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**TITLE XII**  
**COLLABORATIVE RESEARCH SUPPORT PROGRAM**  
**POND DYNAMICS/AQUACULTURE**

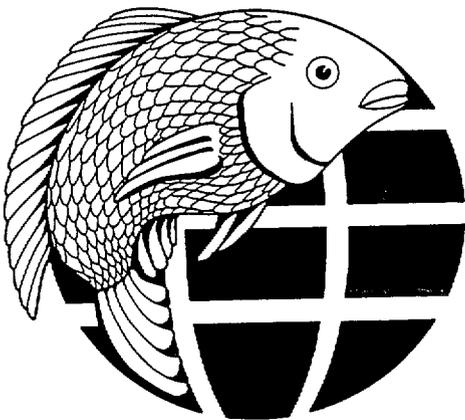
**Continuation Plan**

**Triennial Review**

**Management Review**

**Mission Reviews**

**CRSP Publications**



**Pond Dynamics/Aquaculture CRSP Management Entity**  
**Office of International Research and Development**  
**Oregon State University, Snell Hall 400**  
**Corvallis, Oregon 97331-1641**

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Continuation Plan



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## EXECUTIVE SUMMARY

The Pond Dynamics/Aquaculture CRSP is a global research activity composed of tightly integrated collaborative research projects that are directed toward improving the reliability and efficiency of pond aquaculture production. The goal of this program is to increase the availability of animal protein in less developed countries through pond aquaculture. Pond aquaculture has substantial potential for integration into sustainable agriculture systems. Many successful experiences of high fish yields with minimal locally available inputs are documented.

This CRSP is a global research activity because it operates projects in several geographic regions. It is also a global research activity in the sense that its research findings have global implications. The research results of each project are relevant to a particular country or region and to the larger goal of removing constraints to aquaculture production worldwide.

The PD/A CRSP was formally initiated on September 1, 1982 after several years of planning. From 1982 to 1987, CRSP projects involved the participation of government agencies and educational institutions in six host countries: Honduras, Indonesia, Panama, Philippines, Rwanda, and Thailand. Due to Gramm-Rudman budget reductions in 1986 and 1987, the CRSP presented a reorganization plan to the JCARD Panel on CRSP's. The approved plan went into effect on September 1, 1987 and called for programs in each of the USAID geographical areas originally selected. Country sites retained were Panama, Rwanda, and Thailand. When political initiatives required the CRSP to leave Panama in December 1987, JCARD approved the relocation of the CRSP to Honduras in April 1988.

Since implementation of the PD/A CRSP in 1982, the major research activities have been organized under the *CRSP Global Experiment*. The purpose of the Global Experiment is to understand the physical, chemical, and biological processes that regulate productivity of aquaculture ponds in diverse geographic regions. The observations of pond variables are made in accordance with a standard sampling protocol so that the same variables are measured in all ponds. The same observational and analytical methods are used at all sites and all data are recorded in standard units. This experimental design permits the description of dynamic processes within specific ponds and comparisons among ponds within and between locations.

The CRSP technical work plans are developed by the CRSP Technical Committee composed of all project Principal Investigators. Each work plan represents a detailed experimental protocol for one experimental cycle. A cycle involves two series of observations from at least 12 ponds at each location over four to five months duration. One set of observations is made during the dry season and the other during the wet season.

Four work plans have been developed to date, and three have been completed. The approach to studying pond dynamics in the first three work plans was to manage all of the ponds in the same way to observe the variation in response to fertilizer inputs. The response to specified applications of inorganic fertilizer was studied in the First Work Plan. In the Second Work Plan, application of inorganic fertilizer was compared to organic fertilizer. Responses to different levels of organic fertilizer were observed in the Third Work Plan. In the Fourth Work Plan underway, specific hypotheses about pond dynamics are being tested in different field experiments at each research location.

Standardized data from the work plans are filed in a CRSP Central Data Base maintained by the Management Entity. In this way, the entire data set is available to all CRSP participants, but especially to the CRSP Data Analysis and Synthesis Team (DAST). The responsibility of the DAST is to accomplish data analysis, synthesis, and model development.

Selected global research accomplishments are

All of the standardized data sets from the three completed work plans have been entered into the CRSP Central Data Base. Nearly 90,000 observations on 96 variables related to pond dynamics were made at each field site, resulting in the compilation of over 1.5 million observations into the CRSP Central Data Base.

The DAST used the global data set to develop three empirical models for examining the flow of oxygen through pond systems. A mechanistic model provides a detailed view of short-term oxygen dynamics in ponds. Another model provides an ecosystem view of aquaculture systems and allows simulations using 14 pond variables. The third model analyzes dissolved oxygen and inorganic carbon data to obtain indicators of phytoplankton condition.

A final model was designed to classify ponds according to fertilization practices that have the highest probability for optimizing fish yield. This model groups ponds into general categories based on climate, soils, and water quality. Refinement of the model will allow recommendations to be made on type and amounts of fertilizer, cost effectiveness, and optimization of yield. The final

output of the model will be a manual of guidelines for the efficient management of aquaculture ponds in the tropics

A revised five-year, forward-rolling program plan for continuation of the Pond Dynamics/Aquaculture CRSP is proposed. The broad goal of the CRSP continues to be to increase the availability of animal protein in less developed countries through pond aquaculture. The goal of the CRSP research program for the period of the continuation grant is to determine the most efficient methods of managing aquaculture ponds under different environmental and production regimes.

The information required to satisfy the CRSP research goals and to further understanding of pond processes and improve the efficiency of fish production include

Information on pond soil processes and soil-water interactions, including soil chemistry and temporal variations in soils and sediments

Information on fish growth relationships, including feeding dynamics, multi-species trophic interactions, and interaction of feeds and fertilizers

Information on nutrient cycling, including autotrophic and heterotrophic processes, oxygen consumption/production, water depth/surface relationships, and manure/compost effects

The CRSP Global Experiment will be continued with host country investigations that will include standard observations of pond variables at all locations, and investigations of different aspects of pond dynamics at each location. The scope of the host country and U S components of the research on the Global Experiment are

**Central America-Honduras** The principal objectives of the freshwater research in Honduras will be to determine the effects of oxygen dynamics, aeration, and sediment/water quality interactions on the production of ponds stocked with tilapia. Site-specific studies will focus on practical problems encountered in brackish water aquaculture.

**Africa-Rwanda** The two principal objectives of research proposed for the Rwanda project are (1) to determine the influence of temperature on the productivity of ponds at a range of high elevations, and (2) to assess the use of supplemental feeds to optimize use of the limited protein produced within ponds for growth rather than respiration.

Asia-Thailand The principal objectives of research proposed for the Thailand are (1) to determine the effects of pond size on fish production, (2) to determine the effects of nutrient addition schedules on fish production, and (3) to determine the effects of intraspecific competition or altered reproductive schedules due to fish density on tilapia growth and production Site-specific studies will focus on the polyculture of tilapia and *Clarias* (catfish)

Pond Soil Studies The principal objectives of this proposed research are (1) to determine pond soil-water quality relationships, (2) to network with the Tropical Soils CRSP and other agronomic research institutions to develop soil data bases, and (3) to develop a functional classification of pond soils to be used in improving pond management guidelines

Data Analysis and Synthesis The general objective of this investigation is to provide a global synthesis of CRSP research findings Specific objectives are (1) to analyze research data from the CRSP field experiments from a global perspective, (2) to develop, calibrate, and validate computer models to simulate water quality and fish growth in ponds, and to develop a comprehensive pond classification model to facilitate extension of the specific CRSP research results to other sites, and (3) to prepare and disseminate pond management guidelines on the results of CRSP research

Handbook of Aquaculture Research Techniques The principal objective of this endeavor is to publish a handbook of methods for research in tropical aquaculture The PD/A CRSP and the International Center for Living Aquatic Resources Management (ICLARM) propose to dedicate their resources toward the publication of this handbook CRSP personnel will take the lead in writing sections of the manuscript, while ICLARM will be responsible for editing, publishing, and distributing the handbook

Program organization and management of the PD/A CRSP is patterned after the *Guidelines for Collaborative Research Support Program under Title XII* prepared for and distributed by the JCARD as recommended by the BIFAD and USAID Details of the program infrastructure and the financial plan to support the research are provided

In the Appendix, details of the project narratives are provided for all of the activities proposed and briefly describe above

## BACKGROUND

Title XII of the International Development and Food Assistance Act of 1975 authorized the U S Agency for International Development (AID) and the Title XII Board for International Food and Agricultural Development (BIFAD) to sanction CRSP's among U S universities, government research agencies, and international agricultural research institutions in less developed countries (LDC's) In an earlier stage of Title XII program planning, the Joint Research Committee (now the Joint Committee on Agricultural Research and Development, JCARD) of the BIFAD recommended that fisheries and aquaculture would be an appropriate subject area for a Title XII CRSP intended to solve food, nutritional, and agricultural problems in less developed countries

In recommending an aquaculture CRSP, the Joint Research Committee recognized that the vast potential for producing animal protein in pond culture systems has not been fully realized in less developed countries Pond aquaculture has substantial potential for integration into sustainable agriculture systems Many successful experiences of high fish yields with minimal locally available inputs are documented However, attempts to replicate the most successful and efficient systems have resulted in highly variable levels of production Limited understanding of the principles and mechanisms of pond culture systems is a major factor constraining sustainable low input aquaculture production in less developed countries

A revised five-year, forward-rolling program plan for continuation of the Pond Dynamics/Aquaculture CRSP is proposed in this document The plan includes a description of research work to be conducted, a summary of CRSP organization and management, and a preliminary budget.

### **Program Goal**

The goal of this program is to increase the availability of animal protein in less developed countries through pond aquaculture The proposed studies will take major steps toward attaining this goal by increasing the efficiency of pond aquaculture systems through the elaboration and refinement of models in pond dynamics, through the testing of these models under field conditions, and through the dissemination of guidelines for pond management

## Program Purpose

The purpose of this CRSP is to improve the efficiency of pond culture systems by bringing together the resources of less developed countries and U S institutions into a long-term comprehensive collaborative research program in pond aquaculture

## Definitions

The following terms are used extensively in describing the CRSP program

- 1 *Principles* - the physical, chemical, and biological processes occurring in pond systems and their interactions
- 2 *Practices* - fish cultural activities related to design, management, and operation of pond culture systems
- 3 *Field experiments* - controlled fish production experiments in which quantitative responses to different levels of treatments are measured
- 4 *Experimental treatment* - fish cultural practices (e g , fertilizer application, supplemental feeding, etc ) which modify the physical, chemical, and biological environment
- 5 *Experimental protocol* - a detailed plan of a field experiment which specifies experimental methods, sampling schedules, data collection, etc
- 6 *Data analysis and synthesis* - the process of compiling and analyzing information about pond culture systems from diverse sources into a coherent, usable format that can be applied to the development of predictive models and improving the efficiency of these systems
- 7 *Predictive models* - mathematical models used to simulate the process occurring in pond systems In the context of this CRSP, predictive models are used as analytical and management tools to improve the efficiency of pond systems

## THE CRSP GLOBAL EXPERIMENT

The Pond Dynamics/Aquaculture CRSP is a global research activity composed of tightly integrated collaborative research projects that are directed toward improving the reliability and efficiency of pond aquaculture production. In the context of this proposal, the term "global research activity" has two meanings. The CRSP is a global research activity because it operates projects in several geographic regions. It is also a global research activity in the sense that its research findings have global implications. The research results from each project are relevant to a particular country or region and to the larger goal of removing constraints to aquaculture production worldwide.

### The CRSP Global Experiment

Since implementation of the CRSP in 1982, the major CRSP research activities have been organized under the *CRSP Global Experiment*. The purpose of the Global Experiment is to understand the physical, chemical, and biological processes that regulate productivity of aquaculture ponds in diverse geographic regions. The observations of pond variables are made in accordance with a standard sampling protocol (specified in the CRSP work plans) so that the same variables are measured in all ponds. The same observational and analytical methods are used at all sites and all data are recorded in standard units. This experimental design allows us to describe dynamic processes within specific ponds as well as to make comparisons among ponds within and between locations.

Standardized experimental protocols are developed by the CRSP Technical Committee (described in detail in the Program Organization and Management section of this proposal), and subsequently are incorporated into biennial CRSP work plans. (Work plans were developed annually prior to 1987.)

The Technical Committee makes extensive use of *conceptual models* derived from previous experiments to identify informational needs. Conceptual models are representations of a system that are constructed (explicitly or implicitly) using assumptions based on the accumulated scientific understanding of the system. The scientific information available and the intended use of the models determine the variables or components that are used to describe the system, and to identify

ways in which the variables are interrelated and how they are affected by external conditions. Conceptual models are used to build upon the results of previous CRSP research, and to provide a logical progression toward understanding the dynamic processes occurring in aquaculture ponds. For example, Figure 1 is an earlier version of a conceptual model of the movement of mass in an aquaculture pond. Figure 2 is a more recent iteration of the same model. The increased emphasis on the role of pond soils and sediments and the more comprehensive treatment of detrital processes in Figure 2 reflects new information gained from CRSP research activities in the time interval between the formulation of the models.

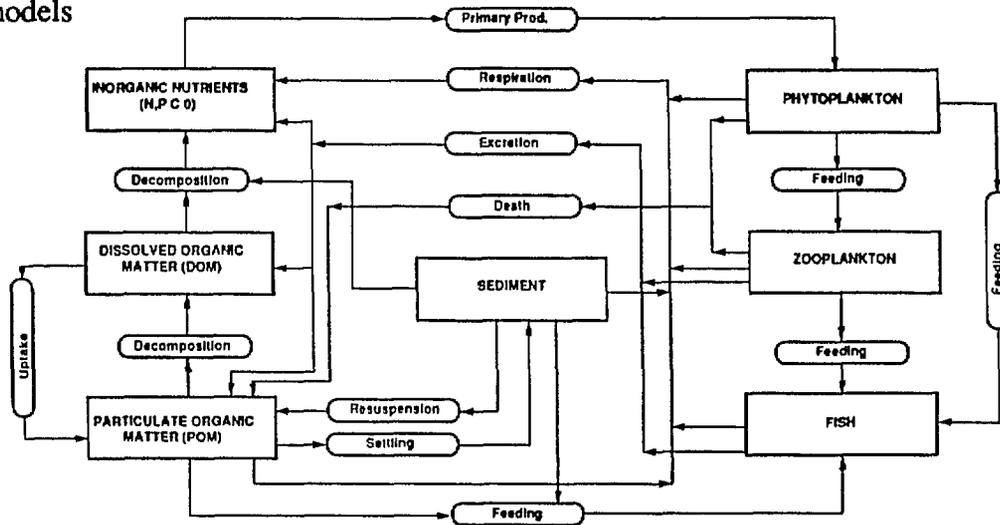


Figure 1 An earlier version of a CRSP conceptual model depicting the movement of mass in an aquaculture pond.

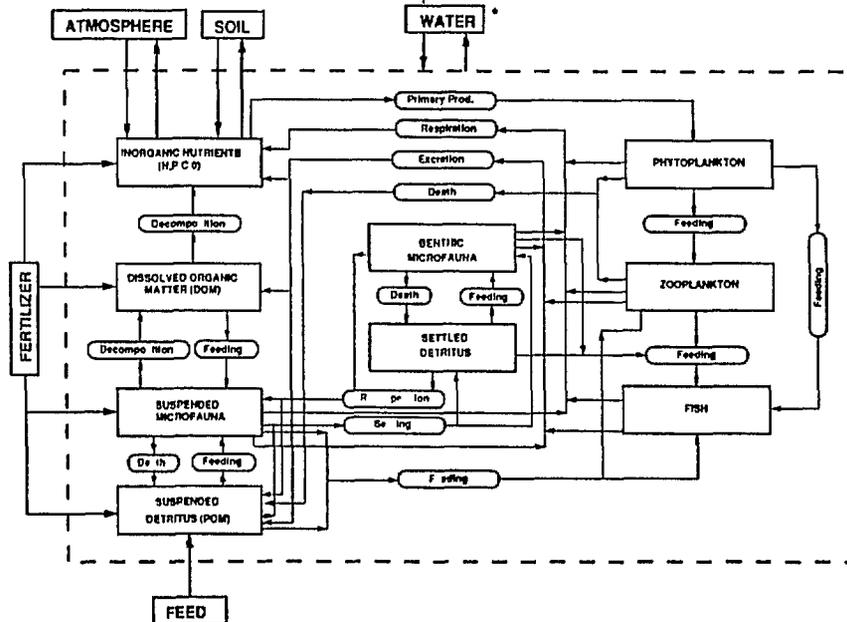


Figure 2 A recent iteration of the conceptual model presented in Figure 1

The principal components of the Global Experiment are field experiments, a centralized data base system, and a data analysis and synthesis activity

Field Experiments. Controlled fish production experiments are designed to statistically evaluate the quantitative responses to experimental treatments. Experimental treatments are fish cultural practices (e.g., fertilizer application, supplemental feeding) that modify the pond environment. The field experiments are conducted in several host countries and involve collaborating scientists from the host countries and U.S. institutions. Standardized work plans and requirements for data collection are developed by the CRSP Technical Committee. The data from each location are evaluated by the research teams working at that location. Each team is responsible for submitting its data to *Collaborative Research Data Reports*, which are published by the CRSP Program Management Office. Results from these experiments are analyzed and synthesized and published in *CRSP Research Reports* as well as in the scientific literature.

