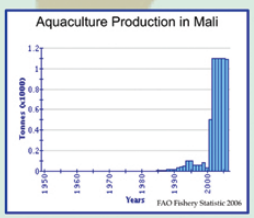
The Republic of Mali is a large, landlocked country in West Africa, characterized by a wide range of climatic and ecological conditions. With an area of approximately 1.24 million square kilometers, it is the seventh largest country in all of Africa. It is bordered on the north by the Sahara Desert and on the south by several inland and coastal countries with subtropical climatic regimes. The ecoregion known as the "Sahel" sweeps across the middle portion of the country. Of great significance to Mali, both ecologically and economically, is the presence of the Niger River, which passes through a good portion of the country, flowing in from Guinea on the southwestern border and out through Niger in the east/southeast, providing significant water resources to an otherwise dry region. The inland delta of the Niger River (20,000 sq km) provides livelihood opportunities for millions of people. Agricultural activities in this area include Irrigated rice cropping, rain-fed agriculture, small-scale fisheries, and grazing and browsing for herds and flocks.

Fish Production in Mali

More than half of the people in West Africa consume fish products on a daily basis. Regionally, the fisheries and aquaculture sector employs about 5 million fishers, fish processors, and fish traders; along with other associated jobs. In Mali, the fisheries and aquaculture sector is an important element of the national economy. Annual fish production is estimated to be 100,000 tons, and under normal hydrological conditions, Mali is ranked among the highest freshwater fish producing countries in Africa. Of its total estimated population of 12.6 million, Mali has over 700,000 fishers, and its annual fish consumption is estimated at 10.5 kg per person. In recent years, the demand for fish for local consumption has increased tremendously, growing at a rate of over 7% annually due to population increases and exports, especially to other African countries. Therefore, fish production is and will continue to be an important source of income for a large portion of the population.

The current supply of fish is far from meeting the demand of local markets, however, and in the future regional and local demands for fish are expected to continue to increase in Mali. According to recent assessments, a number of production constraints have contributed to the current shortfall. Among them, declining fish stocks is the most critical. Improving fisheries management and increasing aquaculture production are among the most promising alternatives for increasing the overall supply of aquatic products.





The AquaFish CRSP Mali Project

The AquaFish Collaborative Research Support Program (AquaFish CRSP) is partnering with the Direction Nationale de la Pêche (Government of Mali) and collaborators from Moi University (Eldoret, Kenya), Shanghai Ocean University (Shanghai, China), and FishAfrica (Nairobi, Kenya) to implement an innovative project for the sustainable development of the aquaculture and fisheries sectors in Mali. Support for this project is provided through a cooperative agreement between the Mali Mission of the United States Agency for International Development (USAID) and Oregon State University. The goal of the project is to improve 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 in target areas.

The project takes a South-South approach, working in three theme areas with corresponding objectives as follows:

- **Theme I** ("Pond Culture"): Advancing Sustainable Freshwater Aquaculture Practices and Technologies; Objective: To identify appropriate strategies for pond aquaculture and make them available to farmers in target areas
- **Theme II** ("Rice-Fish"): Promoting Sustainable Rice-Fish Aquaculture in Irrigated Systems; Objective: To identify appropriate strategies for integrated rice-fish farming and make them available to farmers in target areas
- **Theme III** ("Fisheries Planning"): Building Community and Consensus towards a Fisheries Management Plan; Objective: To assist local organizations in developing appropriate fisheries management plans to ensure long-term viability and sustainability of capture fisheries in target areas

Across these three themes, the project emphasizes creating capacity building opportunities, finding and promoting sustainable solutions to aquaculture and fisheries development, and fostering collaboration between the public and private sectors.

The project therefore focuses its efforts on training, conducting field trials and demonstrations, and holding stakeholder workshops. Theme I is providing hands-on training in pond construction, fish propagation, and pond management, and conducting field trials to identify pond culture systems suitable for implementation in Mali. Theme II provides training and field testing and evaluates potential adaptations of rice-fish systems for introduction into irrigated systems in Mali's Niger River delta, and Theme III is assisting the Mali Government in conducting frame surveys and involving local fishing groups in the development of sound fisheries management agreements, working initially in the Lake Sélingué area.

Most of these activities are being carried out in Mali, but some training is also being conducted in China and Kenya. For example, the first short course conducted under this project, focusing on rice-fish culture techniques that have been practiced in China (Theme II), was held at Shanghai Ocean University, China, in September of 2008. Two Malians who participated in this training will work with the Theme leaders to develop field trials and hold training sessions back in Mali. Similarly, selected Malians will go to Kenya in 2009 for hands-on training in pond culture techniques and return to Mali to set up field trials and participate in training sessions. Initial workshops for Themes I (Pond Culture) and III (Fisheries Planning) were held in Mali from 2-5 and 9-13 February, respectively, and the Lake Sélingué frame survey is to be conducted immediately following the Theme III workshop, beginning on 16 February, 2009.

