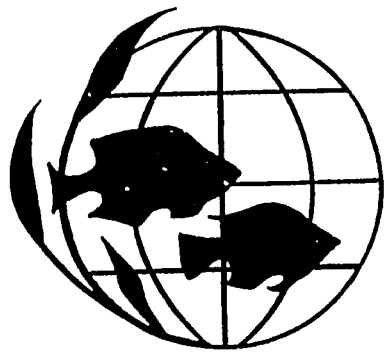
Quarterly Report
April - June 1993

Pond Dynamics/Aquaculture Collaborative Research Support Program



Pond Dynamics/Aquaculture CRSP
Program Management Office
Office of International Research & Development
Snell Hall 400
Oregon State University
Corvallis, OR 97331-1641

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The status of CRSP activities for the April through June 1993 quarter is reported according to project. The CRSP Work Plans provide detailed descriptions of these experiments. This summary highlights technical progress as reported by each university, and includes explanations of problems encountered in reaching stated goals. Financial information is sent to AID in a separate report.

Honduras

Status of the CRSP Experiments

The dry season study of shrimp yields at two densities and two protein levels was completed in April. Results were similar to those of the rainy season in that protein level had no effect on shrimp production, individual shrimp size, or survival at stocking densities ranging from 5 to 10/m^2. However, mean dry season yields (465 kg/ha) were less than one-third of rainy season yields (1782 kg/ha). Lower dry season production is correlated primarily to lower ambient temperatures and secondarily to high salinities. These data indicate that protein level of feed should be no higher than 20% for stocking rates of shrimp used in Honduras, and that a stocking density of 5/m^2 will generally give better economic returns than 10/m^2.

Study 1 of the Seventh Work Plan, estuarine monitoring of water entering shrimp farms, was begun in May and will continue for a minimum of one year.

Study 2 of the Seventh Work Plan was begun in June. This study is a rainy season farm trial of reduction of feeding through the use of inorganic fertilizers. The trial will be completed in its entirety on one farm, and each treatment will be repeated on two other farms.

The Global Experiment, which tests PONDCLASS as a management tool, was begun at the El Carao Station.

Training and Linkages

- David Teichert-Coddington gave a short course on water quality and fish culture to new Peace Corp fish culture volunteers in June.
- Claude Boyd visited Honduras in May to provide advice on chemical analyses of brackishwater and to review research plans. Boyd represented Auburn University at

the dedication of the water quality laboratory in Choluteca. Boyd reports that the laboratory is well organized and equipped for making all water and soil analyses required in the current and proposed studies. He also reports that the results from the first brackishwater studies, which show no difference in shrimp production between 20% protein and 40% protein feed used at two stocking densities, will be of immediate use to farmers, who will be able to cut their feed costs without affecting production.

- Del McCluskey, the CRSP contact at the USAID Mission, left Honduras for an assignment in a natural resources project in the Philippines.

Publications and Presentations

- Teichert-Coddington, D., B. Green. Tilapia yield improvement through maintenance of minimal oxygen concentrations in experimental grow-out ponds in Honduras. Accepted for publication in *Aquaculture.*
- David Teichert-Coddington presented a poster paper at the World Aquaculture Society annual meeting in Torremolinos, Spain in May.

Other Items of Interest

- The laboratory at La Lujosa, Choluteca, is now equipped and operating. Analytical methodologies for use in brackish water are being ironed out, and sampling of estuaries will begin in April.

Rwanda

Status of the CRSP Experiments

Study 2 from the Sixth Work Plan is in progress. This study will determine the inorganic nitrogen input rate required for maximizing primary productivity and fish yield under conditions of excessive phosphorus and inorganic carbon. Researchers are currently completing the third sampling; expected completion date for the study is September 1993.

Study 5 from the Sixth Work Plan, "Economic Analysis of Aquaculture Production Technologies," continues. Some delays have been experienced as a result of travel restrictions. This study compares the economics of resource utilization in aquaculture to that of other agricultural crops. Enterprise budgets for fish production and production of 12 different crops commonly raised on Rwandan farms have been completed. Descriptive analysis of the survey data is completed.

Study 2 from the Seventh Work Plan, a data analysis project in collaboration with the USAID-funded Natural Resources Management Project, continued this quarter. A data base format for entering data generated by Rwandan farmers in over 1000 production cycles was developed on SPSS and data entry has begun. Data will be analyzed to

determine relationships among the following variables: fish production, stocking rate, fish population structure, fish species composition, elevation, nutrient inputs, culture period, producer characteristics, and other pertinent variables.