The CRSP has organized activities to evaluate the CRSP data from a global perspective. The data synthesis component of the CRSP includes a centralized data base management function and a Data Analysis and Synthesis Team.

Data Base Management. The standardized data sets collected in the field experiments are filed in a centralized CRSP Data Base. The variables to be recorded in the Data Base are determined by the Technical Committee as part of the research planning process. Maintenance of the Data Base is the responsibility of the CRSP Program Management Office.

Data Analysis and Synthesis. The Data Analysis and Synthesis Team (DAST) is the primary U.S.-based research component of the CRSP. The purpose of the DAST is to evaluate CRSP research results and data from a global perspective. The activities of the DAST include (1) statistical evaluation of CRSP data to determine relationships among variables, (2) development of models of aquaculture pond systems to aid in understanding the dynamic processes occurring in ponds, and in identifying research needs, and (3) organization of the results for dissemination in the form of management guidelines.

## Accomplishments of the Global Experiment

The CRSP Global Experiment is presently in the second year of its fourth work plan. The approach to studying pond dynamics in the first three work plans was to manage all of the ponds (12 or more ponds at each of seven locations) in the same way and to observe the variation in responses to fertilizer inputs. The response to specified applications of inorganic fertilizer was investigated in the First Work Plan. In the Second Work Plan, application of inorganic fertilizer was compared to organic fertilizer (chicken manure). Responses to different levels of organic fertilizer were observed in the Third Work Plan.

The CRSP Fourth Work Plan differs from the earlier plans with respect to both the number and nature of the field experiments. The first three work plans were accomplished at seven locations in six tropical countries. However, financial constraints made it necessary for the CRSP to reduce the number of research locations from seven to three upon initiation of the Fourth Work Plan.

Observations from the field experiments accomplished under each of the first three work plans were incorporated into increasingly comprehensive conceptual models of aquaculture ponds. By the completion of the Third Work Plan, the iterations of conceptual models enabled CRSP researchers to identify critical pond processes requiring more in-depth investigation. Therefore, in the Fourth (current) Work Plan, specific hypotheses about pond dynamics are being tested in different field experiments at each research location. It is anticipated that this procedure will allow the CRSP to proceed rapidly through the testing process. Otherwise, many years of work would be required to thoroughly evaluate each hypothesis at all sites. This work plan continues the practice of intensive sampling of pond variables using a standardized sampling protocol at all research locations. Similarly, the standardized data are added to the CRSP Data Base to make it even more comprehensive.

All of the standardized data sets from the first three work plans have been entered into the CRSP Central Data Base, which is maintained by the Management Entity. Nearly 90,000 observations on 96 variables related to pond dynamics were made at each field site, culminating in the compilation of over 1.5 million observations into the CRSP Central Data Base. The Data Base is unique in that it contains the largest standardized collection of measurements in pond dynamics and aquaculture in the world. The CRSP, through its data base, provides a great service to the world aquaculture community by collecting and compiling data on photosynthetically active radiation, rainfall, evaporation, air temperature and wind speed concurrently with biological measurements (e.g., primary productivity, fish

growth, and yield) Detailed records such as these are rare in the aquaculture literature

The Central Data Base was designed to facilitate communication with other large data bases, such as the Tropsoils CRSP data base, thereby creating opportunities for collaboration CRSP scientists may access the data base via personal computers or mainframe computers Data also are accessible to the world aquaculture community through electronic communications, computer diskettes, or in print form as it appears in CRSP Data Reports (a series of reports that contain data and results of the Global Experiment)

The outlook for the Central Data Base is healthy Inefficiencies in the computer programs and reporting procedures have been resolved, consequently, compilation of new observations should be quick and easy Revisions in the work plans are reflected in new templates for data entry each year, demonstrating the flexibility of the system Future changes to the Data Base might include additional templates for new field sites (as proposed in Rwanda) and adjustment of reporting frequencies to accept data obtained from automated water quality data acquisition systems (data loggers) more easily

During the past year, major advances were made in analyzing and synthesizing data from the Global Experiment Statistical analyses of the Central Data Base revealed differential growth rates and productivities between sites Preliminary results indicate that the CRSP ponds in Thailand were most productive (i e , experienced the highest yields) and those in Rwanda were least productive Correspondingly, maximum physiological growth rate of tilapia in Rwanda was the lowest (0 42) of the CRSP sites Growth rates at the other CRSP sites averaged 0 66, with Thailand being the highest (0 74) Further statistical analysis (principal component analysis) revealed possible reasons for these differences Strong correlations were found between environmental parameters (e g , solar radiation and air temperature) and pond productivity Future analyses will determine whether density dependence contributes to these differences

The Data Analysis and Synthesis Team used the global data to develop three empirical models for examining the flow of oxygen through pond systems A mechanistic model was designed to provide a detailed view of short-term oxygen dynamics in ponds Another model provides a more general, ecosystem view of aquaculture systems and allows simulations using fourteen variables (e g , phytoplankton, fish number and size, dissolved oxygen, ammonia, pH, inorganic carbon) The third model is being used to analyze dissolved oxygen and inorganic carbon data to obtain indicators of phytoplankton condition

A final model, an *expert system*, was designed to classify ponds according to fertilization practices that have the highest probability for optimizing fish yield. This model groups ponds into general categories based on climate, soils, and water quality. Refinement of the model (through the addition of functional or mathematical relationships) will allow recommendations to be made on type and amount of fertilizer, cost effectiveness, and optimization of yield. Functional relationships, which are being defined by statistical analysis and mechanistic models described previously, will drive the expert system. Verification of the models through field testing will be used to refine the models. The ultimate output will be a manual of guidelines for the efficient management of aquaculture ponds in the tropics. Research results from the Global Experiment are presented in the Sixth Annual Administrative Report.

The Data Analysis and Synthesis Team, which is responsible for model development, provided suggestions to the field researchers for refining their experiments. New measurements (i.e., suspended solids, total volatile solids, water budget parameters) and intensive diel sampling were added to the experimental protocols as a result of this feedback. Researchers at the field sites cooperated with the modelers in designing new experiments that would enhance the comprehensiveness of the Global Experiment.

Accomplishments at the field sites centered on various aspects of the Global Experiment. Researchers from Michigan State University applied knowledge gained from the CRSP experiments in Indonesia (project terminated in August 1987) to new experiments in Thailand. They developed guidelines for adding fertilizer in quantities that would lead to predictable and reliable fish yields.

Researchers from the Royal Thai Department of Fisheries, the Asian Institute of Technology, and The University of Michigan studied the effects of fish stocking density and biomass on pond dynamics. They found that increased stocking density did not increase yield, that carrying capacity of ponds did not vary much with the stocking densities tested, and that increases in fish abundance did not change ecosystem function.

Researchers from the National University of Rwanda (UNR) and Oregon State University examined the effects of locally available inputs (e.g., composts) on fish production. Preliminary results indicate that in-pond compost (raw materials submerged in bamboo enclosures) was the most effective composting method for increasing fish yield. Further studies on autotrophic and heterotrophic pathways will provide the CRSP with better information for applying scarce fertilizer resources. Researchers from Auburn University also worked with scientists from UNR in determining the effects of stocking density on production. Maximum

revenues at the Rwasave Fish Culture Station (a CRSP field site), based on rudimentary estimates of costs, occurred during the third month for ponds stocked at a rate of 1 fish/m<sup>2</sup>. After that, the value of additional production did not compensate for the cost of additional inputs. Maximum return for ponds stocked at 1.5 and 2 fish/m<sup>2</sup> occurred in the fourth and fifth months, respectively.

The CRSP field site in Panama was terminated in December 1987, halfway through this reporting period, when CRSP researchers were directed by USAID to relocate. In this short period, however, a brackish water experiment was completed. Researchers from Auburn University and the National Directorate of Aquaculture in Panama found that increasing stocking density had an immediate effect on shrimp growth and that increasing the level of protein in the diet did not significantly influence production, mean weight, feed conversion, or survival at the two stocking densities tested (4 and 8 shrimp/m<sup>2</sup>). They also found that shrimp production was greater at the higher density but lower economic returns resulted from the lower price per unit weight paid for the smaller shrimp.

After departing from Panama in December 1987, CRSP researchers were faced with finding a new site for conducting the Global Experiment. While maintenance of diversity in field locations through inclusion of a brackish water site was important to the CRSP, the realities of starting over (e.g., cost and time lost) became evident. The CRSP was fortunate to be able to resume its relationship with the Department of Renewable Natural Resources (RENARE) in Honduras. Experiments began in August 1988 at the former freshwater CRSP site in Comayagua. Auburn University will continue to explore the possibility of establishing a brackish water research site for the CRSP in Honduras.

Ancillary to the Global Experiment, but still important to the overall goals of the CRSP, are activities geared toward country-specific research and educational needs. All U.S. staff overseas contribute some time to extension work such as training students and technicians, teaching short courses on aquaculture, and conducting site-specific experiments.

CRSP researchers and staff from the Program Management Office greatly broadened the contact of this CRSP with the world aquaculture community through the dissemination and publication of research results. The rate at which results are being published in the scientific literature continues to climb. The CRSP now has a list of publications (including theses, reports, and presentations) that number over 275 and are distributed to a broad domestic and international audience. Detail on our research and publications is presented in the Sixth Annual Administration Report.

## Justification for Continuation

The CRSP, through its Global Experiment, has taken a major step toward increasing the efficiency of pond culture systems. Controlled additions of fertilizers at all field sites have been effective stimulators of pond production, however, the magnitude of increase varies between sites (Fortes *et al* 1986, Lin 1986a, Batterson *et al* 1988, Hanson *et al* 1988, Green *et al* 1989). The CRSP has gained a clearer understanding of the relationships between primary production and fish yield (Diana *et al* 1987, McNabb *et al* 1988, Smith and Piedrahita 1988). These relationships alone, however, do not account for the variability in pond performance. The CRSP has identified other important components of pond dynamics -- namely, bacteria, detritus, hydrology, and pond soils -- that may contribute to this variation and therefore require further study (Lin 1986b, Piedrahita and Tchobanoglous 1987, Teichert-Coddington *et al* 1988).

The development of pond aquaculture typically is constrained by a lack of management guidelines and an inability to predict yield (Hughes 1985, Lannan *et al* 1986). The CRSP has accumulated a great body of observations on pond dynamics, which have been compiled into a standardized data base (Hopkins 1987). Preliminary analysis of the data base has identified the relative importance of various components. For example, the availability of dissolved oxygen (which is dependent upon a myriad of interactions between various trophic levels) seems to be more critical for increasing fish yield than any other single factor (Diana *et al* 1988, Giovannini and Piedrahita 1988, Piedrahita 1988). The CRSP has constructed three models for studying the cycling of dissolved oxygen through the system. The data base also has been used to statistically analyze fish growth rates, an important indicator of pond performance. Future models will incorporate these statistical relationships to predict pond yield. Further development of the models will allow CRSP researchers to define management guidelines for improving the efficiency of pond aquaculture.

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### **Financial Summary**

This section summarizes the expenditure of USAID, non-federal, and host country funds for CRSP research activities and program management This unaudited summary is intended to provide an overview of PD/A CRSP progress relative to program budgets and matching support

The expenditure of USAID funds by Collaborative Research Projects, Special Topics research, and Program Management is presented in Table 1 for the PD/A CRSP contract years of September 1, 1982 to August 31, 1987 (first grant), and September 1, 1987 to August 31, 1988 (first year of second grant) During the first grant period, our contract called for the establishment and support of research projects in six developing countries Honduras, Indonesia, Panama, Philippines, Rwanda, and Thailand Cumulative percent expenditure of grant funds during the period were Collaborative Research Projects, 80 percent, Special Topics, 5 percent, Program Management, 15 percent

The PD/A CRSP, like the other CRSP's, endured two substantial Gramm-Rudman budget cuts in 1986 and 1987. The 1985 budget of \$1,300,000 was reduced approximately 18 percent to an obligation of \$1,070,000 in 1986. The 1986 budget was further reduced by approximately 13 percent to a final obligation of \$936,000 in 1987.

Our second USAID grant was for a 3-year continuation of the PD/A CRSP during the period of September 1, 1987 to August 31, 1990. This grant obligates level funding of \$920,000 per year. The data for Collaborative Research Projects during the first year of this grant includes all expenditures made to support research efforts at four project sites. Our Continuation Plan called for research projects at three sites, namely Panama, Rwanda, and Thailand. In mid-December 1987, we were required to leave Panama by USAID directive. We received approval to reestablish the Panama CRSP in Honduras in June 1988. Accordingly, Auburn University expended USAID funds for research activities in both Panama and Honduras. No expenditures were reported by the University of Hawaii for research efforts in Honduras and Thailand, and by the University of Arkansas at Pine Bluff for activities in Rwanda. In both instances, turnover in project personnel delayed the start of planned research efforts. These positions have subsequently been filled, and funds have been obligated.

In both grants, the information on Program Management expenditures includes expenses to support the Program Management Office, the Board of Directors, the External Evaluation Panel, and the Data Base Management function. Because 1988 is a Triennial Review year, expenses for the External Evaluation Panel and associated costs have been substantial.

Cost sharing contributions from the U.S. institutions are presented in Table 1. Considering that funds expended for Program Management are exempt, the average cost sharing by the research institutions during the first grant period was 22.5 percent. In the first year of the second grant, cost sharing amounted to 34 percent. These recent figures reflect an increased commitment by the program entities to participation in the CRSP. However, these data require further accounting because the amounts to be excluded in calculating cost sharing requirements in accordance with BIFAD guidelines must be determined after the fact.

Host country contributions (in U.S. dollars) are also presented in Table 1. These data were provided by the Principal Investigators of the projects. Although host country cost sharing is not required, these contributions indicate a strong and continuing commitment to participation in the CRSP by our host country collaborators.

Table 1 Financial Summary of the Pond Dynamics/Aquaculture CRSP funds, Cost Sharing, and Host Country Contributions for the First and Second (first year) USAID grants

Collaborative Research Projects	USAID Funds		Cost Sharing		Total		Host Country	
	1982 87	1988	1982-87	1988	1982-87	1988	1982 87	1988
Honduras Auburn U	434 052	26 469	87 442	6,797	521,494	33,266	327,668	14 850
U Hawaii		0		0		0		0
Indonesia Michigan S U	705 071		185,050	-	890,121	--	284,365	
Panama Auburn U	641 514	87 282	164,067	25 743	805,581	113,025	509,090	30,150
Philippines-U Hawaii	685,194		226,503	--	911,697	-	128,625	
Rwanda-Auburn U	-	56 316	-	20,104	--	76,420	-	0
Oregon S U	631 667	57 011	66,414	18 696	698,081	75,707	300,682	46 980
U Ark P B	-	0	--	0	--	0	-	0
Thailand - Michigan S U	-	30,402	-	40,094	-	70,496	-	0
U Hawaii	-	5 308	--	7,642	--	12,950	--	0
U Michigan	637 415	111,201	99,480	13,255	736,895	124,456	145,450	43,000
Subtotal	3 734 913	373 989	828 956	132 331	4 563,869	506,320	1 695,880	134,980
<u>Special Topics</u>								
Auburn U	50,965	--	10,240	--	61,205	--		
Oregon State U	24 993	23 410	13,325	7,725	38,318	31,135		
U California, Davis	78,393	42,600	14 600	10,650	92,993	53,250		
U Hawaii	16,668	-	5,647	-	22,315	--		
U Michigan	55,640	57,405	14,753	17,221	70,393	74,625		
Subtotal	226,659	123,415	58,565	35,596	285,224	159,011		
<u>Program Management</u>								
Management office-OSU	589,797	174,587			589,797	174,587		
Boards Comm , Panels	120,368	22,207			120,368	22,207		
Subtotal	710,165	196 794			710,165	196,794		
TOTAL	4 671 737	694,198	887,521	167,927	5,559,258	862,125	1,695,880	134 980

## **PLANNING FOR CONTINUATION OF THE CRSP GLOBAL EXPERIMENT**

The approach taken by the CRSP Technical Committee in planning for the continuation of the Global Experiment includes (1) defining the goals of the research program for a five-year planning horizon, (2) identifying the information needed to satisfy the goals, and (3) developing a research program that will provide the needed information

### **Goals**

The goal of the CRSP research program for the period of the continuation grant is to determine the most efficient methods of managing aquaculture ponds under different environmental and production regimes. Prior CRSP research has provided valuable insights about how pond ecological processes influence fish yields. The CRSP is now at a point where, with specific additional information, previous research findings can be used to maximize fish yield per unit input of locally available nutrients over a wide range of pond environments.