Summary

Farmers, fishers and fishing communities, extension and technical personnel, and members of NGOs are the beneficiaries of the workshops, training courses, and field trials being conducted under this project. Through training and participatory field trials, recent and prospective fish farmers will learn current, practicable techniques for the culture of tilapia and catfish in Mali, rice producers will discover and apply techniques for producing crops of fish along with their rice crops, and members of Lake Sélingué fishing groups will participate in the development of lake management plans that will ensure optimum yet sustainable production.

Marketing fish at the landing beach near Lake Sélingué.

Participants learn basic surveying techniques at a workshop on pond construction and management held at the Practical Training Center of the Ministry of Livestock and Fisheries in Bamako, February 2009.

Fish are sampled by cast net in a private fish pond near Bamako during a field trip taken as part of a February 2009 Theme I workshop.

Mali government technicians learned about Chinese rice-fish culture techniques during a six-day course held at Shanghai Ocean University, Shanghai, China, in September 2008.

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AQUAFISH COLLABORATIVE RESEARCH SUPPORT PROGRAM

CONSTRUCTION D'ETANG: LES D'EMARCHE A SUIVRE

position étang Utilisation d'autres étangs comme points de référence.

Marquez le terrain choisi pour la construction.

Creusez un fasse autor de la surface du terrain choisi.

Faitesle creusement en utilisant les ooutils de jardinage comme les binettes.

Applanissez le sol en utilisant un cordon.

La consolidation de digue doit etre faire chaque 15cm(quinze centimeter).

Nivelage de sol. Les murs doivent incline vers l'interieur.

Marquez le canal de sortie.

Connectez le tuyau de sortie pour envoyer l'eau.

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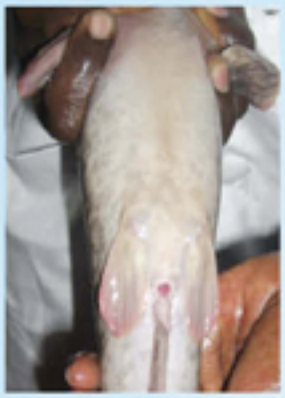
Mai Mahiu Department of Fisheries and Aquatic Sciences

OSU Oregon State University

Department of Fisheries (DoF)

AQUAFISH COLLABORATIVE RESEARCH SUPPORT PROGRAM

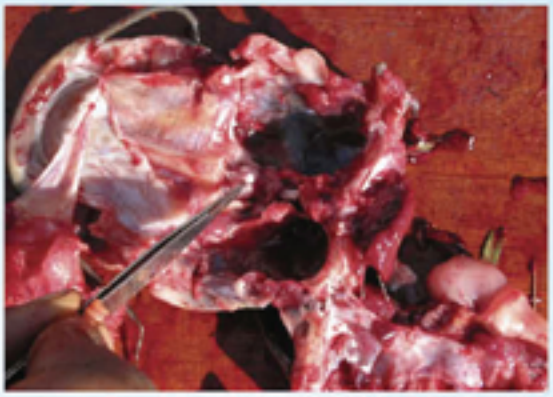
PROPAGATION DE LA POISSON-CHAT



Femelle

Male

Choisissez des male et de femelle appropriates de la niche. On peut differencier les deux genres en les observant.

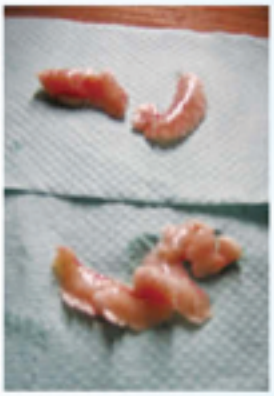


Rammassez la pituitarie en particulier, de genres masculine afin d'utiliser leurs organs maculin (les testis) La pituitarie est un organe globulaire rose et blanche en couleur situe a la ventrale de carveu.

Broyez la pituitarie dans un mortier en utilisant un pilon et la disolvez dans une solution saline.

La femelle est injectee avec la suspension de la pituitarie puis la laisse pour entre onze at douze heures.

Le ventre de male est disseque pour tirer les organs masculins(les testis) sans les pressure.



Sechez les testis avec un morceu de filter ou un papier de sole.

Detaches la femelle (les ouefs sont exposes de papillae gental) en utilisant une serviette moulle presses doucement jusque'au point ou le sang commence a apparatre.

En utilisant une paire de ciseaur faites des incisions aux bouts lobes de crème et presses la subsatance (milt) en utilisant des onglesseches.