Study 6 from the Seventh Work Plan was completed in May. This laboratory experiment isolated the effects of temperature from the other environmental variables linked to elevation, such as soil characteristics and solar radiation. The study monitored the extent to which appetite, growth, and feed conversion efficiency were affected by temperature when feed was provided frequently and at varying rates. Significant differences in growth and efficiency were observed in relation to the temperature regime.

Special Projects

Field work for the supplemental study, "On-farm Gariepinus-Oreochromis niloticus polyculture in Rwanda," was completed in February, and analysis of stomach contents was completed this quarter. The experiment is designed to provide recommendations for a culture strategy appropriate to elevation and economic circumstances; the report of findings is in progress.

Unmet Goals

Some experiments have been delayed or rescheduled due to the hostilities in Rwanda, which curtailed travel. Study 3 from the Sixth Work Plan has been rescheduled and will begin September 1993. Fry have been harvested recently in preparation for this experiment. Work on the data base and economic modeling at UAPB has been severely constrained by their limited access to computers with sufficient capacity. The three-month waiting period to receive approval from the Washington office to purchase needed equipment has hampered project efficiency.

Training and Linkages

- JJ Newman received travel clearance to Rwanda, and arrived 23 June.
- Wayne Seim traveled to Auburn in April to assist in the start of Study 6, and to confer with Tom Popma about publications.
- Newman met with Garace Reynard, the Administrative Officer at the U.S. Embassy in Kigali, and with Kurt Fuller, AID Rwanda Mission. Fuller was invited to the Tenth Anniversary Celebration of the Rwasave Station in July. Newman also met with National University of Rwanda staff, including the Vice Rector, the Dean of Faculty, and members of the Faculty of Agronomy.

Publications

Molnar, J., et al. 1993. Socioeconomic Factors Affecting the Transfer and Sustainability of Aquaculture Technology in Rwanda. International Center for Aquaculture and Aquatic Environments, Alabama Ag Experiment Station, Auburn University.

Other Information

- Travel restrictions for Rwanda have been lifted and opposition groups are in the process of signing a peace agreement. Although the local military in Butare requisitioned the project pickup for one day, Newman now has assurances from the Commandant that they will no longer use the CRSP vehicle.

Thailand

Status of the CRSP Experiments

Study 1, Sixth Work Plan, was completed this quarter. This study is designed to determine the relationships of pond size to fish yield, management practices, and system efficiency. Analysis of data is underway.

Study 6, Sixth Work Plan, was completed this quarter. This study determines the effects of stocking density on pond carrying capacity (fish size and total net yield) in fertilized ponds with supplemental feeding. The goal is to determine the appropriate stocking density, so that extra fertility from supplemental feeding is effectively assimilated. Balancing food supply and water quality can allow farmers to achieve optimal economic production while maintaining environmental quality. Data analysis and manuscript preparation are underway.

Study 7, Sixth Work Plan, was begun this quarter. This study is designed to determine the appropriate time for initial application of supplemental feed in fertilized ponds. Results of this study will help farmers make economically sound decisions regarding supplemental feeding by identifying the critical stages when natural food supply is inadequate to support optimal fish production.

Study 9, Sixth Work Plan, an outreach project to field test least-intensive aquaculture techniques on small-scale integrated farms, continued this quarter. Chris Knud-Hansen arrived in Thailand in May to complete MSU's component of the outreach project in northeast Thailand.

Data analysis continued this quarter on the following experiments:

- Study 10, Fifth Work Plan—Effects of pond size
- Study 1, Sixth Work Plan—Pond management strategies

- Study 4, Sixth Work Plan—Effects of density at high nutrient loads
- Study 10A, Sixth Work Plan—Regional verification in Philippines #1
- Study 10B, Sixth Work Plan—Regional verification in Philippines #2

Special Study Status

Part C of Study 10, "Regional Verification of Fertilizer Guidelines–Philippines," was completed during this reporting period.

Training and Linkages

- Knud-Hansen began a three-month assignment in Thailand. In addition to work on the outreach project in northeast Thailand, he is teaching a course on statistics in aquaculture at the Asian Institute of Technology.

Other Items of Interest

- Jim Szyper transferred his work station from Hawaii to the Asian Institute of Technology. En route to Thailand, Szyper attended the 1993 annual meeting of the World Aquaculture in Torremolinos, Spain.