### **Information Required**

The information required to satisfy the CRSP research goals during the next grant period has been identified by the CRSP Technical Committee. Specific information required to further understanding of pond processes and improve the efficiency of fish production include

- (1) Information on pond soil processes and soil-water interactions
  - (a) pond soil chemistry
  - (b) temporal variation in pond soils and sediments
- (2) Information on fish growth relationships
  - (a) feeding dynamics in different environmental production regimens
  - (b) multi-species (polycultural) trophic interactions
  - (c) interaction of feeds and fertilizers
- (3) Information on nutrient cycling
  - (a) interaction of autotrophic and heterotrophic processes
  - (b) oxygen production/consumption and effect of aeration
  - (c) effect of water depth/surface area relationship
  - (d) effect of manure/compost composition

## RESEARCH PLAN

In order to provide required information, the CRSP will continue the Global Experiment with field experiments in Honduras, Rwanda, and Thailand, and with data analysis and synthesis activities directed toward translation of research findings into pond management guidelines. In addition, the CRSP proposes to initiate new studies on pond soils, to network with the Tropical Soils CRSP and other agencies and institutions to access agricultural soil data bases and models, and to collaborate with the International Center for Living Aquatic Resources Management (ICLARM) to produce a handbook of aquacultural research techniques.

### Field Experiments

The field experiments will include standard observations of pond variables at all locations, and investigations of different aspects of pond dynamics at each location. These activities are described briefly below. A more detailed description of the activities is presented in Appendix A.

### Standardized Sampling Protocol

The CRSP Global Experiment will continue with a modification of the standard sampling protocol. This modified protocol was initiated upon implementation of the CRSP Fourth Work Plan in September 1987. Under this protocol, observations of climatic variables are recorded daily. Also, three intensive samplings of ponds will be conducted during each experiment: (1) during the second week, (2) midway through the experiment, and (3) during the final week. Observations of fish growth are provided by monthly sampling. The protocol also specifies occasional sampling of pond soils, nutrient inputs, and water budgets. Finally, reference ponds will be established and monitored at all locations. These ponds will provide information about how pond soils, sediments, and other pond characteristics change with time. In addition to specifying the sampling frequencies and variables to be observed, the protocol also specifies standard observational and analytical methods and reporting units to be used at all research locations. All standardized data will be added to the CRSP Data Base. (Please refer to Appendix A for more detail on the sampling parameters.)

### Central America - Honduras Project

Freshwater research will concentrate on oxygen dynamics, aeration, and sediment-water quality interactions on ponds stocked with *Oreochromis niloticus* (*Tilapia nilotica*). Variation within ponds of dissolved oxygen (DO) concentrations, influence of weather on DO, fluctuation of DO in ponds treated with manures or chemical fertilizers, and effects of DO concentrations on fish growth and production will be investigated. Emergency, nightly, and continuous modes of aeration will be compared. Acquisition of DO data with multi-channel data loggers will permit continuous observation of DO concentrations. Data analysis will emphasize development of predictive equations, models, and practical recommendations. Pond soil investigations will include dynamics of soil phosphate, consumption of oxygen by soils, and release of reduced substances by soils in ponds treated with manures and other fertilizers.

Brackish water research in Honduras also will focus on practical problems in brackish water aquaculture. The research will investigate relationships among feeding rate, DO concentration, water exchange, and shrimp production, with emphasis on economic evaluation.

### Africa - Rwanda Project

Two avenues of research are proposed for the Rwanda project: (1) to determine the influence of temperature on the productivity of ponds at high elevations, and (2) to use supplemental feeds to optimize the use of the limited protein produced within the pond for growth rather than respiration.

In Rwanda, tilapia are cultured at elevations ranging from 1200 to 2300 meters. The corresponding array of temperature regimes provides a unique opportunity to extend the range of environments under study by the CRSP and to examine the influence of temperature on pond productivity. This research will use farm ponds at five elevations between 1200 and 2300 meters in addition to the experimental ponds at the Rwasave location.

A nutritional study also will be accomplished at Rwasave. In this study, digestibility and nutritive content of organisms ingested by tilapia will be used to determine nutritive requirements of supplemental feeds.

### Asia - Thailand Project

The Thailand project will continue research that evaluates management manipulations and their effects on dynamics of tilapia ponds. Three manipulations to be evaluated are (1) the effects of pond size on fish production, (2) the effects of nutrient addition schedules on fish production, and (3) the effects of intraspecific competition or altered reproductive schedules due to fish density on tilapia growth and production. A bioassay system will be developed for the practical determination of limiting nutrients in fish ponds. All of these studies will follow standard data collection protocols.

In addition to these objectives, the Thailand project will initiate three new lines of research: (1) supplemental feeding of fish, (2) polyculture of *Clarias* and tilapia, and (3) evaluation of tilapia production systems for a variety of ponds. The first two areas of research involve polyculture trials with *Clarias* and tilapia. Treatments 1 and 2 will use uncaged *Clarias* that receive supplemental feed and no feed, respectively. Treatment 3 will use caged *Clarias* and tilapia and no feed. Tilapia production systems will be evaluated in an extension project involving Thai farmers, who will be provided fry, fertilizer, and management schedules based on our experiments. Yields from these farms will be tabulated by CRSP researchers and will be used to test the reliability of our experimental predictions.

### Pond Soil Studies

Physical and chemical properties of soil samples from all CRSP research locations and other selected locations will be determined. Soils will be analyzed in laboratory studies to determine their abilities to absorb and release phosphate and ammonium under a variety of environmental conditions. The influence of manure on soil properties will be studied, and techniques for managing organic matter in soils of manured ponds will be evaluated. Improved methods of determining lime requirements of pond soils, including acid-sulfate soils, will be evaluated. The relationship between water chemistry and sedimentation processes in pond soils also will be determined.

Concurrent with the laboratory studies, the Data Analysis and Synthesis Team will network with the Tropical Soils CRSP and other organizations and institutions to retrieve information from agricultural soils data bases. This information will be compared to data from the laboratory studies and the CRSP Data Base to determine the degree to which pond soils have unique properties and the degree to which information about agricultural soils can be applied to pond management.

## Data Analysis and Synthesis

The Data Analysis and Synthesis Team (DAST) plays an important role in the CRSP by providing a global analysis and synthesis of CRSP research information. Maintaining a unity of purpose and coherence of the CRSP Global Experiment is based, to a certain extent, on the activities of the DAST. Whereas the researchers involved in the CRSP field experiments evaluate their findings from a site-specific perspective, it is the responsibility of the DAST to synthesize and evaluate CRSP research findings from a global perspective.

Activities of the DAST include the global analysis of research data from the CRSP field experiments, development of computer models to simulate water quality and fish growth in ponds, and continuing refinement of a pond classification system to facilitate extension of site-specific CRSP research results to other sites. Information resulting from the activities of the DAST are used to identify CRSP research objectives, and to develop pond management guidelines based on CRSP research results.

The DAST is the principal U.S.-based research component of the CRSP. The DAST is a fully integrated group including a biometrician (Chang), an aquacultural scientist (Lannan), and an agricultural engineer (Piedrahita). Each of the DAST members has primary responsibility for one of the focus topics mentioned above. The work of the DAST is primarily based on computer analysis of the data, and on computer modeling and simulation, including the use of expert systems.

## Deliverable Products: CRSP Manuals and Handbooks

A major goal of the CRSP is the dissemination of information about pond aquaculture. Consistent with this goal, the CRSP intends to prepare and publish a manual of pond management guidelines and a handbook of aquaculture research techniques during the period of the continuation grant.

Manual of Pond Management Guidelines. One of the goals of the CRSP grant is to translate research findings into guidelines for the management of aquaculture ponds under different environmental and production regimes. The first CRSP manual of pond management guidelines will be completed prior to implementing the continuation grant. The manual will represent a significant advancement in pond aquaculture technology. However, further refinement is both possible and necessary.

During the proposed continuation grant period, the DAST will prepare a second, more comprehensive version of the pond management manual. The manual will include improvements based on analysis of new field data and relationships derived from computer models. This manual will be an important contribution of the CRSP in that it will present a practical summary of the CRSP findings in terms of production strategies and pond management techniques. The manual will be prepared in two forms: (1) a printed handbook, and (2) a computer application.

Additional detailed information about the contents and preparation of the manual is provided in Appendix A under Data Analysis and Synthesis.

Handbook of Aquaculture Research Techniques. A general manual of pond aquaculture research information does not currently exist. Such a manual would represent a significant contribution, and could lead to substantial improvement in the quality of aquaculture research by providing researchers with a ready reference to current research techniques. It is proposed that the CRSP collaborate with the International Center for Living Aquatic Resources Management (ICLARM) to prepare, print, and distribute such a manual. The manual will be available at minimal cost to aquacultural scientists worldwide.

Additional detailed information about the contents and preparation of this handbook is provided in Appendix A under A Handbook of Aquaculture Research Techniques.

## **PROGRAM ORGANIZATION AND MANAGEMENT**

This section describes the organization and management of the CRSP. Several changes in organization and management relative to the last CRSP proposal (1987-1990) have been made. These changes are intended to strengthen the CRSP and are based upon a variety of experiences and recommendations, including 1) recommendations of CRSP participants based on previous experience in operation of the CRSP, 2) recommendations from the first and second Triennial Reviews, and 3) the revised BIFAD guidelines.

### **Memoranda of Understanding**

In February 1980, the Joint Research Committee (now JCARD) designated Auburn University, the University of California at Davis, and the Consortium for International Fisheries and Aquaculture Development (CIFAD) as the participants in the Pond Dynamics/Aquaculture CRSP. The participants subsequently elected Oregon State University to be the Management Entity for the CRSP. As Management Entity, Oregon State University negotiated Memoranda of Understanding with the participating U.S. institutions. The participants have in turn negotiated appropriate Memoranda of Understanding with host country agencies or institutions for the various collaborative research activities. These Memoranda have been revised from time to time as needed, and continue to serve as the foundation for CRSP organization and management.

With the initiation of the new CRSP grant in 1987, host country and U.S. institutions renewed their Memoranda of Understanding. The new Memoranda reflect the structural changes in the organization of the CRSP (i.e., the consolidation of the CRSP in three countries) that have occurred since 1987. While several U.S. universities collaborate at each country site, only one was selected to represent the U.S. in each Memorandum. This structure provides for a more equitable arrangement with the host country institutions. For example, the University of Michigan, a CIFAD member, has separate Memoranda with the Thai Department of Fisheries (renewal of the original partnership) and the Asian Institute of Technology (new partnership). The University of Michigan and the Thai Department of Fisheries act as the lead U.S. university and host country institution, respectively, in Thailand. This provides a focal point for the other institutions that work on the CRSP project in Thailand. The University of

Michigan in turn has informal subagreements with Michigan State University and the University of Hawaii. Likewise, the National University of Rwanda (UNR) has a Memorandum of Understanding with Oregon State University, which is the lead U.S. university on the Rwanda project. As lead, Oregon State University is the main contact for the Rwandan researchers and is responsible for overall coordination of U.S. CRSP research activities in Rwanda. Auburn University and the University of Arkansas at Pine Bluff collaborate with Oregon State University in Rwanda. In Honduras, Auburn University has a Memorandum with the Honduran Department of Renewable Natural Resources (RENARE) and acts as lead university to the University of Hawaii which also is involved in research activities in Honduras.

This hierarchical structure differs from the contractual arrangements among U.S. universities and the Management Entity. While all participating institutions have access to the services of the Management Entity, the Management Entity has formal contracts only with Auburn University, the University of California at Davis, and CIFAD. CIFAD in turn has formal contracts with its member universities. The University of Michigan, Michigan State University, Oregon State University, the University of Hawaii, and the University of Arkansas at Pine Bluff. The hierarchical arrangement arrived at through the designation of lead U.S. universities promotes a greater degree of cooperation among U.S. universities and greater involvement of the host institutions at the highest level.

### **Management Entity**

Oregon State University serves as the Management Entity of the Pond Dynamics/Aquaculture CRSP. In this capacity, Oregon State University acts as the legal and fiscal agent in the receipt and disbursement of CRSP funds to participating institutions. It is responsible to USAID for the performance of the program and compliance with the grant. Other responsibilities entail

- Coordinating the implementation and operation of individual projects comprising the CRSP,
- Implementing the financial plan,
- Providing a focal point for the interaction of the Technical Committee, Board of Directors, External Evaluation Panel, USAID staff, and BIFAD/JCARD,
- Fiscal and technical reporting to USAID, and
- Maintaining liaisons with overseas and domestic participants

The Management Entity also is responsible for communications, publications of CRSP research, and management of the CRSP Central Data Base.

## **Program Management Office**

Within Oregon State University the CRSP is administered by a Program Management Office. The Program Management Office moved to the Office of International Research and Development (OIRD) in 1986 from its original home in Newport, where it had been based since 1982. The new location, which is next to the Oregon State University Administration Building, facilitates the streamlining of many administrative details essential to properly servicing the CRSP grant. The OSU Office of Business Affairs (located in the Administration Building) provides support for contracting and fiscal reporting.

The CRSP also is part of OSU International Fisheries at OIRD, which is comprised of the Consortium for International Fisheries and Aquaculture Development (CIFAD), the Foreign Fisheries Observer Program, and the International Institute of Fisheries Economics and Trade. This arrangement with OIRD affords the Management Entity increased support in accounting, purchasing, and other services. The Management Entity now is integrated into the larger framework for international agricultural programs at Oregon State University and derives benefits from frequent interaction with these programs. The CRSP, formerly part of the Department of Fisheries and Wildlife in the College of Agriculture, now reports directly to the Vice President for Research, Graduate Studies, and International Programs through the Director of OIRD. Ties to the Department of Fisheries and Wildlife, however, are maintained through faculty appointments and professional and academic interests.

At the present time the staff of the Program Management Office include

- CRSP Director (half-time) - Dr. Howard Horton
- Associate Director (full-time) - Ms. Hillary Egna
- Director of Data Management (half-time) - Ms. Hilary Berkman
- Secretary (half-time) - Mrs. Lydia Perry
- Accounting Supervisor (0.10 FTE) - Ms. DyAnne Johnson

The Director and Associate Director provide executive linkage between the Management Entity and operations under this CRSP. The Director serves as ex-officio member of the Board of Directors and the Associate Director serves as ex-officio member of the Technical Committee. The present CRSP Director also serves as Director of International Fisheries at Oregon State University.

## **Board of Directors**

The Board of Directors is the primary policy-making body for the CRSP. The Board is comprised of one administrative member from each participating U.S. institution: Auburn University, CIFAD, and the University of California at Davis. The Program Manager from USAID and the CRSP Director serve as ex-officio members. All Board members function in the objective interest of the CRSP regardless of their institutional affiliation. At the present Board members are

- Dr. R. O. Smitherman, Auburn University
- Dr. Philip Helfrich, University of Hawaii
- Dr. Robert Fridley, University of California at Davis

The Board of Directors is responsible for

- Reviewing program budgets for the allocation of funds to research projects and the Program Management Office,
- Recommending budget allocations to the Program Management Office,
- Reviewing the administrative and technical status of overseas research projects and U.S.-based research activities,
- Advising the Program Management Office on policy guidelines,
- Approving the formation of ad hoc committees,
- Appointing at-large members to the Technical Committee and members of the External Evaluation Panel,
- Selecting the CRSP Director and making a nomination to USAID, BIFAD, and JCARD, and
- Monitoring the performance of the Program Director and Management Entity

## **Technical Committee**

Technical guidance is provided by a Technical Committee. Voting members of the Technical Committee include Principal Investigators from each host country institution and each funded project at a U.S. institution. These individuals also serve as members of the four subcommittees: budget, materials and methods, work plan, and technical progress. Other U.S. and host country scientists participate in the Technical Committee meeting as non-voting members. The Technical Committee may recommend to the Board of Directors at-large members whose areas of expertise are not represented on the Technical Committee.

The Technical Committee may form from among its voting members an executive panel with one member each from Auburn University, the University of

California at Davis, and CIFAD. The executive panel is authorized to act on urgent matters on behalf of the Technical Committee in cases where convening the full Committee is impractical or impossible.

The Technical Committee elects a chair and a recording secretary annually from among its voting members. The CRSP Associate Director and USAID Project Manager are ex-officio members to the Technical Committee.

Responsibilities of the Technical Committee are

- to develop biennial work plans and to submit them to the Board of Directors through the CRSP Director for approval and implementation,
- to prepare annual budget recommendations for CRSP research activities and to submit them to the Board of Directors through the CRSP Director for consideration in the development of the annual CRSP budget,
- to review the technical progress of the CRSP or components thereof and to propose modifications of the work plan to the CRSP Board of Directors, and
- to review materials and methods utilized in CRSP research and recommend modifications to the Board through the Program Management Office.