On peut utiliser une plume pour melanger les ouefs avec les sperms. Ajoutez tout de suite un peu de l'eau et le melangez avec les ouefs en bougeant le boule doucement. il faut faire fait ca pour detacher le (milt) exces.

Mettez les oeufs en couche unique dans un plateau d'incubation ou utilisez des fibes comme substrata (couche inferieure) pour les ouefs.Après trios jours, la jaune sera absorbee et les alevin un petit poisson, commencera a chercher la nourriture.

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AQUAFISH
COLLABORATIVE RESEARCH
SUPPORT PROGRAM

AQUA FISH
COLLABORATIVE RESEARCH SUPPORT PROGRAM

AQUATIC RESOURCE USE AND CONSERVATION FOR SUSTAINABLE FRESHWATER AQUACULTURE AND FISHERIES IN MALI

The Mali Project works within the framework of three thematic areas: Pond Culture, Rice-Fish Culture, and Fisheries Planning. For the aquaculture themes, the project seeks to identify appropriate strategies for pond aquaculture and rice-fish culture and to make those strategies available for implementation by farmers in selected areas. For the fisheries sector, it seeks to evaluate the present status of the Lake Sélingué fishery and involve local stakeholders in the planning processes necessary for sustainable management of their fishery. During 2008 and 2009, a variety of activities were conducted under the Project's three thematic areas.

POND CULTURE:

- Conducted a short-course on pond construction and management in Bamako (24 trainees)
- Trained 4 Malians in catfish propagation techniques at Sagana Aquaculture Centre in Kenya
- Conducted a short-course on catfish propagation techniques in Bamako (22 trainees)
- Conducted on-farm research trials in the Bamako area to evaluate alternative pond culture strategies (20 trainees)
- Started academic training of 1 BS degree student

RICE-FISH CULTURE:

- Adapted rice-fish technologies from China to Mali (2 trainees)
- Set up and ran rice-fish demonstration plots in the Baguineda irrigation area (21 trainees)
- Held a post-demonstration workshop to discuss the outcomes of the research demonstration plots
- Conducted a workshop on appropriate aquaculture post-harvest technologies for Mali
- Started academic training of 2 BS degree students

December 2009

FISHERIES PLANNING:

- Developed and adapted fisheries management technologies from Kenya to Mali (31 trainees)
- Conducted and analyzed a frame survey of Lake Sélingué
- Stakeholders' workshops are planned to discuss findings of the Sélingué frame survey and consider lake management options

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Partenaires

Direction Nationale de la Pêche
(Gouvernement du Mali)
Moi University (Eldoret, Kenya)
Shanghai Ocean University (Shanghai, China)
FishAfrica (Nairobi, Kenya)

Chefs de Projet

Dr. Héry Coulibaly, Direction Nationale de la Pêche, Ministry of Livestock and Fisheries Development (MLFD), Mali
Dr. Charles Ngugi, Moi University, Kenya
Dr. Liu Liping, China
Ms. Nancy Gitonga, Kenya
Dr. James Bowman, Oregon, USA
Dr. Hillary Egna, Oregon, USA

Diverses parties prenantes de l'industrie aquacole du Mali participent et bénéficient des activités du Projet AquaFish CRSP au Mali. Ces parties prenantes comprennent les fermiers, les pêcheurs et leurs communautés, les membres des ONG, ainsi que le personnel technique et de vulgarisation. Les nouveaux pisciculteurs et les fermiers éventuellement intéressés à la pisciculture apprennent des techniques modernes faisables de culture du tilapia et du poisson-chat au Mali. Les producteurs de riz seront capables de découvrir et appliquer les techniques de production des poissons en plus de leurs récoltes de riz. Les membres des groupes de pêche du Lac Sélingué pourront activement participer dans le développement des plans de gestion du lac qui assureront une production optimale durable.

Février 2010

AquaFish
Collaborative Research Support Program

Utilization et Conservation des Ressources Aquatiques Pour un Système Durable de Pêche et D'aquaculture en eau Douce au Mali

Aquaculture & Fisheries
Collaborative Research Support Program
Oregon State University
College of Agricultural Sciences
418 Snell Hall, Corvallis, OR 97331 USA

Tel: 1-541-737-6426 | **Email**: aquafishcrsp@oregonstate.edu
Web: aquafishcrsp.oregonstate.edu

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Buts et Objectifs du Project du Mali

Le but du projet est d'améliorer la productivité et le revenu des producteurs au Mali en leur facilitant l'accès aux technologies et en développant la capacité des parties prenantes actives dans la pisciculture en eau douce et dans la gestion des pêches de capture..