Publications and Presentations

- Hopkins, K.D. Systematic variation in the growth parameter *Phi* prime. In preparation for submission to *Aquabyte*.
- Hopkins, K.D. and J.R. Bowman. 1993. A research methodology for integrated agriculture-aquaculture farming systems. Pages 89-98 in Jaw-Kai Wang (ed.), *Techniques for Modern Aquaculture*. American Society of Agricultural Engineers, St. Joseph, Michigan.
- Knud-Hansen, C., T.R. Batterson, and C.D. McNabb. The role of chicken manure in the production of Nile tilapia (*Oreochromis niloticus*). *Aquaculture and Fisheries Management*. In press.
- Knud-Hansen, C. and A.K. Pautong. On the role of urea in pond fertilization. Accepted for publication in *Aquaculture*.
- Knud-Hansen, C. and M.K. Shrestha. Increasing attached microorganism biomass as a management strategy for Nile tilapia *(Oreochromis niloticus)* production. Accepted for publication in *Aquacultural Engineering*.
- Knud-Hansen, C. and C.K. Lin. Strategies for stocking Nile tilapia *(Oreochromis niloticus)* in fertilized ponds. In review for *The Proceedings of the Third International Symposium on Tilapia in Aquaculture*.

DAST

Status of the CRSP Experiments
Study 2, Sixth Work Plan, Quantification of Light and Dark Respiration Rates, continued this quarter. Work focused on developing and testing a field respirometer for continuous measurements of diel water column respiration rates. A data acquisition and analysis model has been written for the respirometer using Extend™ software on a Macintosh computer. Dissolved oxygen probes and meters are being tested by the manufacturers to determine whether the instability experienced in testing is inherent to the instruments or if they are malfunctioning.

The Model for Temperature and Dissolved Oxygen in Stratified CRSP Ponds, Study 3, Sixth Work Plan, is being used to test temperature and dissolved oxygen regimes for various pond configurations.

During the current reporting period, a solar radiation-temperature model has been implemented in Borland True Basic™ as part of the refinements for PONDCLASS Version 2.0. The temperature model assumes completely mixed conditions in ponds, and uses some of the same functions at the stratified model developed by the UCD/DAST. User inputs required to run the model are limited to the geographical characteristics of a site (latitude, longitude and altitude) and anticipated diurnal temperature oscillations. The model has been tested against data from Ayutthaya, Thailand, and has given satisfactory results. Further testing with data from other CRSP sites is on-going. The temperature model has been linked to the fish growth model implemented earlier to allow simultaneous simulation of water temperature profiles for a particular pond and growth curves for Nile tilapia *(Oreochromis niloticus)*.

The user interface for the File Manager routine of the DOS version of PONDCLASS Version 1.1 has been considerably refined to support easy file creation, data entry and editing. Numerous on-line help screens have also been implemented in the software. Modification of other routines (Planner, Manager, and Simulator) is currently underway.

A core architecture for the next generation of PONDCLASS, which includes a simulation environment, file management and graphing capabilities programmed in C++ has been implemented as a Microsoft Windows-based software application. The OSU/DAST is currently in the process of moving the existing functionality of PONDCLASS to this architecture.

Publications and Presentations

- Culberson, S.D. 1993. Simplified model for prediction of temperature and dissolved oxygen in aquaculture ponds using reduced data inputs. M.S. thesis. University of California, Davis.
- Culberson, S.D. and R.H. Piedrahita. 1993. Model for predicting dissolved oxygen levels in stratified ponds using reduced data inputs. In: *Techniques for Modern Aquaculture, Proceedings, American Society of Agricultural Engineers.* 21-23 June 1993. Spokane, WA.
- Szyper, J.P., R.H. Piedrahita., and P. Giovannini. 1993. Requirements for maximizing bloom stability and net oxygen production in earthen ponds. Poster paper presented at World Aquaculture Society meeting, Torremolinos, Spain. May.
- Grace, G. and R.H. Piedrahita. 1993. Carbon dioxide control with a packed column aerator. In: *Techniques for Modern Aquaculture, Proceedings.* American Society of Agricultural Engineers. 21-23 June 1993. Spokane, WA.
- Lu, Z. and R.H. Piedrahita. 1993. Nitrifying characteristics of a high rate packed column. In: *Techniques for Modern Aquaculture, Proceedings.* American Society of Agricultural Engineers. 21-23 June 1993. Spokane, WA.
- Ernst, D.H., Bolte, J.P., S.S. Nath. A decision support system for finfish aquaculture. In: *Techniques for Modern Aquaculture, Proceedings.* American Society of Agricultural Engineers. 21-23 June 1993. Spokane, WA.