The Technical Committee meets at least once a year and reports its findings to the Board of Directors through the Program Management Office. The present members of the Technical Committee are listed in the Table below.

<b>THE CRSP TECHNICAL COMMITTEE</b>		
Name	Institution	Subcommittees
<b>Principal Investigators (Voting Members)</b>		
Dr. Ted Batterson	Michigan State University	B*
Sr. Marco Ivan Rodriguez	Directorate of Renewable Natural Resources, Honduras	B
Dr. Claude Boyd	Auburn University	M
position vacant	National University of Rwanda	W
Dr. William Chang	University of Michigan	B
Dr. James Diana	University of Michigan	T
Dr. Peter Edwards	Asian Institute of Technology, Thailand	W
Dr. Carole Engle	University of Arkansas at Pine Bluff	W
Dr. Kevin Hopkins	University of Hawaii at Hilo	W*
Dr. Kitjar Jaiyen	National Inland Fisheries Institute, Thailand	M
Dr. James Lannan, Chair	Oregon State University, Chairman of Tech. Committee	T*
Dr. Raul Piedrahita	University of California at Davis	M*
Dr. Thomas Popma	Auburn University	W
Mr. Wayne Seim	Oregon State University	B
Dr. James Szyper	University of Hawaii at Manoa	T
* subcommittee chairpersons		

<b>Table Continued Technical Committee Members</b>	
<b>Non-Voting Members</b>	
Mr H Alvarenga	Directorate of Renewable Natural Resources, Honduras
Ms Hilary Berkman	Oregon State University, Management Entity
Mr Dan Dettweiler	University of Michigan
Dr Bryan Duncan	Auburn University
Mr Bart Green	Auburn University, in Honduras
Mr Sompong Hiranyawat	National Inland Fisheries Institute, Thailand
Dr Howard Horton	Oregon State University, Management Entity
Dr Chris Knud-Hansen	Michigan State University, in Thailand
Dr Kwei Lin	University of Michigan and Asian Institute of Technology, in Thailand
Dr Cal McNabb	Michigan State University
Mr Steve Riggs	University of Michigan
Mr Eugene Rurangwa	National University of Rwanda
Dr David Teichert Coddington	Auburn University, in Honduras
Mr Sompote Ukkatawewat	National Inland Fisheries Institute, Thailand
Ms Karen Veverica	Oregon State University and Auburn University, in Rwanda
<u>At-large Members</u>	
Dr Donald Garling	Michigan State University
Dr George Tchobanoglous	University of California at Davis
<u>Ex officio Members</u>	
Ms Hillary Egna	Oregon State University, Management Entity
Dr Richard Neal	S&T/AGR, U S Agency for International Development
W Work Plans B=Budgets T=Technical Progress M=Materials and Methods	

Work Plan Subcommittee

The Work Plan Subcommittee is responsible for the preparation of a working draft of the work plan. The draft is submitted to the Program Management Office on or before 31 December of every other year. The Program Management Office distributes the draft to the Technical Committee for consideration at the annual meeting. The Work Plan Subcommittee facilitates discussions about the work plan at the annual meeting and then prepares a final draft of the work plan immediately following the meeting. This draft is forwarded to the Board of Directors through the Program Management Office.

### Materials and Methods Subcommittee

This Subcommittee determines standard materials and methods for inclusion into the work plan. The Materials and Methods Subcommittee also may revise the standard materials and methods when necessary.

### Technical Progress Subcommittee

The Technical Progress Subcommittee continuously reviews work plans, materials and methods, and data resulting from the various CRSP research activities. This Subcommittee identifies problems that may impede technical progress and prepares a report that contains recommendations for corrective action. This report is distributed to the Technical Committee prior to its annual meeting. The Technical Progress Subcommittee moderates discussions about technical progress at the annual meeting and then presents written reports of its findings and action taken to the Board of Directors through the Program Management Office immediately following the annual meeting.

### Budget Subcommittee

The Budget Subcommittee prepares budget recommendations for CRSP research activities in accordance with guidelines from the Board of Directors regarding the allocation of CRSP funds between research activities and program management. The Program Management Office may act as a conduit for this information. The Budget Subcommittee moderates discussions about the proposed research budget at the annual meeting and presents its recommendations to the Board of Directors and the Program Management Office at the close of the annual meeting.

### **External Evaluation Panel**

The External Evaluation Panel, which is composed of eminent aquaculture specialists, periodically evaluates the accomplishments of CRSP research activities and of the program as a whole. This process ensures that CRSP research remains carefully directed and cost effective. The present members of this panel are

- Dr. Kenneth Chew, Chairman- University of Washington
- Dr. Homer Buck- Illinois Natural History Survey
- Dr. Herminio Rabanal- University of the Visayas, Philippines

The Management Entity provides the External Evaluation Panel with copies of significant CRSP documents in order to keep the panel advised of CRSP

activities. Panel members are invited to attend the annual meeting contingent on the availability of funding. Attendance at the meeting provides the panel members with the opportunity to discuss progress with CRSP scientists and to observe the various CRSP planning activities.

In years coinciding with the Triennial Review, the Panel visits overseas research sites and attends the annual meeting. The External Evaluation Panel also may visit the Program Management Office and attend other significant CRSP meetings that are held during the year of the Triennial Review. At the conclusion of the Review, the External Evaluation Panel submits a written report of its findings to the Management Entity, Board of Directors, the USAID Program Manager, and BIFAD. The External Evaluation Panel serves without compensation but receives reimbursement for all travel expenses. Panel members, however, receive an honorarium during years in which the Triennial Review is held.

## FINANCIAL PLAN

The financial plan for the Pond Dynamics/Aquaculture CRSP 5-year Continuation Plan is presented in the following four tables. Table 1 presents an overall budget by principal project component for projected totals from USAID, U S institution cost sharing, and host country contributions. Tables 2-4 provide a more detailed breakdown of requested USAID funds by the U S institutions and the Management Entity.

TABLE 1  
PROGRAM BUDGET

	Year 9	Year 10	Year 11	Year 12	Year 13
<b><u>AID CONTRIBUTION</u></b>					
<b><u>Research Program</u></b>					
Honduras Project	195,607	205,387	248,515	260,941	273,988
Rwanda Project	201,522	211,598	241,340	253,406	266,077
Thailand Project	296,573	355,763	355,887	373,681	392,365
Data Synthesis	135,000	141,750	162,000	170,100	178,605
Soils Project	17,759	21,252	21,311	22,377	23,495
<b><u>Management Entity</u></b>	<b><u>284,375</u></b>	<b><u>277,383</u></b>	<b><u>283,546</u></b>	<b><u>335,395</u></b>	<b><u>312,212</u></b>
<b>Total AID Contribution</b>	<b>1,130,836</b>	<b>1,213,133</b>	<b>1,312,599</b>	<b>1,415,900</b>	<b>1,446,742</b>
<b><u>NON-FEDERAL CONTRIBUTIONS</u></b>					
Estimated U S Institution Cost Sharing	197,407	216,058	218,604	229,532	241,013
Estimated Host Country Contributions	<u>158,768</u>	<u>166,706</u>	<u>174,942</u>	<u>183,793</u>	<u>192,983</u>
<b>Total Non-Federal Contributions</b>	<b>356,175</b>	<b>382,764</b>	<b>393,546</b>	<b>413,325</b>	<b>433,996</b>
<b>GRAND TOTAL</b>	<b>1,487,011</b>	<b>1,595,897</b>	<b>1,706,145</b>	<b>1,829,225</b>	<b>1,880,738</b>

TABLE 2  
PARTICIPATING UNIVERSITY BUDGET

		Year 9	Year 10	Year 11	Year 12	Year 13	Line Totals
<u>AID CONTRIBUTION</u>							
<u>Research Program</u>							
Honduras Project	Auburn	174,988	183,737	223,772	234,961	246,709	1,064,167
	U Hawaii	20,619	21,650	24,743	25,980	27,279	120,271
Rwanda Project	OSU	94,199	98,909	113,039	118,691	124,625	549,463
	Auburn	102,323	107,439	122,788	128,927	135,374	596,851
	UAPB	5,000	5,250	5,513	5,788	6,078	27,629
Thailand Project	UM	158,719	211,016	190,463	199,986	209,985	970,169
	MSU	82,672	86,806	99,206	104,166	109,375	482,225
	UH	55,182	57,941	66,218	69,529	73,005	321,875
Data Synthesis	OSU	45,000	47,250	54,000	56,700	59,535	262,485
	UC Davis	45,000	47,250	54,000	56,700	59,535	262,485
	UM	45,000	47,250	54,000	56,700	59,535	262,485
Soils Project	Auburn	17,759	21,252	21,311	22,377	23,495	106,194
Total Research Program		846,461	935,750	1,029,053	1,080,505	1,134,530	5,026,299
Managment Entry	OSU	284,375	277,383	283,546	335,395	312,212	1,492,911
<u>TOTAL PROGRAM BUDGET</u>		1,130,836	1,213,133	1,312,599	1,415,900	1,446,742	6,519,210

TABLE 3  
LINE ITEM BUDGET FOR AID CONTRIBUTION<sup>1/</sup>

	Year 9	Year 10	Year 11	Year 12	Year 13
<u>Research Program</u>					
Personnel	387,174	430,445	473,364	497,032	521,884
Equipment	40,754	46,788	51,453	54,025	56,727
Services and Supplies	87,435	93,574	102,905	108,051	113,453
Travel	108,094	121,648	133,777	140,466	147,489
Other Direct Costs	69,949	74,860	82,324	86,440	90,762
Indirect Costs <sup>2/</sup>	153,055	168,435	185,230	194,491	204,215
Total, Research Program	846,461	935,750	1,029,053	1,080,505	1,134,530
<u>Management Entity<sup>3/</sup></u>					
Personnel	113,658	119,341	125,308	131,573	138,152
Equipment	1,800	9,000	6,000	2,500	2,500
Services and Supplies	17,500	23,000	23,150	22,498	24,073
Travel	76,975	52,818	52,308	88,789	60,636
Other Direct Costs	3,000	3,150	3,308	3,473	3,647
Indirect Costs	71,442	70,074	73,472	86,562	83,204
Total, Management Entity	284,375	277,383	283,546	335,395	312,212
<u>Total AID Contribution</u>	1,130,836	1,213,133	1,312,599	1,415,900	1,446,742

<sup>1/</sup> As reasonably necessary, amounts may be switched among line items within the Research Program Budget, and within the Management Entity Budget

<sup>2/</sup> Subgrantees are entitled to indirect costs at their federally negotiated rates

<sup>3/</sup> Includes Board of Directors and External Evaluation Panel

TABLE 4  
MANAGEMENT ENTITY BUDGET

	Year 9	Year 10	Year 11	Year 12	Year 13
<u>Personnel</u>					
Academic, 1 90 FTE	72 600	76 230	80 042	84,043	88,246
Classified, 1 15 FTE	16,130	16,937	17 784	18,674	19,607
OPE 30 5% and 38%	24 928	26 174	27 482	28,856	30,299
<u>Equipment</u> <sup>1/</sup>	1 800	9 000	6,000	2,500	2,500
<u>Services and Supplies</u>	17 500	23 000	23,150	22,498	24,073
<u>Travel</u> <sup>2/</sup>					
National	35 135	36 892	38,736	40,673	42,707
International <sup>3/</sup>	41 840	15 926	13,572	48,116	17,929
<u>Other Direct Costs</u>	3 000	3,150	3,308	3,473	3,647
<u>Indirect Cost</u>					
@ 36, 36 5 37% <sup>4/</sup>	64 269	66,570	70,486	78 313	79,260
Off Campus @ 22%	7 173	3,504	2,986	8,249	3,944
TOTAL	284 375	277 383	283,546	335,395	312,212

<sup>1/</sup>Exempt from Indirect Cost

<sup>2/</sup>Includes Board of Directors and External Evaluation Panel

<sup>3/</sup>Off Campus Indirect Cost Rate

<sup>4/</sup> Indirect Cost Rates are provisional on 6/30/89

**APPENDIX A**  
**Project Narratives**  
**The CRSP Global Experiment**

**1 Field Experiments**

Global Sampling Protocol

Central America - Honduras project

Africa - Rwanda project

Asia - Thailand project

Pond Soil Studies

Handbook of Aquaculture Research Techniques

**2 Data Analysis and Synthesis Team**

## FIELD EXPERIMENTS

### Global Sampling Protocol

The CRSP Global Experiment will continue intensive sampling of pond variables during the course of field experiments. A standardized sampling protocol will be used at all locations, and the standardized data will be added to the existing centralized CRSP Data Base. The fish cultural and analytical methods will continue as presented in appropriate appendixes to the CRSP Fourth Work Plan. All research locations will follow the same protocol for daily measurements, diel studies, fish measurements, optional and occasional measurements, and reference ponds. Pond variables and frequencies of observation include

#### Daily measurements.

- water temperature
- solar radiation
- wind speed
- air temperature
- rainfall
- evaporation
- pond depth
- pond water inflow

#### Intensive Sampling and Diel Studies.

Each experiment includes three intensive sampling periods: (1) during the second week, (2) midway through the experiment, and (3) during the final week. The variables to be observed include

- total Kjeldahl nitrogen
- ammonia nitrogen
- total phosphorus
- Secchi visibility
- chlorophyll *a*

- dark bottle respiration
- total suspended solids
- volatile suspended solids
- diel studies (sampling times pre-dawn, 1000, 1400, 1800, 2300, and pre-dawn the next day, sampling depths near-surface, mid-water, and near the bottom for each pond), variables include
  - dissolved oxygen
  - temperature
  - pH
  - alkalinity
  - wind
  - solar radiation

### **Fish Measurements.**

In order to monitor fish growth and survival in each experiment, the total number of fish stocked or harvested, and the length, weight and number of individual fish in statistically significant samples will be measured and recorded at initial stocking, at harvest, and at monthly intervals between stocking and harvesting

### **Optional Monthly Measurements.**

- phytoplankton composition
- zooplankton composition
- benthos composition

### **Occasional Measurements.**

- pond soil characteristics at the beginning of each experiment
- pond morphology
- seepage
- chemical oxygen demand (COD) of inputs
- nutrient analysis of inputs

### **Reference Ponds.**

The characteristics of pond soils and water are known to change over time. The degree to which the temporal changes influence pond dynamics are not well understood. Therefore, three replicates of a standard treatment (25g tilapia stocked at 20,000/ha with weekly manure additions) will be established at each CRSP research location, and this standard treatment will be repeated in each subsequent experiment in order to document temporal changes in the ponds

Measurements of water quality and soil properties will be made in accordance with the standard sampling protocol

Experience suggests that the soil and water of new ponds change rapidly, but that the rate of change becomes progressively slower with time. In order to better assess the influence of lime and fertilizer addition, the top ten centimeters of soil will be removed from each pond bottom before the pond is flooded for the initial experiment. Removal of the top layer of soil will facilitate observation of the initial, rapid changes that are expected to occur. In subsequent experiments, ponds will be drained for harvest, but bottom soils will not be removed.

## Central America - Honduras Project

### Cooperating Institutions and Principal Investigators

Honduras Ministry of Natural Resources  
Sr Marco Ivan Rodriguez

Auburn University (lead U S institution)  
Dr Bryan Duncan and Dr Claude Boyd

CIFAD (University of Hawaii)  
Dr James P Szyper and Dr Kevin Hopkins

### Background

The proposed research in Honduras will have three areas of focus. The first area, oxygen dynamics in ponds and the effects of artificial aeration on oxygen dynamics, will build upon and extend the research results thus far obtained by the CRSP. The second area, interactions between bottom soil and water quality, is needed for a more complete understanding of pond dynamics. The third area of focus is a study of the dynamics of brackish water as an aquacultural environment.

Most of the existing literature on the dynamics of dissolved oxygen (DO) in aquaculture ponds describes general relationships among DO and other environmental variables. More detailed information is required in order to increase our understanding of the role of DO in fertilized ponds.

Although most of the CRSP research has been conducted in freshwater ponds, it is essential that pond dynamics in brackish water systems be examined because 1) brackish water sites may become more available and more important in the near future (if the present worldwide expansion of brackish water shrimp farms is unprofitable, many of these farms will become available for other types of brackish water aquaculture), and 2) the host countries have expressed a desire to increase their knowledge of brackish water systems (as is true in the present case of Honduras).

### Objectives

Experiments will be conducted with the following five specific objectives

- 1 To determine the effects of dissolved oxygen on fish growth,
- 2 To determine the effects of aeration on plankton biomass and dissolved nutrients,
- 3 To quantify soil-water interactions involving phosphorus, dissolved oxygen, and toxic reduced substances (i.e., ammonia, nitrite, and hydrogen sulfite),
- 4 To quantify the spatial and temporal fluctuations of DO within ponds, and
- 5 To quantify the effects of weather on DO

The rationale for each of these objectives is

**Objective 1** Aeration can be used to improve DO concentrations in ponds but it is not clear which manner of aeration is most effective. Most research on DO requirements of fish have used static systems in which DO was maintained at one level and survival and growth rate of the fish rarely were determined. However, fertilized pond systems are highly dynamic and experience wide fluctuations in DO concentrations. Experiments will be conducted to determine the minimum allowable DO levels in these dynamic systems.