Objectifs Généraux

- Faciliter l'accès et l'adoption des technologies améliorées de production aquacole dans les zones du projet afin d'augmenter et de diversifier les revenus des fermiers
- Améliorer la capacité du gouvernement Malien en ce qui concerne le développement et la vulgarisation de technologies adéquates
- Identifier les stratégies appropriées pour la mise en place de la rizipisciculture dans les zones du projet
- Faciliter le développement d'un bon plan de gestion des pêches afin d'assurer la viabilité et la durabilité à long terme des pêches de capture dans les zones spécifiques
- Aider dans la mise en place de liens interinstitutionnels nécessaires au développement futur des pêches et de l'aquaculture au Mali

Adoption D'une Approche Sud-Sud de Collaboration à Travers Trois Thèmes:

Thème I: Pisciculture en Etangs

Promotion des Méthodes et Techniques Durables D'Aquaculture en eau Douce

Realisations:

- Session de Travail sur la Pisciculture en Etangs au Mali - Février 2009, Bamako, formation de 24 stagiaires (dont 5 venaient de la Direction Régionale des Pêches à Bamako et Koulikoro) par Charles Ngugi
- Reproduction artificielle et Gestion de L'ecloserie du Poisson-Chat I: Avril 2009 au Centre Aquacole de Sagana au Kenya, avec 4 stagiaires venant du Mali
- Reproduction artificielle et Gestion de L'ecloserie du Poisson-Chat II : Juillet 2009, conduit par James Mugo et Charles Ngugi au Centre de Formation Pratique en Elevage de Bamako, Mali. 22 participants
- Travaux Préliminaires de Préparation des Essais sur le Terrain: Juin 2009 à Bamako, Mali. 20 participants
- Installation et Cinduite des Essais sur le Terrain: Juillet 2009 - Janvier 2010

Matières D'etude:

- Planification de l'aquaculture
- Sélection du site
- Choix des espèces de poissons
- Gestion d'une écloserie
- Gestion et économie agricoles
- Gestion et propagation du poisson-chat

Thème II: Rizipisciculture

Promotion D'un Systeme Durable de Rizipisciculture Dans les Zones Irriguées

Realisations:

- Cours de Formation en Rizipisciculture: Septembre 2008 à Shanghai Ocean University, Chine. 2 stagiaires Maliens
- Session de Travail sur les Methodes Modernes de Rizipisciculture en Chine: Juin 2009 à Bamako, Mali. Deux Maliens formés par le CRSP ont présentés les techniques rizipiscicoles à 21 participants
- Session de Travail sur les Techniques Aquacoles Appropriées Apres-recolte: Novembre 2009 au Mali
- Session de Travail sur la Formation et Développement des Capacités de Vulgarisation: Novembre 2009, 27 participants

Thème III: Aménagement Des Pêcheries

Developper un Sens de Communauté et de Consensus Dans le Cadre D'un Plan de Gestion des Pêches

Realisations:

- Formation des Surveillants des Enquêtes Cadres: Février 2009, Lac Sélingué, 11 participants
- Formation des Agents Recenseurs des Enquêtes Cadres: Février 2009, Lac Sélingué, 20 stagiaires
- Enquête Cadre sur le Lac Sélingué: Février 2009
- Analyse des Données de L'enquéte cadre: Juin 2009

Partners

Direction Nationale de la Pêche (Government of Mali)
Moi University (Eldoret, Kenya)
Shanghai Ocean University (Shanghai, China)
FishAfrica (Nairobi, Kenya)
Oregon State University (Corvallis, Oregon, USA)

Project Leaders

Dr. Héry Coulibaly, Direction Nationale de la Pêche, Ministry of Livestock and Fisheries Development (MLFD), Mali
Dr. Charles Ngugi, Moi University, Kenya
Dr. Liu Liping, China
Ms. Nancy Gitonga, Kenya
Dr. James Bowman, Oregon, USA
Dr. Hillary Egna, Oregon, USA

The AquaFish CRSP Mali project involves various stakeholders in the Mali aquaculture industry as beneficiaries, including farmers, fishers, fishing communities, extension and technical personnel, and members of local NGOs. Novice and prospective fish farmers will learn current, practicable techniques for the culture of tilapia and catfish in Mali. Rice producers will discover and apply techniques for producing crops of fish along with their rice crops. Members of Lake Sélingué fishing groups will participate in the development of a lake management plan that will ensure optimal and sustainable production.

February 2010

AquaFish Collaborative Research Support Program

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

Aquaculture & Fisheries
Collaborative Research Support Program
Oregon State University
College of Agricultural Sciences
418 Snell Hall, Corvallis, OR 97331 USA

Tel: 1-541-737-6426 | **Email**: aquafishcrsp@oregonstate.edu
Web: aquafishcrsp.oregonstate.edu

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Mali Project Goals & Objectives

The goal of the project is to improve the productivity and income of producers in Mali by facilitating access to technologies and building capacity of stakeholders involved in freshwater fish farming and capture fisheries management.