Other Staff Activities

- R.H. Piedrahita attended the World Aquaculture Society meeting in Torremolinos, Spain in May.
- John Bolte attended the the Annual Meeting of the American Society of Agricultural Engineers in Spokane, WA. Steve Culberson, Doug Ernst, and Phil Giovannini attended the meeting, Techniques for Modern Aquaculture, which was sponsored by the American Society of Agricultural Engineers.
- Piedrahita is on sabbatical leave at the Norwegian Hydrotechnical Laboratory in Trondheim, Norway until August 1993.

Social Science Project

Funding for "Socioeconomic Dimensions of Aquaculture Development: A Comparative Assessment of Financial Returns, Adoption Barriers, and Impacts of Tilapia Production Regimes" began this quarter. This project was selected in June from three proposals submitted in response to the RFP issued by the Management Office to elicit studies integrating social science themes into current PD/A CRSP research.

The objectives of the project are: to develop a global integrated framework for considering socioeconomic factors affecting the implementation and sustained pursuit of pond aquaculture; to determine the costs and returns associated with alternative production regimes specified by the CRSP Work Plan; to establish a baseline profile of financial profitability per system per country; to describe the practices, technical proficiency, and receptivity to the adoption of CRSP technologies and production regimes among tilapia farmers; and to obtain basic production, marketing, labor, input supply, and farming system information from potential adopters of CRSP-related technologies that might be incorporated in expert systems that rely on comprehensive socio-bio-economic models of pond aquaculture.

During this reporting period, the CRSP researchers at three project sites have been contacted and notified of the project's inception. An interviewer has been engaged for the Honduras data collection work. The Honduras Peace Corps will collaborate and lend logistical support to the data collection in that country. Initial discussion of funding, personnel, and logistical arrangements for data collection in Thailand has begun. The technology clusters developed by the CRSP have been identified and operationalized in a draft questionnaire.

Egypt Project

Status of the CRSP Experiments

The preparations for the Global Experiment at Abbassa were completed during this quarter; canals and ponds were cleared of weeds and debris; equipment was installed. Ponds were flooded after initial mud samples were taken. Monosex (male) tilapia (*Oreochromis niloticus*) fingerlings (average weight of 0.7 grams) were obtained from a private hatchery and transported to Abbassa where they were stocked into nursery ponds for further growth. When the fish reached an average individual weight of about 3 grams, they were transferred to the Global Experiment ponds and the experiment was initiated.

The bioconversion experiments are underway. Fingerlings of grass carp and black carp were obtained, and after an acclimatization period were stocked in the experimental ponds.

Additional ponds and canals are being prepared to be used in a biotechnology experiment, which is scheduled to start next quarter.

Biotechnology research continued at Oregon State University. Experiments were conducted to identify the biochemical characteristics of the androgen receptor in tilapia gonads. The dissociation constant of tilapia testicular cytosol was determined.

Breeding populations of tilapia were set up in the fish holding facility and an incubation system was developed for tilapia eggs. Masculinization and feminization experiments were begun using either methyltestosterone or ethynylestradiol.

Progeny testing to identify "YY" male tilapia progressed at Auburn University. Ninety male tilapia from six populations which may contain "YY" individuals have been individually paired with control females and allowed to spawn. All offspring produced will be cultured to a minimum length of 5 cm, a subsample will be taken, and the sex ratio will be determined.

The start of the experiment investigating the effects of methyltestosterone on fish growth at the Mariculture Research and Training Center of Hawaii has been delayed because of difficulties in obtaining *Oreochromis aureaus*. However, the arrival of the fish is scheduled for July and experiments will begin thereafter as described in the work plan.

Other Staff Activities

- Bill Shelton arrived on June 13 in Egypt for two months of work on the bioconversion studies at Abbassa.
- Bart Green, Gamal Osman El Nagar and Fatma Abdel Fattah Hafez attended the World Aquaculture Society annual meeting and the Workshop on Aquaculture of Freshwater Species in Torremolinos, Spain in May.

Program Management Office

Highlights of activities conducted during the quarter

During the last quarter, the Management Office accomplished the following:

- Distributed the Tenth Annual Administrative Report.
- Coordinated routine travel and purchasing arrangements for PIs in the U.S. and host countries.
- Filled numerous requests for program information.
- Completed the layout of the Seventh Work Plan. Draft copies were sent to the AID Project Manager and BIFEDEC. The Seventh Work Plan has been printed and is being distributed this quarter.
- Designed and printed the new PD/A CRSP brochure.
- Collaborated with Claude Boyd in creating a prospectus for the new PD/A CRSP book *Dynamics of Pond Aquaculture.*
- Effected a smooth transfer of the CRSP Central Data Base to Kevin Hopkins at University of Hawaii.
- Initiated and supervised a graduate student internship in Agricultural Economics.