**Objective 2** During pond aeration, mixing of waters from the soil-water interface probably results in the resuspension of dissolved and undissolved nutrients. Resuspension and mixing of nutrients may result in increased primary and secondary productivity. The data logger information, zooplankton counts, and chemical analyses of water will be used to quantify changes in plankton biomass and dissolved nutrients that may occur during pond aeration.

**Objective 3** The soil and sediments constituting pond bottoms are in continuous contact with the water and constantly exchange materials with it. Bacteria in the sediments use dissolved oxygen, feed upon and break down organic materials (e.g., fish wastes), and recycle nitrogen and phosphorus. Experiments will be conducted to better understand the role of soil and sediments in pond dynamics.

**Objective 4** Dissolved oxygen concentrations vary within ponds and through time. The concentration in a single water sample does not, therefore, necessarily represent the availability of oxygen to the organisms in the pond. In order to design an appropriate sampling program, it is necessary to know how much variation in DO may be found within a pond under different conditions. In the past, intensive sampling programs needed to determine the proper distance between neighboring sample locations and the frequency of sampling were

beyond the logistical and financial reach of the CRSP. However, multichannel, automated data-logger systems are now available for use in aquaculture. These devices are able to record, in computer-coded form, several different variables simultaneously. They automatically record the data repeatedly as programmed, and store the results for transfer to processing computers. One of these data-logger systems has recently been installed and is operating at the CRSP site in Honduras.

Although we now have the capability of collecting voluminous amounts of DO data with automated data-logger systems, the techniques to relate these data to other measurements in a useful way must still be developed. For example, current CRSP protocols specify interim sampling of the length and weight of fish in 5- to 6-month experiments at intervals of one month while also specifying that DO measurements be taken with the data-logger system at 1-hour intervals. Presently, it is difficult to translate the DO data into a single number or index (or set of indices) for comparison with the monthly growth data. Statistical and empirical analyses of logger-monitored data will be made in a search for useful, larger-scale indices of the conditions experienced by the fish.

**Objective 5** Weather conditions have a major impact on the DO concentrations in ponds through the effects of wind, rain, and light. Different ponds not only experience different weather conditions, but may be differently affected by similar weather due to different inherent physical characteristics. By including "weather-logging" capabilities in our data-logger systems, we will be able to evaluate the effects of weather on DO fluctuation.

### **Experimental Protocol**

The planned experiments are interrelated in many ways and will provide information necessary for attainment of several objectives simultaneously. Experiments and monitoring protocols will include the following:

**Experiment 1 Aeration** - Tests of the effects of artificial aeration on the space- and time-related variation of oxygen levels and other measurements will be conducted using four experimental treatments: no aeration, emergency (when concentrations of DO < 1 ppm), nightly, and continuous aeration. Fish growth will receive particular attention.

**Experiment 2 Pond Soils** - During the other experiments, samples of bottom muds will be collected and analyzed for determination of phosphorus.

budgets and for use in the determination of redox potentials. Development of *in-situ* techniques to determine the DO requirements of soils will be conducted in close coordination with the data-logger experiments.

**Experiment 3 Brackish water** - As the brackish water experiments will be conducted with farmer cooperators, the experiments must provide practical information on the effects of feeding and stocking rates on yield in addition to the more complete information on pond dynamics needed by the CRSP. The effects of intentional water exchange (5 to 30% of pond volume per day) and rainfall on salinity, and the effects of buildup of nitrogenous wastes and salinity on yield will receive particular emphasis.

**Experiment 4 Reference Ponds** - Automated data-logging systems, including weather monitoring, will be installed in the reference ponds to detect variability in DO and other parameters within the ponds. Comparison of the logger-data and data from sensors deployed in a single location may allow additional inferences to be made from previous CRSP data collected at single locations.

### **Benefits**

Accomplishment of our objectives will result in a better understanding of the dynamics among fish and those factors influencing their growth, and the dynamics among soil and those dissolved chemicals which affect primary production and fish growth.

Organic fertilization of ponds results in an environment with a high biological oxygen demand, which eventually could result in growth reduction or suffocation of fish through an imbalance of oxygen consumption and production. These experiments will indicate levels of DO below which fish growth could decline, as well as the usefulness and profitability of artificial aeration. Effects of aeration will be partitioned among those related to DO and those related to mixing in the water column.

Brackish water aquaculture is accounting for a higher percentage of Honduras' export earnings every year. Our experiments will help farmers be more competitive in world markets by increasing their efficiency of production or use of local resources. These experiments will also increase our limited understanding of dynamics of brackish water systems.

## **Africa - Rwanda Project**

### **Cooperating Institutions and Principal Investigators**

National University of Rwanda  
(New Principal Investigator to be announced soon)

Oregon State University (lead institution)  
Mr Wayne Seim and Dr Richard Tubb

Auburn University  
Dr Thomas Popma

University of Arkansas at Pine Bluff  
Dr Carole Engle

### **Background**

The temperature for optimum growth of tilapia is greater than 25°C. Growth is reduced at lower temperatures, but little information is available to accurately assess the utilization of natural pond organisms by tilapia at elevations where temperatures are marginally cool. There currently are 3,000 private rural fish ponds in operation in Rwanda at altitudes ranging from 1,300 to 2,500 meters. The array of temperature regimes resulting from the altitude differences presents a unique opportunity to more clearly define the effects of altitude (especially temperature) on the dynamics and productivity of tilapia ponds.

Little is known about the effect of diurnal changes in temperature on the appetite and growth of tilapia. Is minimum, maximum or average temperature the most critical for tilapia growth? This aspect could be examined under laboratory conditions.

High-quality protein is generally more expensive than the energy-rich ingredients used in supplemental feeds for fish. In most intensive production systems, high energy ingredients are added to "spare" the maximum amount of protein for growth rather than for respiration. In many developing countries, however, the principal source of dietary nutrients for fish is naturally occurring organisms from enriched ponds. Information on the digestibility of protein and energy in natural food organisms will help identify which feed ingredients best supplement the nutritional deficiencies of natural foods available to fish in nutrient-enriched ponds.

These studies also will help differentiate whether the effect of temperature on the growth of tilapia is more a function of changes in the dynamics and productivity of enriched ponds or of the capability of this fish to efficiently utilize the pond organisms at lower temperatures

### **Specific Objectives**

The specific objectives of experimental work in Rwanda from 1990 to 1995 will be

- 1 To classify ponds according to the ten existing agro-ecological zones defined for Rwanda
- 2 To determine the relationship between temperature (and elevation) and fish production for two input strategies organic fertilizer only, and enrichment plus supplemental feeding
- 3 To evaluate the effect of diel temperature patterns on tilapia food consumption and growth
- 4 To estimate the digestibility of crude protein and energy of the natural diet of tilapia in ponds receiving one of the following treatments no input, chemical fertilizer, chicken manure, swine manure, compost, compost plus a supplemental diet of fresh leaves, and fresh leaves only
- 5 To test conclusions of objective 4 by comparing growth of fish fed a diet with adjusted protein energy ratio as compared to a diet consisting of the standard 11 kcal digestible energy per gram of digestible protein

### **Experimental Protocols**

The following summarizes the experimental protocols for each objective listed above

#### **Experiment 1 Classification and selection of ponds**

- 1 A pond classification system will be adopted or modified from an existing land classification system for Rwanda based on agro-ecological factors
- 2 Five ponds will be selected at each of five elevation ranges 1300-1400, 1500-1600, Rwasave Station (1700), 1800-2000, and 2100-2300 meters The sites will be selected on the basis of the previously mentioned land classification system

Ponds for subsequent experiments will be selected based on similarity of source water, alkalinity, hardness, pH, soil acidity, and organic matter

3 Extension agents and farmers will be trained in experimental protocols and data collection in a series of workshops

Experiment 2 Relationship between temperature and fish production with organic fertilizer inputs

1 Tilapia production will be measured in each of 20 farmer-managed ponds and five Rwasave station ponds. Advanced juvenile tilapia will be stocked at 1 fish per m<sup>2</sup>. Fish will be handled as described in the CRSP work plan with the exception that if fish growth is exceptionally slow, a sample will be taken at five months and the experiment will be continued until fish reach market size (150g)

2 Parameters measured in rural ponds (at 2.5 and 5 months) will include N, P, and C of inputs and soil, N, P, alkalinity, hardness, dissolved oxygen, pH, and transparency of pond water. Maximum-minimum temperatures will be taken weekly by extension agents. Temperature recording devices will be used to obtain 24-hour records of temperature for as many periods as necessary to characterize the temperature regime for each altitude range. Fish stomach contents will be taken from 5 fish per pond at harvest and analyzed for food composition.

3 The nutrient input for Experiment 2 will be organic fertilizer added at 750 kg/ha/wk. The following table details the experimental design for Experiment 2 and 3

Elevation (m)	No ponds	Experiment 2		Experiment 3	
		(organic fert.)	(feed)	(organic fert.)	(organic fert.)
1300-1400	5	750 kg/ha/wk	2%	750 kg/ha/wk	750 kg/ha/wk
1500-1600	5	750 kg/ha/wk	2%	750 kg/ha/wk	750 kg/ha/wk
1700 (Rwasave)	5	750 kg/ha/wk	2%	750 kg/ha/wk	750 kg/ha/wk
1800-2000	5	750 kg/ha/wk	2%	750 kg/ha/wk	750 kg/ha/wk
2100-2300	5	750 kg/ha/wk	2%	750 kg/ha/wk	750 kg/ha/wk

Experiment 3 Relationship between temperature and fish production with supplemental feed and organic fertilizer

This experiment is similar to Experiment 2 with the exception that nutrient input will be intensified. An aquacultural by-product such as rice bran also will be added at a rate of 2% of body weight/day. Organic fertilizer also will be added at 750 kg/ha/wk.

Experiment 4 Effect of diel temperature patterns on tilapia feed consumption and utilization

1 Fish will be raised in tanks at diurnally fluctuating temperatures. Three tanks at two different temperature ranges and at their corresponding average temperature (16-24, 20-28, 20, and 24°C) will be stocked with tilapia. Fish will be fed four times daily to satiation with a standard floating catfish pellet. Appetite, growth, and feed conversion will be measured over the four-week period. The experimental design of subsequent trials will be based on the results of the first trial.

Experiment 5 Digestibility by tilapia of protein and energy in natural food organisms from ponds enriched with various nutrient inputs

1 Advanced juvenile tilapia will be stocked at 1 fish per m<sup>2</sup> in 12 ponds with two replicates, each with six nutrient inputs: none, chemical fertilizer, chicken manure, swine manure, compost alone, and compost plus edible fresh leaves. Fish receiving fresh leaves only will be confined in floating cages.

2 Stomach and feces samples will be collected from each pond after six weeks (or when fish have attained an average weight of at least 50 grams). Replicate samples will be collected again two weeks later.

3 Organisms in stomach ingesta will be quantitatively and qualitatively identified by microscopic examination.

4 Laboratory analysis will be used to quantify the crude protein (by micro-kjeldahl), total energy (by bomb calorimetry) and indigestible "indicator" pigments in feed and feces samples. Digestibility of crude protein and energy in the ingesta will be estimated by standard formulas proposed by Maynard and Loosli.

Experiment 6 Balancing nutritional deficiencies of natural pond organisms with supplemental feeds

1 Based on Experiment 5, a supplemental ration will be chosen on the assumptions that fish in food-enriched ponds will ingest equal quantities (on a dry weight basis) of natural pond organisms and supplemental rations, and that the desired protein-energy relationship of the combined ingesta is 10-11 kcal digestible energy per gram of digestible crude protein.

- 2 Fifteen ponds will be stocked with advanced juvenile tilapia at a density of 1 fish per m<sup>2</sup>
- 3 All ponds will be enriched with fresh grasses at a rate of 500 kg (dry weight)/ha/wk
- 4 Two supplemental rations will be fed at two feeding rates for approximately five months
  - a A standard diet (10-11 kcal digestible energy/g crude protein) at 2% of body weight daily,
  - b A standard diet at 4% of body weight daily,
  - c The "adjusted"ration (as calculated above, in #1) at 2% of body weight daily,
  - d The "adjusted" ration (as calculated above, in #1) at 4% of body weight daily

### **Benefits**

These experiments will extend the range of environments examined by the CRSP into the coolest environments tolerated by tilapia. These experiments also will determine how temperature influences production and how management strategies should change with altitude. Such results could be used not only by the rural farmer in many high altitude countries of world but by agencies at the planning level in allocating land and resources to fish culture. Combined with an economic analysis, both biological and social factors could be addressed to land use and resource allocation decisions. If supplemental feeds can be selected from available materials on the basis of their energy/protein content to maximize the use of scarce natural protein for growth (as opposed to respiration), natural pond organisms will be used more efficiently for fish production.

## **Asia - Thailand Project**

### **Cooperating Institutions and Principal Investigators**

National Inland Fisheries Institute  
Dr Kitjar Jaiyen

Asian Institute of Technology  
Dr Peter Edwards

University of Michigan (lead institution)  
Dr James S Diana and Dr C Kwei Lin

Michigan State University  
Dr Cal D McNabb and Dr Ted R Batterson

University of Hawaii  
Dr Kevin D Hopkins and Dr James P Szyper

### **Background**

Experiments conducted under the first three CRSP work plans in Thailand have addressed the relationships of fertilizer input to yield of fish, primarily tilapia, under "standardized" conditions. These relationships have been tentatively quantified. During the Fourth Work Plan, the restrictions on "standard" conditions were relaxed to allow examination of effects of differences in management techniques related to pond depth, fish stocking density, and nutrient balance in the fertilizers. The results of the experiments in the Fourth Work Plan are now being analyzed.

During the period 1990 to 1995, we propose to expand the applicability of the CRSP results by conducting refined versions of the Fourth Work Plan experiments, by including polyculture (growth of more than one fish species in a pond at the same time), and by using supplemental feeding. The need for this expansion was anticipated and was mentioned in the 1987 Continuation Proposal.

### **Specific Objectives**

The experiments in Thailand will have the following objectives during the period 1990 to 1995:

- 1 Determination of the relationships of pond size to fish yield, management practices, and system efficiency,
- 2 Quantification of the rates associated with the key processes which link fertilizers and nutrient (P, N, C) cycles in ponds to fish growth and yield,
- 3 Identification of factors which affect harvest size of tilapia,
- 4 Collection of baseline information on simple polyculture systems and refinement of hypotheses regarding pond dynamics in these systems, and
- 5 Determination of the applicability of results obtained under controlled conditions to extension field situations

Each of these objectives is further detailed below

**Objective 1 Effects of Pond Size** - The standard CRSP experiments in Work Plans 1 through 4 used 250 m<sup>2</sup> ponds. The direct applicability of the results of those experiments to larger or smaller ponds is yet to be determined. In larger ponds, maintenance of uniform conditions (for example, fertilizer distribution) is much more difficult than in the 250 m<sup>2</sup> ponds. In smaller ponds, the increased pond surface-to-volume ratio and pond perimeter-to-volume ratio may have significant impacts on the pond dynamics. By quantifying the relationships of pond size to fish yield and management practices, the effect of pond size on system efficiency (in terms of nutrient, land, and labor inputs) can be determined. Quantification of the relationship is required in order to compare results from extension field trials in which ponds of many different sizes will be used. Also, this research will allow estimation of the minimum size of research pond from which results will apply to conditions in commercial aquaculture ponds.

**Objective 2 Phosphorus, Nitrogen, and Carbon Cycles** - Our previous experiments with fertilizers demonstrated that productivity of microbial plants and animals at the base of the food chains depends on adequate supplies of phosphorus (P), nitrogen (N), and inorganic carbon (C) in the proper proportions. A very significant finding of those experiments was that application of moderate quantities of fertilizers which have a P/N ratio of 1/7 by weight to ponds with high content of inorganic C resulted in fish yields equivalent to yields in intensively managed ponds in which pelleted feed was used. However, the dynamics of the processes underlying this approach have not yet been investigated thoroughly under the research protocols which we have used to date. Translation of these research results into farm practices requires greater

understanding of the key processes controlling the abundance of usable forms of P, N and inorganic C

**Objective 3 Harvest Size of Tilapia** - Higher fish densities resulted in reduced individual growth, but similar total yield (number of fish times average weight) during the Fourth Work Plan experiments. Possible reasons for this are competition for food resources and precocious sexual maturation. The relative importance of each of these or other factors in determining average harvest size will be determined in order to improve management practices.

**Objective 4 Polyculture** - Polyculture systems try to exploit the many ecological niches present within a pond by simultaneously growing more than one fish species which have different feeding habits. The CRSP will initially examine simple polyculture systems which have potential applicability throughout S E Asia. An improved understanding of how polyculture affects pond dynamics in these systems will then allow the development of refined hypotheses which have much wider applicability.