General Objectives

- Facilitate access and adoption of improved aquaculture production technologies in targeted areas to increase and diversify the incomes of farmers
- Enhance the capacity of the GOM to develop and disseminate relevant technologies
- Identify appropriate strategies for implementing integrated rice-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
- Assist in establishing linkages for further development of aquaculture and fisheries in Mali

Taking a South-South approach towards collaboration across three themes:

Theme I: Pond Culture

Advancing Sustainable Freshwater Aquaculture Practices and Technologies

Outputs:

- Pond Culture Workshop in Mali: February 2009 in Bamako, led by Charles Ngugi with 24 trainees, including 5 from the Regional Fisheries Directorates in Bamako and Koulikoro
- Catfish Propagation/Hatchery Management I: April 2009 in Kenya at the Sagana Aquaculture Center with four Malians traveling to Sagana
- Catfish Propagation/Hatchery Management II: July 2009 led by James Mugo and Charles Ngugi at the Centre de Formation Pratique en Elevage in Bamako, Mali with 22 participants
- Preliminary On-Farm Trials Workshop: June 2009 in Bamako, Mali with 20 participants
- Setup and Running of On-Farm Trials: July2009-January 2010

Topics Covered:

- Aquaculture planning
- Site selection
- Fish species selection
- Hatchery management
- Farming economics and management
- Catfish management and propagation

Theme II: Rice-Fish

Promoting Sustainable Rice-Fish Aquaculture in Irrigated Systems

Outputs:

- Training Course on Rice-Fish Culture: September 2008 at the Shanghai Ocean University in China with two Malians
- Workshop on Up-to-Date techniques for rice fish culture in China: June 2009 in Bamako, Mali where two CRSP-trained Malians presented techniques on rice-fish culture to 21 participants
- Workshop on Appropriate Aquaculture Post-Harvest Techniques: November 2009, Mali
- Workshop on Training and Extension Capacity Building: November 2009, 27 participants

Theme III: Fisheries Planning

Building Community and Consensus Towards a Fisheries Management Plan

Outputs:

- Frame Survey Training for Supervisors: February 2009, Lake Sélingué, 11 participants
- Frame Survey Training for Enumerators: February 2009, Lake Sélingué
- Frame Survey of Lake Sélingué: February 2009
- Analysis of Frame Survey Data: June 2009

Towards The Development Of Sustainable Freshwater Aquaculture And Fisheries Management In Mali: Collaborative Work Under The AquaFish CRSP

James Bowman[1], Lisa Reifke[1], Héry Coulibaly[2], Charles Ngugi[3], Yang Yi[4], Liu Liping[4], Nancy Gitonga[5], Peter Nzungi[6], and Hillary Egna[1]

[1]Oregon State University, Corvallis, Oregon USA, [2]Direction Nationale de la Pêche, Mali, [3]Moi University, Kenya, [4]Shanghai Ocean University, Shanghai, China, [5]FishAfrica, Nairobi, Kenya, [6]Fisheries Department, Nairobi, Kenya

Introduction

In 2007 the AquaFish Collaborative Research Support Program partnered with the Direction Nationale de la Pêche (Mali) and collaborators from Moi University (Kenya), Shanghai Ocean University (China), and FishAfrica (Kenya) to begin the *Mali Project*, an effort to promote the sustainable development of the aquaculture and fisheries sectors in Mali. Support for the project is being provided by the Mali Mission of the United States Agency for International Development (USAID), through a cooperative agreement with Oregon State University.

The Mali Project works within the framework of three thematic areas: Pond Culture, Rice-fish Culture, and Fisheries Planning. For the aquaculture themes, the project seeks to identify appropriate strategies for pond aquaculture and rice-fish culture and to make those strategies available for implementation by farmers in selected areas. For the fisheries sector, it seeks to evaluate the present status of the Lake Sélingué fishery, identify fishery management concerns, and involve local stakeholders in the planning processes necessary for sustainable management of their fishery.