- Completed "Color Comparator Chart" for the Rwanda Project. The color chart will be used by farmers to determine pond water quality based on color of water.
- Coordinated the internal and external review of three proposals submitted in response to the RFP for a new PD/A CRSP social sciences project.
- Coordinated and participated in the BOD conference call on 11 June 1993.
- Began planning for the next Annual Meeting. The meeting will be held 28-30 March 1994 in Hilo, Hawaii.
- Prepared background information for U.S. Congressional aides.
- Responded to requests from the EEP for information needed for completion of their review of the CRSP.
- Coordinated development of the work plan and benchmarks for the OSU/DAST and for the new social science project.
- Provided an update on CRSP activities for the Office of International Research & Development at OSU.
- Completed Portfolio Review materials for AID/Washington.

Publications

The following publications were issued:

- Egna, H.S., N. Brown, and M. Leslie. *Pond Dynamics/Aquaculture Collaborative Research Data Reports Volume One: General Reference Site Descriptions, Materials and Methods for the Global Experiment.* Second printing. PD/A CRSP, Office of International Research & Development, Snell Hall, Oregon State University, Corvallis, Oregon 97331-1641, USA.
- Seventh Work Plan, 1 September 1993 to 31 August 1995. PD/A CRSP Program Management Office, Office of International Research & Development, Snell Hall 400, Oregon State University, Corvallis, Oregon 97331-1641, USA.
- Quarterly Report January-March 1993. PD/A CRSP Program Management Office, Office of International Research & Development, Snell Hall 400, Oregon State University, Corvallis, Oregon 97331-1641, USA.
- Lin, C.K., K. Jaiyen, V. Muthuwan. May 21, 1993. *Integration of Intensive and Semi-Intensive Aquaculture: Concept and Example.* CRSP Research Reports 93-54. PD/A CRSP Program Management Office, Office of International Research & Development, Snell Hall 400, Oregon State University, Corvallis, Oregon 97331-1641, USA.

The following Notices of Publication were also issued:

- Teichert-Coddington, D.R., B.W. Green, and R.P. Phelps. *Influence of site and season on water quality and tilapia production in Panama and Honduras.* CRSP Research Reports 93-49. PD/A CRSP Program Management Office, Office of International Research & Development, Snell Hall 400, Oregon State University, Corvallis, Oregon 97331-1641 USA. [Originally published in *Aquaculture* 105 (1992) 297-314.]

- Suresh, A.V. and C.K. Lin. *Tilapia culture in saline waters: A review.* CRSP Research Reports 93-50. PD/A CRSP Program Management Office, Office of International Research & Development, Snell Hall 400, Oregon State University, Corvallis, Oregon 97331-1641 USA. [Originally published in *Aquaculture* 106 (1992) 201-226.]
- Knud-Hansen, C.F. *Analyzing standard curves in the chemistry of waters used for aquaculture.* CRSP Research Reports 93-51. PD/A CRSP Program Management Office, Office of International Research & Development, Snell Hall 400, Oregon State University, Corvallis, Oregon 97331-1641 USA. [Originally published in *NAGA, the ICLARM Quarterly* January 1992.]
- Szyper, J.P. and J.Z. Rosenfeld. *Diel cycles of planktonic respiration rates in briefly incubated water samples from a fertile earthen pond.* CRSP Research Reports 93-52. PD/A CRSP Program Management Office, Office of International Research & Development, Snell Hall 400, Oregon State University, Corvallis, Oregon 97331-1641 USA. [Originally published in *Limnology and Oceanography*, 37(6), 1992, 1193-1201.]

Other staff activities

- Hillary Egna traveled to Washington DC in April to attend the AAAS meeting on Science in Africa: Women Leading from Strength.
- Egna traveled to Washington DC in May to attend CRSP Council meetings. She edited the final script for the CRSP Council presentation to members of Congress; she and John Yohe, INSORMIL CRSP, narrated the presentation. She then attended the International Congress of Comparative Endocrinology in Toronto, Canada.
- Several personnel changes occured at the Management Office during this reporting period. Hilary Berkman, Manager of the CRSP Central Data Base, left the CRSP to pursue her career in law. Naomi Weidner, CRSP Administrative Assistant, returned from a year's leave of absence, replacing Nancy Astin.