**Objective 5 Demonstration Field Trials** - As the CRSP completes experiments, it is essential to field test predictions based on the earlier controlled experiments in order to verify that farmers will obtain similar results. The field trials will be conducted in cooperation with the Thailand Department of Fisheries and will continue for the duration of the CRSP.

### **Experimental Protocols**

The following protocols are for the period 1990-1991. Protocols for the subsequent years will depend upon the results of these experiments.

**Experiment 1 Pond Size** - An experiment using three pond sizes (200, 400 and 800 m<sup>2</sup> ponds) and four replicates of each will be conducted. Based on the best results from the Fourth Work Plan experiments, ponds will be stocked with tilapia at a single density and will be fertilized with chicken manure and urea. Pond dynamics and yield will be evaluated as in previous experiments.

**Experiment 2** This will deal with physical and biological steps in cycles of phosphorus (P), nitrogen (N), and inorganic carbon (C) in fertilized ponds. The goal will be to determine rates of important processes at the base of fish food webs in fertilized ponds. Particular processes to be studied are shown in the upper left hand portion of Figure 2. Reference to that portion of Figure 2 will illustrate the purpose of selecting measurements that are discussed in the following paragraphs.

Phosphorus, nitrogen, organic carbon, and inorganic carbon will be measured in fertilizers added to ponds. Quantities of these nutrients will also be measured in surface water added to ponds during experiments. Rates of release of N, P, and C from fertilizers will be measured in the laboratory using pond water as a medium for release. Sediment traps will be placed in ponds to determine rates of deposition of P, N, and C on bottom sediments. Exchange rates with the atmosphere will be calculated for nitrogen as ammonia gas and inorganic carbon as CO<sub>2</sub>. Measurements of ammonia gas and CO<sub>2</sub> will be obtained in ponds to determine the status of air/pond equilibria, and exchange rates will be calculated from the results. Measurements will be made of amounts of carbon removed from pond water during daily photosynthesis. Amounts of phosphorus and nitrogen required daily to complement photosynthetic carbon will be calculated by procedures we have used earlier in the CRSP. These procedures rely on the assumption that microorganisms in ponds use P, N, and C in a ratio of 1:7:40 by weight. To examine this assumption, the microalgae + microheterotroph fraction of samples of pond water will be analyzed for P, N, and C. Respiration will be measured in ponds to determine rates at which carbon (CO<sub>2</sub>) enters the water from this source.

The fertilization protocol for this work will be taken from the best results of the Fourth Work Plan where performance of chicken manure + urea supplements was studied. One level of fertilizer applications will be used. Three fish stocking regimes, for example dealing with different fish densities in monoculture or polyculture, will also be selected from results of the Fourth Work Plan. Four ponds will be used for each fish stocking regime. A five-month grow-out period will be used. Much of the data required in this experiment will be collected using the usual standardized CRSP protocol for sampling and analyses. Exceptions include the laboratory work on nutrients released from fertilizers, the sampling and analyses associated with sediment traps, and analysis of nutrients in microorganisms.

Measurements from this experiment will be used to partially explain average mass balance conditions of P, N, and C in the water of experimental ponds during fish grow-out periods. Unmeasured rates of nitrogen fixation and denitrification, and of nutrients released from sediments and excreted by pond organisms will constitute the residue term in mass balance equations made for P, N, and C. The magnitude of the residue term, relative to other measured terms in these equations, will determine whether it is important to CRSP goals to have detailed data on residue term processes. If so, procedures will be developed to examine these processes. The goal is to explain inorganic nutrient dynamics related to the upper left hand corner of Figure 2.

Experiment 3 Harvest Size of Tilapia - This experiment will use male-only and mixed-sex groups of tilapia at two stocking densities (1 or 2 tilapia /m<sup>2</sup>) Each of the four treatments will have four replicates In addition to evaluating standard pond dynamics, the date and size at maturation will be evaluated for each treatment

Experiment 4 Polyculture - Three simple polyculture systems involving Clarias and tilapia will be examined In the first, Clarias will be stocked in cages in ponds and given a supplemental feed Tilapia will be at large in the ponds In the second treatment, both Clarias and tilapia will be stocked at large into the ponds and a supplemental feed will be provided for the Clarias No supplemental feed will be provided to fish stocked at large in the last treatment All treatments will use chicken manure and other supplements at an optimal rate

Experiment 5 Demonstration Field Trials - Ten to twenty farmers will stock fish, apply fertilizer and harvest using a CRSP-specified schedule Inputs and yields will be monitored The results from the farmers' ponds will then be compared to results obtained in the CRSP ponds

### **Benefits**

A goal of the CRSP is to evaluate basic management practices and their effects on pond dynamics in small, tropical fish ponds These experiments will complete tests of the major potential manipulations (fertilizer quantity and quality, stocking density, sex controls, pond depth, and pond size) for tilapia culture Selected Thai farmers will use these optimal practices to validate the models and extend the methodology to other farmers

Polyculture experiments will test the applicability of results from earlier CRSP experiments with monoculture Higher total yields are more likely to occur in polyculture than in monoculture The flow of energy through the system also differs between the two types of culture Understanding gained through polyculture experiments will further improve our ability to manage pond systems efficiently

## **Pond Soil Studies**

Auburn University  
Dr Claude E Boyd

Oregon State University  
Dr James E Lannan  
CRSP Data Analysis and Synthesis Team

Earlier CRSP studies have provided information on the characteristics of pond soils at CRSP research locations. These findings have been largely descriptive, so they provide limited insight into pond soil-water quality relationships. Therefore, we propose to conduct a modest research project on pond soils. Pond soil samples will be collected at all CRSP research locations, laboratory work will be conducted at Auburn University. The pond soils studies also will include networking with the Tropical Soils CRSP and other agronomic research institutions to compile additional information from agricultural soils data bases. The CRSP Data Analysis and Synthesis Team (see later section) will use the findings from the CRSP field and laboratory studies and the agricultural soils data bases to develop a functional classification of pond soils to be used in improving pond management guidelines.

The proposed field and laboratory research activities are as follows

(1) Obtain a wide range of pond soil samples from Rwanda, Thailand, Honduras, United States, and possibly other countries. These samples will be subjected to a variety of analyses: pH, organic matter, nitrogen, phosphorus, cation exchange capacity, exchangeable cations, particle-size distribution, lime requirement, free calcium carbonate, and characteristics of clay by x-ray defraction. These data will demonstrate the range of bottom soil characteristics of fish ponds, and the samples will also be used in laboratory studies of interactions between soil and water.

(2) Use laboratory soil-water systems to determine equilibrium concentrations of nutrients in water standing over different soils. The absorption rates by soils of phosphate and ammonium added to laboratory soil-water systems will be analyzed. Capacities of soils to absorb phosphate and ammonium will be determined and appropriate equations used to describe absorption isotherms.

(3) Laboratory soil-water systems will be treated with different amounts of manure, and the influence of manure on soil properties will be ascertained by monitoring soil properties over time. The influence of adding agricultural limestone, nitrogen fertilizer, and supplemental aeration (alone or in various combinations) on soil properties in laboratory soil-water systems also will be determined.

(4) The influence of salinity on exchange of substances between soil and water will be studied in laboratory mud-water systems.

(5) The relationship between pH and base unsaturation of soils from different regions will be established so that the lime requirement procedure of Boyd (1974) can be modified for specific locations.

(6) A method for assessing the potential of acid-sulfate soils to produce acidity will be developed. A laboratory technique for determining the lime requirement of acid-sulfate soils also will be evaluated.

(7) Sedimentation rates of suspensions of different types of soils in waters of different chemical composition will be determined. Effects of organic matter additions on flocculation of suspended soil particles will be investigated.

(8) Results of laboratory studies will be integrated with data on water quality, bottom soils, and fish production from reference ponds. Also, a few research ponds on the Auburn University Fisheries Research Unit will be maintained for field testing of hypotheses resulting from laboratory investigations.

## **A Handbook of Aquaculture Research Techniques**

### **Cooperating Institutions**

**International Center for Living Aquatic  
Resources Management (ICLARM)**

**Dr Roger S V Pullin**

**Mr Jay Maclean**

**University of Hawaii (lead institution)**

**Dr Kevin D Hopkins**

**Oregon State University**

**Ms Hillary S Egna**

**Michigan State University**

**Dr Chris Knud-Hansen**

**(Editors and authors subject to change)**

Many aquaculture researchers have several treasured volumes of methods for the examination and assessment of aquatic resources. Unfortunately, these volumes are often prohibitively expensive for many researchers, particularly those in less developed countries. The Pond Dynamics/Aquaculture CRSP and the International Center for Living Aquatic Resources Management propose to dedicate their resources toward the publication of a handbook of methods for research in tropical aquaculture. This handbook will provide a single source of such information at an affordable price.

A major goal of the CRSP is the dissemination of information developed through CRSP activities. Towards this goal, the CRSP has been distributing copies of its work plans upon request. In addition to experimental designs, these work plans contain detailed descriptions of the equipment and analytical techniques which were used in the experiments. The equipment and techniques specified in the work plans were selected (and sometimes modified) for conditions which are commonly encountered in pond dynamics research in developing countries. For this reason, CRSP work plans have been copied and have found substantial use outside the CRSP.

The number of techniques in each work plan are restricted to those required for the successful completion of the experiments in that plan. A more general manual

or handbook of aquaculture research techniques does not currently exist. Such a manual could lead to substantial improvement in the quality of tropical aquaculture research by providing researchers with a ready reference to techniques that have been carefully selected and/or modified for applicability to tropical aquaculture. A handbook would also foster further global standardization of aquaculture research methods.

In order to make the handbook readily available throughout the world at a minimal cost, we propose that the CRSP and ICLARM collaborate on the preparation, printing, and distribution of the handbook. ICLARM has an excellent reputation for conducting and publishing the results of high quality fisheries and aquaculture research. ICLARM's non-profit status and its use of editorial and publishing capabilities in Southeast Asia will ensure worldwide availability of the manual at a reasonable cost (possibly \$15 or \$20 per copy compared to about \$100 for other currently published technical manuals). Through this arrangement, the CRSP will contribute manpower and editorial services to the project. Financial resources from the CRSP research budget will not be allocated for this activity.

The CRSP will take the lead in retaining leading aquacultural scientists both within and outside the CRSP to write sections of the handbook. The initial handbook will emphasize techniques for research on pond aquaculture systems. Future editions may expand the scope to include other aquacultural research topics. Preliminary editing will be conducted by CRSP personnel. Further editing, publication and distribution will be conducted by ICLARM.

Volume 1 of the handbook will focus on general aquaculture research techniques that apply particularly to tropical pond systems that rely on natural productivity. The proposed outline of chapters for the first volume is:

**Chapter 1 Research Infrastructure** Research management, description of facilities, record keeping, data management, and quality control will be described for systems that rely primarily on natural productivity. Also, a review of the aquaculture literature and names of research organizations and networks will be provided.

**Chapter 2 Design of Yield Trials** Traditional replicated designs, nontraditional designs based on regression and cluster analyses, and microcosm designs will be outlined.

**Chapter 3 Physical Environment** Techniques for collecting climatological (meteorological) and hydrological data will be described in addition to techniques for measuring pond morphology.

Chapter 4 Water Chemistry Sampling methods and analytical techniques will be described for the collection of a variety of water quality (chemistry) parameters Recommendations for the effective use of automated data-logger systems for obtaining water quality measurements also will be provided

Chapter 5 Pond Soils Methods for collecting samples and a variety of analytical techniques will be described

Chapters 6, 7, and 8 will focus on the collection of benthos, plankton, and detritus from fish ponds Techniques for analysis and identification also will be described

Chapters 9 and 10 will describe techniques for sampling and identifying cultivated crustaceans and fish Field and laboratory methods (e g , electrophoretic techniques) will be included

Chapter 11 Reproduction Maintenance of breeding populations, natural spawning, induced spawning, induced maturation, and sex reversal will be described

Chapter 12 Quantification and Analysis of Nutrient Inputs Techniques for collecting samples and analyzing organic and inorganic fertilizers will be described

Chapters 13 and 14 will focus on techniques for analyzing growth and mortality in fish ponds

Chapters 15 Food Habits and Supplemental Feeding Techniques for analyzing gut contents (stomach analysis) and supplemental feed (through proximate analysis) will be described

Chapter 16 will describe methods for identifying diseases and quantifying the incidence of diseases in fish ponds

Successive volumes will include other topics such as selective breeding, integrated agriculture-aquaculture, etc , nutritional requirements, and behavioral studies While the authors will not endorse particular brands of equipment, a list of materials and costs also will be included in the book

## Data Analysis and Synthesis Team

University of Michigan, Ann Arbor  
Dr William B Chang

Oregon State University  
Dr James E Lannan

University of California, Davis  
Dr Raul H Piedrahita

### **Purpose of the Data Analysis and Synthesis Team**

The Data Analysis and Synthesis Team (DAST) plays an important role in the CRSP by providing a global analysis and synthesis of CRSP research information. Maintaining a unity of purpose and coherence of the CRSP Global Experiment is based, to a certain extent, on the activities of the DAST. Whereas the researchers involved in the CRSP field experiments evaluate their findings from a site-specific perspective, it is the responsibility of the DAST to synthesize and evaluate CRSP research findings from a global perspective. The DAST is the principal U S research component of the CRSP.

### **DAST Research Activities**

The research activities of the DAST have focused on analysis of the global data base, on the development of computer models to simulate pond processes, and on the development of tools for organizing and presenting practical production guidelines to different audiences. The flow of research information from field experiments through data analysis and synthesis to pond management guidelines is as follows:

(1) The field experiments test specific hypotheses about dynamic processes occurring in ponds. The information resulting from the field experiments includes descriptions of specific pond processes and additional standardized data entries into the CRSP data base, which becomes more comprehensive with each entry.

(2) Statistical evaluation of the CRSP data base by the DAST identifies relationships between variables. The information resulting from statistical testing includes identification of empirical relationships that may find application in descriptive computer models.

(3) Computer models developed by the DAST are used to simulate pond processes. The information resulting from the simulations includes identification of additional information needs and functional relationships that can be incorporated into pond management guidelines. The identified needs for additional information become the focus of subsequent field experiments.

(4) An expert system model based on ecological classification of aquaculture ponds is used by the DAST to organize CRSP research information into a form that can be translated into pond management guidelines. The expert system is also a tool for identifying additional information requirements.

**General Objective** To provide a global synthesis of CRSP research findings.

### **Specific Objectives**

The specific objectives of the DAST for the 1990-1993 period are:

- 1 To analyze research data from the CRSP field experiments from a global perspective,
- 2 To develop, calibrate, and validate computer models to simulate water quality and fish growth in ponds, and to develop a comprehensive pond classification model to facilitate extension of site-specific CRSP research results to other sites, and
- 3 To prepare and disseminate pond management guidelines based on the results of CRSP research.

### **Proposed DAST Activities**

The proposed research activities of the DAST corresponding to the objectives stated above for the 1990-1993 period are primarily based on computer analysis and modeling.

Global Data Analysis Data from the CRSP Field Experiments completed to date will be analyzed by statistical methods. Principal component analysis and

traditional statistical analysis techniques will be used to identify significant relationships between variables. Analyses carried out by the DAST will be evaluated from a global perspective.

Statistical relationships between the increase in fish weight and nutrient enrichments have been determined for the data collected from earlier field experiments. The numerical relationships between fish growth, climatic factors, and other environmental variables are being determined. The growth rates observed at the different research locations were found to be similar for fish cultured in similar enrichment environments and physical conditions. Ordination techniques will be used to determine the numerical functions for describing conditions for each site. The calculations using ordination methods will be related to the fish growth data.

Computer Models Several models have been developed during the current grant period. These models are based on statistical analysis of data from the first three CRSP work plans. To date, the models developed or under development include (1) three mechanistic models that describe pond processes, including (a) a mechanistic ecosystem model that simulates 14 pond variables, (b) a mechanistic model that simulates dissolved oxygen concentration, and (c) a mechanistic model to analyze diurnal measurements of dissolved oxygen, pH, temperature, and alkalinity, (2) a fish growth model, and (3) a pond classification model.

The mechanistic models are presently being calibrated with data from CRSP field experiments. Models developed to date have been based primarily on the relationships between internal pond parameters. As an example, models of phytoplankton growth may be based on concentrations of nutrients found in the water. The next, and critical step from the management viewpoint, is to develop models that relate the concentrations of nutrients and the various process rates to pond inputs, soil conditions, and climate factors. Because of the complexity of pond ecosystems and the amount and quality of information collected in the field experiments, the models will be developed as mixed empirical-mechanistic models. Wherever there is sufficient scientific background and data, mechanistic submodels will be used to simulate the processes in the system. These mechanistic submodels will be supplemented with empirical relationships derived from the global data analysis. The models will be calibrated and the integrated empirical-mechanistic models will be validated with data collected during the next grant period.