Pond Culture

The objectives of the pond culture component are accomplished by providing hands-on training in pond construction, fish propagation, and pond management, and by conducting field trials to identify pond culture systems suitable for implementation in Mali. Summary of activities to date:

- Pond Culture Workshop in Mali- February 2009, Bamako: 24 trainees
- Catfish Propagation/Hatchery Management Training- April 2009, Sagana, Kenya: 4 trainees
- Catfish Propagation/Hatchery Management Training- July 2009, Bamako: 22 trainees
- Preliminary On-Farm Trials Workshops- June 2009, Bamako: 20 trainees
- Setup and Running of On-Farm Trials- July 2009 – January 2010: various locations in Mali

Rice-Fish Culture

This theme provides training and field testing and evaluates potential adaptations of rice-fish systems for introduction into irrigated systems along Mali's Niger River. Summary of activities to date:

- Training Course on Rice-Fish Culture- September 2008, Shanghai Ocean University, China: 2 Malian trainees
- Workshop on Up-to-Date Techniques for Rice Fish Culture- June 2009, Bamako: 21 trainees
- Setup and Running of Rice-Fish Demonstrations- July – November 2009, Baguineda irrigation area: 4 rice farmers
- Workshop on Appropriate Aquaculture Post-Harvest Techniques- November 2009, Baguineda: 22 trainees
- Workshop on Training and Extension Capacity Building for Rice-Fish Culture- November 2009, Mali: 27 trainees

Fisheries Planning

This theme provides assistance to the Mali Government in conducting frame surveys and involving local fishing groups in the development of sound fisheries management agreements, working initially in the Lake Sélingué area. Summary of activities to date:

- Frame Survey Training for Supervisors- February 2009, Lake Sélingué: 11 trainees
- Frame Survey Training for Enumerators- February 2009, Lake Sélingué: 20 trainees
- Frame Survey of Lake Selingue- February, 2009
- Analysis of Frame Survey Data- Analysis completed and full report submitted to the Government of Mali June 2009

Stakeholder workshops to discuss the survey results, consider lake management options, and begin the planning process are planned for February 2010.

Success Stories

Fish farmer Seydou Toé: Mr. Toé is farmer who had previously tried fish farming but experienced problems due to insufficient technical information on pond construction and management. Following participation in project pond culture training events, he has greatly improved his own fish farming efforts, by renovating old ponds, building new ponds, and producing catfish fingerlings for sale. He is also now training other farmers.

Enhancements to existing training facilities: A new catfish hatchery setup was built and installed at the Sotuba Centre de Formation Pratique en Elevage by CRSP trainees returning from project-sponsored pond culture training in Kenya in April 2009. This facility was used in a subsequent training course for Malian farmers, and continues to be operated by the Association des Pisciculteurs et Aquaculteurs du Mali to produce catfish fry.

Rice farmer Mamadou Samake: Mr. Samake is a rice producer in the Baguineda irrigation area east of Bamako. In June 2009, he volunteered to participate in the project's rice-fish demonstrations by modifying his rice field and stocking it with fish. His field was stocked in July and by November, more than 106 kg of fish were harvested, generating additional income for Mr. Samake. His experience also generated interest among other rice producers, many of whom now plan to go into rice-fish culture during their next production cycle.

Formation of the Jigiya ("Hope") Association: Following his participation in a CRSP pond culture training course in February 2009, Moussa Ballo returned home to form the Jigiya ("Hope") Association. This 11-member group of fishers is now building ponds and growing fish together. The Jigiya Association offered their first pond they constructed in on-farm trials organized by the CRSP pond culture component. The pond was stocked in July 2009 and is scheduled to be harvested in February 2010.

Summary

Across its three themes, the project emphasizes creating capacity building opportunities, finding and promoting sustainable solutions to aquaculture and fisheries development, and fostering collaboration between the public and private sectors. Farmers, fishers and fishing communities, extension and technical personnel, and members of NGOs are the beneficiaries of the workshops, training courses, and field trials being conducted under this project. Through training and participatory field trials, recent and prospective fish farmers are learning current, practicable techniques for the culture of tilapia and catfish in Mali, rice producers are discovering and applying techniques for producing crops of fish alongside their rice crops, and members of Lake Sélingué fishing groups are participating in the development of lake management plans that will ensure optimum sustainable production.

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AquaFish Collaborative Research Support Program

OSU Oregon State University

Vers le Développement d'un Système Durable de Gestion des Pêches et d'Aquaculture en Eau Douce au Mali : Travaux de Collaboration Dans le Cadre du Projet AquaFish CRSP

James Bowman[1], Lisa Reifke[1], Héry Coulibaly[2], Charles Ngugi[3], Yang Yi[4], Liu Liping[4], Nancy Gitonga[5], Peter Nzungi[6], et Hillary Egna[1]

[1]Oregon State University, Corvallis, Oregon USA, [2]Direction Nationale de la Pêche, Mali, [3]Moi University, Kenya, [4]Shanghai Ocean University, Shanghai, China, [5]FishAfrica, Nairobi, Kenya, [6]Fisheries Department, Nairobi, Kenya

Introduction

En 2007, The Aquafish CRSP Collaborative Research Support Program (Aquafish CRSP) a commencé un partenariat avec la Direction Nationale de la Pêche (Mali) en collaboration avec les chercheurs de Moi University (Kenya), Shanghai Ocean University (China), et FishAfrica (Kenya). Ainsi, le *Projet du Mali* a été lancé dans le but de favoriser un développement durable de l'aquaculture et des pêches au Mali. Le projet est conduit sous l'appui de la Mission au Mali de l'Agence des Etats-Unis pour le Développement International (USAID) à travers un accord de coopération avec l'Université de l'Etat d'Oregon (Oregon State University).

Les travaux du Projet du Mali sont basés sur des thèmes variés couvrant trois secteurs principaux: la Pisciculture en Etangs, la Rizipisciculture, et la Planification des Pêches. Les thèmes de l'Aquaculture visent à d'identifier les stratégies appropriées pour la pisciculture en étangs et la rizipisciculture, et à développer des méthodes de vulgarisation permettant la dissémination et la mise en pratique de ces stratégies par les fermiers des zones identifiées par le Projet. Quant au secteur halieutique, le projet veut évaluer la situation actuelle des pêcheries du Lac Sélingué, identifier les problèmes de gestion des pêches, et faire participer les parties prenantes locales dans les processus de planification requis pour une gestion adéquate de leurs pêcheries.

Pisciculture En Étangs



Les objectifs de la pisciculture en étangs sont accomplis en fournissant une formation pratique en construction des étangs, reproduction artificielle des poissons et la gestion des étangs. Des essais pratiques ont été conduits sur le terrain afin d'identifier les meilleures méthodes de pisciculture en étangs applicables au Mali. Le résumé des activités accomplies se présente comme suit:

- Session de Travail sur la Pisciculture en Etangs au Mali - Février 2009, Bamako, Mali: 24 stagiaires
- Session de Formation sur la reproduction artificielle et Gestion de l'ecloserie du Poisson-Chat - Avril 2009, Sagana, Kenya: 4 stagiaires
- Session de Formation sur la reproduction artificielle et Gestion de l'ecloserie du Poisson-Chat - Juillet 2009, Bamako, Mali: 22 stagiaires
- Travaux Préliminaires de Préparation des Essais sur le Terrain – Juin 2009, Bamako, Mali: 20 stagiaires
- Installation et Conduite de la première série d'essais sur le Terrain - Juillet 2009-Janvier 2010: plusieurs sites au Mali
- Installation et conduite de la deuxième série d'essais sur le terrain: essais multilocaux conduits au Mali de Janvier à Juin 2010
- Session de Travail et Formation sur l'Analyse économique, l'Analyse financière et la Comptabilité: Bamako, 10-14 Mai 2010: 14 stagiaires.

Rizipisciculture

Sous ce thème, le Projet fournit la formation nécessaire, conduit des essais sur le terrain et évalue les techniques rizipiscicoles applicables aux zones irriguées longeant le fleuve Niger au Mali. Le résumé des activités accomplies est le suivant:

- Cours de Formation en Rizipisciculture - Septembre 2008, Shanghai Ocean University, Chine : 2 stagiaires maliens
- Session de Travail sur les Méthodes Modernes de Rizipisciculture – Juin 2009, Bamako, Mali : 21 stagiaires
- Installation et Exécution des Démonstrations Rizipiscicoles – Juillet-Novembre 2009, Zones irriguées de Baguineda: 4 fermiers
- Session de Travail sur les Techniques Aquacoles Appropriées Apres-Récolte - Novembre 2009, Baguineda: 22 stagiaires
- Session de Travail sur la Formation et Développement des Capacités de Vulgarisation de la Rizipisciculture - Novembre 2009, Mali: 27 stagiaires
- Session de Travail sur Les Bonnes Pratiques en Rizipisciculture: Bamako, du 31 Janvier au 3 Février 2010, 20 stagiaires.

Aménagement Des Pêcheries

Le but de ce thème est d'assister le Gouvernement du Mali dans la conduite des enquêtes cadres et de faire participer les pêcheurs locaux dans le développement des plans de cogestion adéquats des pêcheries, en commençant par celle du Lac Sélingué. Le résumé des activités accomplies est le suivant:

- Formation des Surveillants pour les Enquêtes Cadres – Février 2009, Lac Sélingué: 11 stagiaires
- Formation des Agents Recenseurs pour les Enquêtes Cadres – Février 2009, Lac Sélingué: 20 stagiaires
- Enquête Cadre sur le Lac Sélingué- Février, 2009
- Analyse des Données de l'Enquête Cadre – L'analyse a été terminée et un rapport complet a été soumis au Gouvernement du Mali en Juin 2009.
- Première Session de Travail avec les Parties Prenantes : Bamako, 10-11 Mai 2010
- Deuxième Session de Travail avec les Parties Prenantes : La Sélingué, 12-13 Mai 2010

Des sessions de travail avec les parties prenantes pour discuter les résultats de l'enquête, évaluer diverses options pour la gestion du lac, et commencer le processus d'élaboration des plans de cogestion des Pêcheries seront organisées.