As the reliability of the models improves, they will be used to refine management practices and propose field experiments. This activity will provide an essential test of the accuracy of the models and of the possible applications of techniques.

derived from the data analysis and modeling efforts to field use. The proposed field experiments will be presented to the CRSP Technical Committee for evaluation and inclusion in the experimental work plans.

Accurate estimates of fish growth are essential for aquaculture management and planning purposes. Therefore, improvement of fish growth models is considered to be of critical importance. The fish growth model will be made more comprehensive by incorporating statistical and numerical relationships identified in the global data analysis. Sensitivity analyses will be performed to determine the relative importance of parameters used in the model, and to define the relationships among the parameters and stocking density. Improvements in fish biomass estimation techniques have been incorporated into the global sampling protocol during the last grant period, and these should translate into more reliable information for model development.

The pond classification model uses an expert system to organize research information for dissemination as management guidelines. The pond classification model is a hierarchical classification of aquaculture ponds according to source water, soil, and climatic variables. In its present form, the classification model specifies the management actions that are appropriate for each ecological classification. The next step is to integrate the classification model and the computer models described above. The inclusion of functional relationships derived from the computer models will extend the capability of the classification model to specify the levels and frequencies of recommended management actions. The functional relationships to be developed include (but are not necessarily limited to) (1) lime requirement as a function of type of lime, source water characteristics, soil characteristics, and climatic factors, (2) inorganic nutrient requirements as a function of type of fertilizer, source water characteristics, soil characteristics, and climatic factors, and (3) organic fertilizer requirement as a function of type of manure or compost, source water characteristics, soil characteristics, and climatic factors.

Organization and Dissemination of CRSP Research Information One of the goals of the CRSP grant is to translate research findings into guidelines for the management of aquaculture ponds under different environmental and production regimes. The first CRSP manual of pond management guidelines will be completed by the conclusion of the present grant period. The manual will represent a significant advancement in pond aquaculture technology. However, further refinement is both possible and necessary.

The classification model described above will be used to prepare a second, more comprehensive version of the pond management manual developed during the

present grant period. The manual will include improvements based on analysis of new field data and relationships derived from computer models. This manual will be an important contribution of the Pond Dynamics/Aquaculture CRSP in that it will present a practical summary of the CRSP findings in terms of production strategies and pond management techniques.

The manual of farm management guidelines will be prepared in two forms: (1) a printed handbook and (2) a computer application. Both versions will present the rationale for ecological classification of farm ponds, the classification system, the functional relationships among ecological variables and management practices, and the recommended management practices for each ecological classification.

### **Benefits**

The global synthesis of CRSP research findings is of interest to three audiences: aquacultural producers, development planners, and aquacultural scientists. Producers want to maximize the efficiency of pond aquaculture systems. They need dependable guidelines on the fish cultural practices that are appropriate given certain technical and economic constraints. Development planners want to assess the economic feasibility of proposed or existing pond aquaculture activities. They need dependable methods of evaluating the suitability of proposed pond sites, and production functions describing probable yields given various inputs. Scientists want to understand the dynamic processes occurring in aquaculture ponds. They need reliable information about the functional relationships between components of aquaculture ponds. The activities of the DAST are directed toward all of these needs.

PN-ABR-545

**TITLE XII**  
**COLLABORATIVE RESEARCH SUPPORT PROGRAM**

**POND DYNAMICS/AQUACULTURE**

Triennial Review



**Pond Dynamics/Aquaculture CRSP Management Entity**  
**Office of International Research and Development**  
**Oregon State University, Snell Hall 400**  
**Corvallis, Oregon 97331-1641**

**SECOND TRIENNIAL REVIEW REPORT**

on the

Pond Dynamics/Aquaculture Collaborative Research Support Program

Prepared by the

**CRSP EXTERNAL EVALUATION PANEL**

Dr Homer Buck  
University of Illinois

Dr Kenneth Chew, Chairman  
University of Washington

Dr Herminio Rabanal  
Bureau of Fisheries and Aquatic Resources, Philippines

May 15, 1989

## EXECUTIVE SUMMARY SYNOPSIS OF RECOMMENDATIONS

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## EXECUTIVE SUMMARY

Although funds were reduced substantially, the three active host country projects (Honduras, Thailand, and Rwanda) in the present program appear to be strong and viable. The abrupt transition from Panama to Honduras did impede normal progress of studies for some time, but all evidence shows a smooth transition in the shift into Honduras.

There has been serious concern about keeping the global research data base current by the Data Base Manager and having it communicated back to host countries. This has been caught up to date by 1988 and this portion of the support program must be current at all times.

Panel members were favorably impressed by important and substantial contributions by research personnel from all projects through such ancillary activities as presentation of papers at scientific meetings and the publishing of research findings, as well as by the strengthening of host country capabilities through such varied activities as enlargement or improvement of facilities, the development of teaching and training curricula, training of students and support personnel, extension of information and technologies, and the initiation or encouragement of independent studies by host country personnel. Such activities greatly enhance the overall contributions of the CRSP without detracting from its primary objectives.

## SYNOPSIS OF RECOMMENDATIONS

- 1) That site visits by the External Evaluation Panel (EEP) members be made prior to the annual meeting so that discussions at the annual meeting can eliminate some of the deficiencies recognized during a preliminary drafting of the EEP report.
- 2) That laboratory personnel (chemists, computer technicians, etc.) in host countries be placed on permanent status or be provided adequate competitive salaries in order to minimize turnovers and to increase stability, continuity, and integrity of the projects.
- 3) That consideration be given to the potential for more effectively extending information and technologies in host countries without diminishing the

primary goals and research activities Perhaps a review of opportunities for non-mainline activities would be appropriate in light of interaction with the farmers via extension needs

- 4) In the interest of morale and program stability, it is recommended that consideration be given to adjusting stipends and fringe benefits of Research Associates (RAs) to levels provided to overseas personnel by other agencies
- 5) That efforts be extended to enlist assistance from host country agencies in supporting and training more students Based on discussion in Rwanda, it is suggested that the AID Mission and the Ministry of Education in Kigali might be helpful in this area
- 6) That RAs be more aggressive in stating their needs and problems to the Management Entity (ME), and that host country institutions be made more aware of how they might improve working conditions for the RAs in appropriate instances
- 7) Encourage the Data Analysis and Synthesis Team (DAST), which handles the data and modelling program, to be current and to ensure that the flow of information back to host country collaborators is done in a reasonable time
- 8) Due to limited resources available to the PD/A CRSP program, perhaps there should be encouragement to seek out possibilities of "buy-in" programs related to and integrated with the primary objectives of present programming An example might be a "buy-in" via AID Mission or host country organizations
- 9) More efforts need to be made by the ME to recognize and communicate with the field RAs There is a perception they are low on the ladder under the U S and host country PIs, even though they are probably the most critical to the programs
- 10) That the duties and importance of the EEP, and the funding of its activities be re-evaluated

## EXTERNAL EVALUATION PANEL REPORT

### I INTRODUCTION

#### A Background

The Pond Dynamic/Aquaculture Collaborative Research Support Program (PD/A CRSP) was initiated in September 1982, to increase the availability of aquaculture-derived animal protein in selected developing countries through a specific coordinated research program. It is a comprehensive, long-term, collaborative research program which focuses the technical resources of the developing countries and U S institutions on the improvement of pond culture systems through the clarification of mechanisms that control pond productivity, and on the manipulation of these mechanisms to achieve greater production of animal protein.

The administrative and technical tasks necessary to establish projects originally in six host countries (Honduras, Indonesia, Panama, Philippines, Rwanda, and Thailand) and to manage the overall program were completed during the initial year in 1983. Research was under way at all of these sites and results were beginning to be accumulated as reported in the last EEP Triennial Review Report dated March 1985. Unfortunately, due to budgetary constraints since that report, three host country projects in Honduras, Indonesia, and the Philippines had to be phased out and consolidated into project areas in Panama, Rwanda, and Thailand. This was complicated further when at the end of 1987 the political situation in Panama forced the program to terminate, followed by attempts to reestablish the PD/A CRSP in Honduras.

Periodic external evaluation of program accomplishments in the overall program activities is considered an important element of program management. Thus, the EEP was established for this purpose in accordance with the stipulated management guidelines. The first triennial evaluation made by the EEP was completed in March 1985. This is the second triennial review by the EEP.

After review of the above-mentioned information, the EEP was to prepare a written evaluation report to the ME, AID and JCARD-BIFAD.

It should be noted that because of budget constraints the EEP members were not able to come together to discuss in detail the results of the site reviews. However, trip reports were written. Further, the EEP members were not invited to attend the CRSP Board of Directors and Technical Committee meetings on October 21 and 22, 1988 at Oregon State University. Attendance at these meetings would have been helpful in crystallizing further opinions, thoughts, and recommendations relative to this second Triennial Review.

## B External Evaluation Panel Duties and Membership

The EEP is composed of impartial senior scientists selected by the CRSP Board of Directors (formerly Executive Council) and approved by the JCARD-BIFAD. Three scientists were appointed to the panel in 1987. Members participating in this second Triennial EEP Review are

Dr. Homer Buck, University of Illinois  
Dr. Kenneth Chew, University of Washington  
Dr. Herminio Rabanal, Bureau of Fisheries and Aquatic Resources,  
Philippines

The panel will attempt to review and assess the merits of component projects and the technical and administrative accomplishments of the program as a whole. The members of the EEP followed the basic criteria as provided in Appendix A. Information for the evaluation process was obtained from the following sources: 1) Site visits to three active country projects (Honduras, Rwanda, Thailand) and two recently terminated country projects (Philippines and Indonesia), 2) Follow-up review of recommendations made during the first Triennial Review of the EEP reported in March, 1985, 3) Review of various reports and documents provided by the ME, and 4) The PD/A CRSP Fifth Annual Administrative Report for 1987. The site review teams were composed of one representative each from the EEP, the BOD, and USAID, Washington.

## II PROGRAM REVIEW

### A Recommendations from First Triennial Review

The first Triennial Review by the EEP provided a synopsis of recommendations for the administrative and technical management as

well as for other related activities. A response by the CRSP ME was provided for these recommendations in a separate section following the first EEP report which was released on December 16, 1985. It was noted that the CRSP is in fact a partnership between AID, U S universities, and institutions in developing countries. The response to those recommendations was provided unilaterally by the CRSP. A request was made to Dr. Howard Horton, Director of PD/A CRSP, to review these recommendations and to determine if there were any changes or further comments related to the recommendations provided in the first EEP review. After discussions between the chairman of the EEP and Dr. Horton, a letter summarizing the thoughts as related to these recommendations is found in Appendix B. The overall clarification of various issues and justification for decisions relating to each of the recommendations are clearly stated.

## B Administrative and Technical Management

### 1 Management Office - Project Director

The Management Office and Project Director at Oregon State University appear to be functioning well and there appears to be no unusual problems related to funding of the various projects. It also appears that the ME was able to maintain contact with the host country bodies as well as the AID Mission offices. One problem that surfaced was the fact that in the process of writing the grant application for the 3-year Continuation Proposal, no funds were set aside for the second Triennial Review by the EEP. The funding constraints diminished the quality and completeness of the report in two principal ways: (1) By eliminating the opportunity for EEP members to have follow-up discussions with appropriate and varied project personnel to fill in the voids recognized following the site visits, and (2) By preventing EEP members from meeting to discuss, evaluate, and coordinate their findings following the site visits.

Since the last EEP review, Dr. Howard Horton has replaced Dr. James Lannan as the Program Director. This changeover did not appear to delay the normal management process and operations because the other support staff was already in place. Both the ME and Program Director were able to provide answers to most of the questions which the EEP raised relative to the total programming and will be covered below. Overall it would appear that the ME has

made efforts to work well with the Board of Directors and the Technical Committee

Although operating well, the ME office must continue to review the communication system to the Board of Directors, the Technical Committee, and host country RAs in the field. It is much better now than it was during the last EEP review, but there needs to be continued awareness that there are always places for improvement with more recent technologies and electronic mailing systems

## 2 Board of Directors

The Board of Directors (BOD), formerly the Executive Council, is the primary policy making body for the CRSP, and is comprised of one administrative member each from Auburn University, the Consortium for International Fisheries and Aquaculture Development (CIFAD), and the University of California at Davis. The BOD has a large role to play in the total programming and in advising the ME on CRSP programming. Further, the BOD reviews annual summaries and fiscal reports, approves formation of any ad hoc committees, appoints review panels, reviews performance of the CRSP Director, and finally, reviews planned research activities for consistency with CRSP policy before submission to USAID for funding.

The EEP members were able to meet with the BOD at the PD/A CRSP Annual Meeting in Hawaii in January 1988 and would judge that the Board is operating quite well. The BOD was very sensitive to the various issues that had been brought up during the meeting by the Technical Committee and was quick to act on them. Overall the EEP looks upon the BOD as being generally very aggressive in their overall responsibilities.

## 3 Technical Committee

The former Technical Advisory Committee and research team described in the original CRSP proposals have been incorporated into a new body called the CRSP Technical Committee (TC). This committee is composed of the Principal Investigators (PIs) (host country and U.S. institution) of the collaborative research projects, the CRSP DAST, and members at large designated by the BOD. The CRSP Director and AID Program Manager serve as ex-officio

members of the committee. From all indications as reviewed by the EEP, the TC is operating very well under the chairmanship of Dr James Lannan. Their charge is to prepare annual budget recommendations for CRSP research activities and submit them to the BOD, to review technical projects of the CRSP or components thereof, and to propose appropriate modifications of the technical plan to the CRSP BOD.

During the site reviews in the host countries, the RAs in some cases felt they may be left out and not getting adequate information from the TC. Overall, the TC appears to be working well, but again this question of communication and satisfying the RAs in the field through more prompt communication would be helpful when decisions are made which affect them. The EEP recognizes this situation is difficult to control and different for each host country. This is called to the attention of the TC because the PIs serve as an important linkage to the workers in the field.

Finally, the TC has a very important job aside from what has been stated in the above paragraph. They are the first ones to develop the overall projects in terms of the work plan, budget, and materials and methods, and still maintain a watchful eye toward the global concepts of the overall programming. Thus, this has necessitated the development of four standing subcommittees which are the Work Plan, Budget, Materials and Methods, and Technical Progress Subcommittees, all working together as a cohesive unit. The EEP is impressed with the activities of the TC in getting things done expeditiously.

## C EVALUATION OF PROGRESS

### 1 Schedule

The PD/A CRSP gained much experience in the first three to four years of activity. Although there have been some major changes in moving from a six-country involvement to three, the experience received from the initiation of this program in the earlier years certainly helped in the operation of the global programming during this second Triennial Review of the EEP. The fourth experimental cycle is in place now and operating. Aside from some of the problems related to the switch from Panama to Honduras, all evidence indicates that progress is being made and on schedule.

## 2 Quality of Research and Data Analysis

Although there was some question as to some of the problems related to startup and development of experimental sites in the various host countries, as well as to data collection and data management, the particular areas of concern have been addressed and apparently resolved as of the second Triennial Review by the EEP. There continues to be some delay in feedback of information between the various host countries and U.S. institutions, but they have been worked out to a great extent.

One major problem remaining as late as early 1988 was that of refining templates and receiving and verifying data from seven CRSP projects in six countries. Since then it has been resolved and as of May 1988, all of the CRSP data available from field stations have been received, verified, and made available to the DAST. Management of CRSP data is now kept current on a daily basis. The gap between the accumulation of field data and the interpretation of results has now been narrowed significantly and this has helped a great deal, especially for those countries' scientists who are collecting the data.

## 3 Funding

The funding for the PD/A CRSP appears to be precarious at best. It was revealed by the Program Manager that since the last triennial report of the EEP in March 1985, the PD/A CRSP has endured budget reductions of 18% and 13.5%. As a consequence, three of the six host country projects have been eliminated as indicated above. During the earlier series of recommendations, there was a request for at least two added members to the BOD from the participating host country institutions. As a result of these reductions, expansion of the BOD to include two members from participating host country institutions was not advisable or financially possible. The EEP would agree to this, noting that the present number on the BOD seems to be adequate. An expansion in size is not necessary.

Another major problem area is the fact that there is a need for approximately \$50,000 to reimburse the PD/A CRSP for the relocation from Panama to Honduras. Some equipment was left behind and will need to be replaced. Further, Auburn University

anticipates they will have a minimum deficit of approximately \$43,000 by April 1989 as a result of this change in countries. Necessary startup funds in Honduras need to be provided quickly so that the program can get back on track as rapidly as possible.