Cas Exemplaires de Succès

Seydou Toé, Pisciculteur: Mr. Toé est un fermier qui avait auparavant essayé la pisciculture mais sans beaucoup de succès à cause d'un manque d'informations techniques suffisantes sur les méthodes de construction et de gestion des étangs. Après avoir participé aux sessions de formation sur la pisciculture offertes par ce projet, il a considérablement amélioré ses propres installations et pratiques en rénovant de vieux étangs, en construisant de nouveaux étangs, et en produisant des alevins de poisson-chat pour la vente. Il a été promu formateur d'autres fermiers.

Perfectionnements des centres de formation existants: Une nouvelle écloserie du poisson-chat a été construite au Centre de Formation Pratique en Elevage de Sotuba par des stagiaires du CRSP retournant d'une formation en pisciculture financée par ce projet au Kenya en Avril 2009. Cette infrastructure a été utilisée ultérieurement pour les cours de formation des fermiers Maliens, et l'Association des Pisciculteurs et Aquaculteurs du Mali continue l'utilisation de l'écloserie pour la production des alevins de poisson-chat.

Mamadou Samake, Rizipisciculteur: Mr. Samake est un producteur de riz dans la zone irriguée de Baguineda située à l'Est de Bamako. En Juin 2009, il s'est porté volontaire pour participer aux démonstrations rizipiscicoles du projet et a ainsi modifié son champ de riz afin d'y élever également des poissons. Le champ a été mis en charge en Juillet et, déjà en Novembre, plus de 106 kilogrammes de poissons ont été récoltés, produisant ainsi un revenu supplémentaire pour Mr. Samake. Son expérience a également motivé d'autres producteurs de riz qui envisagent pratiquer la rizipisciculture dès le début du prochain cycle de production.

Formation de l'Association Jigiya ("Espoir"): Par suite de sa participation à un cours de formation en pisciculture en étang offert par le Project CRSP en Février 2009, Moussa Ballo a décidé de former l'Association Jigiya ("Espoir") dès son retour à la maison. Ce groupe de 11 pêcheurs construit maintenant des étangs et pratique l'élevage de poissons sous forme de coopérative. L'Association Jigiya a offert au CRSP le premier étang qu'ils ont construit pour conduire les essais sur terrain. L'étang a été mis en charge en Juillet 2009 et la récolte de poissons est prévue en Février 2010.

Résumé

A travers ses trois thèmes, le projet insiste sur le développement des capacités endogènes, aide à identifier et promouvoir les solutions durables aux problèmes de l'aquaculture et de la gestion des pêches, et stimule une collaboration entre les secteurs publics et privés. Les fermiers, les pêcheurs et leurs communautés, les membres des ONG, ainsi que le personnel technique et de vulgarisation, bénéficient des cours de formation, des sessions de travail divers, et des essais pratiques sur le terrain qui ont été conduits dans le cadre de ce projet. Grâce aux sessions de formation et essais pratiques participatoires conduits sur le terrain, les nouveaux pisciculteurs et les fermiers éventuellement intéressés à la pisciculture apprennent les techniques courantes et faisables pour la culture du tilapia et du poisson-chat au Mali, les producteurs de riz sont en train de découvrir et d'appliquer les techniques de production des poissons en plus de leurs récoltes de riz, et les membres des groupes de pêche du Lac Sélingué participent activement dans le développement des plans de gestion du lac qui assureront une production optimale durable.

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Direction Nationale de la Pêche

BP 275 • Tél. : standard (00223) 20 22 54 58 / 20 22 76 77
Tél. : / fax : (00223) 20 22 52 30 / 20 22 20 67
E-mail : dnp@datatech.net.ml

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AQUAFISH COLLABORATIVE RESEARCH SUPPORT PROGRAM

Rizipisciculture de Baguineda

• Amenagement des parcelles

• Parcelle amenagée

• Prise en charge des Parcelles

• Mise en eau des Parcelles

• Parcelles mise en eau

Direction Nationale de la Pêche

BP 275 • Tél. : standard (00223) 20 22 54 58 / 20 22 76 77
Tél. : / fax : (00223) 20 22 52 30 / 20 22 20 67
E-mail : dnp@datatech.net.ml

AQUAFISH
COLLABORATIVE RESEARCH
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Oregon State University
418 Snell Hall
Corvallis, OR 97330-1643 USA