#### 4 Summary

In summary, the EEP finds that the program, even though reduced substantially in funding and confined to three host countries, is strong and viable and would merit continued support by USAID. The initial growing pains made the program mature and able to responsibly adjust under difficult situations and still maintain a program that will provide a global emphasis on pond dynamics. The fact that all countries reviewed as of late show good interaction with host country institutions as well as the AID Mission tends to indicate to the EEP members that due credit needs to be given to the many PIs and RAs that have contributed greatly to the program. The EEP feels that although there are perhaps a few glitches left in the execution of the overall process, by and large it is working very well in the countries presently designated for project studies. The probability of the program attaining its stated goals are excellent and the information resulting from the research will be valuable in furthering the science of controlled aquaculture in developing countries.

### III PROJECT REVIEWS

Aside from reviews of pertinent documents provided the EEP members, site visits were made at on-going country projects (Honduras, Rwanda, and Thailand) and at two terminated country projects (Indonesia and the Philippines). Panama had been selected to be the site of one of the three post-1985 continuing projects, but because of political difficulties between the U.S. and Panamanian governments, the Panama project was transferred to Honduras in 1988.

#### A On-going Country Projects

- A1 **HONDURAS** - Directorate of Renewable Natural Resources (Recursos Nacionales Renovables) - Auburn University - University of Hawaii

Site Visit March 14-18, 1988, by Dr Kenneth Chew, Dr Robert Fridley, and Mr Kenneth Osborn

1 Background

a Cooperating Institutions and Principal Investigators

Auburn University (lead university) Dr C Boyd, Dr B Duncan

University of Hawaii Dr K Hopkins, Dr J Szyper  
Directorate of Renewable Natural Resources (RENARE)  
Dr H Alvarenga, Mr M I Rodriguez

Project personnel involved with Honduras are firmed up, especially in light of the change of project activities from Panama to Honduras. Agreements have been developed between Auburn University and RENARE, and between Auburn University and the Escuela Agricola Panamericana at Zamorano to reestablish a working relationship for the PD/A CRSP to return to Honduras. During the site review, Mr Bart Green was working for Auburn University at the El Carao aquaculture experimental station at Comayagua under special assignment through funding from the AID Mission. Mr Green is apparently one of the main contact persons that will assist in the reestablishment of a CRSP program back in this country.

b Logistics

A visit was made to the El Carao aquaculture experimental station as a potential place for reestablishing project activities under the CRSP program. Discussions with principal people involved at the station and later with Director General Adan Benavides revealed that there is strong support for this reestablishment through the Fisheries Department under RENARE. A trip was taken also to review the potentialities of having a brackish water site at San Lorenzo located at the Gulf of Fonesca. No decision was made at the time of the site visit.

Virtually all the necessary equipment for the project in Panama, which would have been good to have for the

Honduras site, is lost. The need for substantial funds to reestablish activities in Honduras is noted to be close to \$50,000. Resources at this level are apparently not available at this writing.

## 2 Baseline Research

Scheduling has been established. Some programs in Honduras are just beginning, as noted in the Fourth Annual Work Plan, and it will be another year or two before something visible can be expected to be seen in terms of data generation. Further questioning to the ME concerning the Honduras status is provided in the next section.

## 3 Site Specific Research (although not research being conducted under PD/A CRSP)

The research that is being conducted at El Carao is generally under the supervision of the Coordinator of Aquaculture under the Department of Fisheries for RENARE, Mr. Marco Tulio Saomiento. Mr. Saomiento works closely with Mr. Green in various projects related to 1) producing fingerlings of various species of tilapia, 2) hybrids and sex reversal research on tilapia, and 3) implementing the extension and training program for farmers and extension people. The three basic thrusts of the station appear to be well established and well recognized.

## 4 Linkages

### a USAID Mission

Meetings with Mr. John Warren of the AID Mission office revealed that there is strong emphasis on wanting to go into shrimp culture activities. This emphasis is related to AID's desire to go into brackish water research, and perhaps this can be looked upon as part of the PD/A CRSP activities later. However, Mr. Warren indicated that it was a good move to have the CRSP program back in Honduras where it should not have left in the first place.

b Country Agencies

There appears to be good appreciation for past CRSP programs. They were very happy to see the CRSP come back into their country and were willing to assist in this process.

5 Summary Comments

Overall, the reestablishment of the PD/A CRSP program in Honduras is a mixed blessing for the Hondurans. They feel a bit leery about being dropped out the first time. However, they are quite happy that the program is being reestablished. The big concern is getting adequate funding to make this change from Panama to Honduras. There are good indications, however, that the fourth experimental cycle is now being implemented in Honduras with studies being conducted at El Carao to understand oxygen dynamics of fish production ponds and to refine production systems to make them more economically productive in Honduras and tropical Central America.

A2 RWANDA - National University of Rwanda - Oregon State University - Auburn University

Site Visit February 29-March 3, 1988, by Dr. Homer Buck, Dr. Howard Horton, and Mr. Kenneth Osborn

1 Background

a Cooperating Institutions and Principal Investigators

Oregon State University (lead university) Dr. R. Tubb,  
Mr. W. Seim

Auburn University Dr. T. Popma, Dr. B. Duncan

National University of Rwanda Dr. I. Butare\*

\*Dr. Butare may have been replaced

In January 1988, Karen Veverica replaced Boyd Hanson as the U.S. Research Associate, and assumed primary responsibility for the day-to-day operation of the project.

This followed the replacement of the Rwandan PI, Dr Valens Ndoreyaho, by Dr Innocent Butare, and the replacement of Dr Tubb by Mr Wayne Seim as the OSU PI. These major transfers of authority seem to be occurring rather smoothly, with no anticipated loss of effectiveness or efficiency. Ms Veverica is fluent in French, and appears to enjoy a full measure of respect and cooperation from Eugene Rurangwa, her Rwandan counterpart, and from the host country PI. It seems likely that this new team will maintain the high quality of performance and the fine degree of collaboration achieved during the tenure of Boyd Hanson.

b Logistics

Thanks to major financial support from the European Economic Community, the assistance of the National University of Rwanda, and the on-site expertise and leadership of Boyd Hanson, the number and quality of ponds, as well as laboratory facilities, seem adequate to comfortably accommodate baseline research objectives, as well as an effective program of site-specific projects. Such operational problems as could be identified seemed minor in nature, and quite typical for such facilities. For example, the nature of the water supply makes it extremely difficult to completely prevent extraneous fish from entering the experimental ponds, and large numbers of tadpoles also divert pond resources from use by target species. While these problems do not appear to seriously compromise project objectives, their elimination should be addressed.

2 Baseline Research

a Schedule and Results

The work plan for the 4th cycle projected a startup date of September 1987 for all projects. This timetable was not met in Rwanda, partly because Karen Veverica did not assume her post as U.S. RA until late January 1988, and partly because of the special nature of the project. Probably more than for other studies in the global project, the Rwandan studies require the development of new skills and untested procedures, some of

which required the on-site participation of the U S RA  
However, good progress was being made at the time of the site visit by the EEP, and baseline Experiment 1 in the new cycle was expected to move ahead quite rapidly The research team felt that the delay yielded compensations through the time made available for accumulating useful background material, for developing new techniques and procedures, and for conducting site-specific projects useful to the baseline studies

b Quality of Research

At the time of the site visit, no data had yet been collected from baseline experiments in cycle 4, but Experiment 1 was very close to activation A laboratory with adequate instrumentation and trained technicians is in place, all personnel appear well qualified, and the quality of research is expected to be high

c Analysis of data

No data has been collected for Cycle 4 Please refer to the 5th and 6th Annual Administrative Reports for prior and subsequent data

3 Site-specific Research

Rwandan personnel have completed three site-specific projects within the cycle 4 time frame The **first** involved an evaluation of four types of compost 1) green grass, 2) dried grass, 3) a mixture of dried grass and cow manure, and 4) a mixture of dried grass and distillery wastes The project was undertaken by Felicien Rwangano, a Rwandan now enrolled in the graduate school at OSU who will analyze the data as a thesis for the MS degree

A **second** project with 15 ponds compared the values of enrichment with manure with that of two types of compost 1) dried grass, and 2) distillery wastes

A **third** project evaluated three stocking densities of tilapia (1, 1.5, and 2/m<sup>2</sup>) Tilapia at the lowest density were not fed, those at the two higher densities were supplied rice bran at 10% of body weight/day

A **fourth** site-specific project was initiated February 12, 1988 in the 21 ponds to be used in baseline experiments. The purpose was to observe the range in variations in the production of tilapia in 21 ponds all given the same treatment. The project was to be terminated at or before the time when preparations were completed for initiation of the baseline experiments.

#### 4 Linkages

##### a USAID Mission

It seemed clear that the excellent relationship established with the Kigali USAID people in the earlier days of the project has in no way diminished. The Mission continues to be supportive in important ways, with an apparent desire to contribute to what they perceive to be a successful and worthwhile project.

##### b Country Agencies

The level of interest and support at all levels within the National University of Rwanda seemed very strong. The Dean of the College of Agronomy remarked how much he appreciated the frank and open relationship with the CRSP project, rating it the most successful of many collaborative projects, and offering congratulations and thanks to those responsible for initiating the project, and for the way in which it was carried out. Similar comments were expressed by various other administrators, including the Rector of the University. The strength of interest and support at the national level was evident in extremely favorable comments made by the Director General of Scientific Research within the Ministry of Education. We were told that the President of Rwanda continues to observe the project with great interest.

The CRSP has productive relationships with various local volunteer groups and with various agencies, including the National Office of Project Planning.

##### c Technical Committee, Executive Council, Program Manager and other CRSP projects

Field personnel in Rwanda feel that problems identified during the first Triennial Review have been eliminated, that misunderstandings and/or disagreements with the TC have been clarified, and that they are presently "very pleased" with current relationships with all entities in the program, both in the U S and in Rwanda. Problems identified related to local needs, such as the installation of a station telephone, the use of a vehicle, and a streamlining of interactions (mostly paper work) with the University, all for which appear scheduled for solutions.

## 5 Summary Comments

In spite of extensive efforts to follow the guidelines and to address all aspects of the program, it is felt that the present report has certain deficiencies. It would seem advantageous if the site visits could precede the annual meeting so that discussion at the annual meeting could eliminate some of the gaps or deficiencies recognized during a preliminary drafting of the report.

It is believed, however, that the Rwandans had full opportunity to express their views. Their remarks were for the most part favorable, or complimentary, and those criticisms offered were constructive in nature. The lack of a strong training program for Rwandans was widely viewed as a serious deficiency. Strong recommendations were made at all levels of the University, as well as within the Ministry of Education and the USAID Mission, that the training of Rwandans be strengthened so that long-term benefits from the program would be ensured. All pledged their support and cooperation toward achieving this goal.

An additional need in the view of the Rwandans is for an expansion of extension activities. While this raises some concern that the primary goals of the project might become obscured, it seemed to be widely recognized that the global aspects of the program must remain preeminent.

While the project is behind schedule, the reasons are understandable. The project is expected to achieve its objectives because it seems to have all of the necessary

elements excellent facilities, strong leadership, a competent, well-motivated staff, strong institutional and host country support, and an exceptionally high level of collaboration between cooperating personnel of the two countries

A3 **THAILAND** - Thailand Department of Fisheries - University of Michigan, University of Hawaii - Michigan State University

Site visit April 3-9, 1988 by Dr Kenneth Chew, Dr Philip Helfrich, and Mr Kenneth Osborn

1 Background

a Cooperating Institutions and Principal Investigators

University of Michigan (lead university) Dr J Diana,  
Dr C Kwei Lin  
Michigan State University Dr C D McNabb, Dr T  
Batterson  
University of Hawaii Dr K Hopkins, Dr J Szyper  
National Inland Fisheries Institute Dr K Jayen

A review of the field operations would tend to indicate that the first, second, and third cycle activities have reached their goals in obtaining the necessary information for the total global concept of the studies. The fourth cycle experiments on pond dynamics were basically a refinement of the previous experimental designs, which addressed pond depth, stocking density, and appropriate N P ratio in organic fertilizer. The results appear to be coming in as expected. Dr Lin appears to be one of the main catalysts in pulling this project together in the host country and has been the key person to work out details related to U S and host country involvements.

One of the key problems appears to be the potential of turnover of Thai staff that have been trained through the CRSP program. Once they have been trained, they are a marketable commodity to be hired away for higher salaries.

Problems and areas of concern surfaced during the site visit but most have apparently been worked out by the

end of 1988 and the PD/A CRSP project seems to be going quite well at the present time

b Logistics

The interaction between the Asian Institute of Technology (AIT), National Inland Fisheries Institute (NIFI) at Kasetsart University, and U S investigators appears to be going as well as expected. There was some question at the beginning when other countries were phased out and activities were incorporated into Thailand, but no major problems developed.

The site that has been selected for the next cycle of studies is at the Bang Sai fishery station at Ayutthaya. The CRSP studies have been sandwiched in with other ongoing research studies conducted by NIFI and there appears to be good cooperation. The facilities and equipment available to the project appear to be very adequate for successful continuation of research into the fourth experimental cycle.

2 Baseline Research

a Schedule and Results

The first three cycles of study have been completed and the fourth experimental cycle is in effect at the present time. Apparently the research is being conducted according to the research design for the site.

b Quality of research

The instrumentation for chemical analysis appears to be in place. The analysis measurement and research techniques show a high level of accuracy and analytical expertise. The people involved with the project are highly qualified and no problems are anticipated.

3 Site Specific Research

There appear to be ancillary site-specific studies being conducted at the experimental site at the Bang Sai Station at

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Ayutthaya and at the AIT. Although these studies were not specifically indicated by the investigators to the EEP members, the coordination and research efforts for the major proposed studies as noted in the fourth experimental cycle appear to be in place and performing well.

#### 4 Linkages

##### a USAID Mission Bangkok

There is excellent interaction between the USAID Mission and on-site personnel involved with the PD/A CRSP program. There exists strong support and cooperation for the program in Thailand.

##### b Country Agencies

During the last EEP review, communication was one of the major questions between the Department of Fisheries and U.S. CRSP personnel. This was reviewed carefully in light of the addition of two extra U.S. universities to the Thailand program (Michigan State University and University of Hawaii). After one year of careful phasing in of these two new universities, the Thailand project of global concept goals and specific studies involving all U.S. and host country institutions are in place and working well.

#### 5 Summary Comments

The efforts made toward the CRSP program in Thailand were highly regarded by Dr. David Delgado (USAID Mission) for its significant contribution to the knowledge of pond dynamics in Thailand. Further, there was good indication of an excellent working relationship between Dr. C. K. Lin (U of Michigan), Dr. Kitjar Jaiyen (Thai Dept. of Fisheries), and Dr. Delgado. Further, the interaction with Dr. Peter Edwards of the AIT appears to be good. The overall regard of Dr. Lin in Thailand is very high, as this surfaced at most of the meetings attended related to the PD/A CRSP. Dr. Lin is considered the main liaison person for the U.S. and host country institutions in Thailand.

During the site visit, there was some indication that the USAID Mission would be involved with a "buy-in" to the CRSP program to extend activities toward extension and training of local biologists and farmers. This would be good if it materializes.

There is still a strong feeling by the host country and the USAID Mission that there needs to be an opportunity to apply the CRSP experimental results to practical fish production through extension service. How this can be achieved should be brought up at the BOD or TC meetings in the future.

Further, there is a feeling by the host country scientists that analysis of experimental data can be done in the field where the experiments are done and the results of each experimental cycle can be prepared jointly within a reasonable period of time upon concluding the experiment. How this can reasonably be done should be discussed at the earliest opportunity.

The fact that a new post-doctorate fellow position was filled in September 1980 by Dr. Christopher Knud-Hanson through Michigan State University has been very helpful to the host country activities. This, complemented by the fact that the University of Hawaii will be having Dr. Kevin Hopkins, the new PI, spend up to three months each year in the field will be of much help to the overall program.

## B Terminated Country Projects

### B1 INDONESIA - Bogor Agricultural University (Indonesia) Michigan State University

Site visit April 9-13, 1988, by Dr. Herminio Rabanal, Dr. Philip Helfrich, and Mr. Kenneth Osborn

#### 1 Background

##### a Project Personnel

Host Country Personnel Met During Visit  
Dr. M. Eidman, Formerly Host Country Principal Investigator

Mr K Sumantadinata, Formerly Host Country Research Associate  
Mr D Dana, Formerly Research Associate  
Ms E Salamah, Formerly Host Country Technician, CRSP Project  
Mr D Yusadi, Formerly Data Recorder and Computer Operator, CRSP Project, Bogor  
Ms Y Hadirosenyani, Formerly Host Country Staff  
Mr W Gumawan, Formerly Host Country Staff  
U S Research Personnel, None, as the Project terminated in August 1987

b Logistics

Facilities consisting of experimental ponds, a water supply system and buildings for laboratories, offices, and a wet laboratory have been provided by the government at the site. A setup provided for hatching of freshwater fish was also made available. The project assisted in funding an additional pump system for the water supply. While the experimental site is located at Babakan Village, the new main campus of most of the facilities of the Bogor Agricultural University are in the process of completion only about two kilometers away at Darmaga Village. The team was informed that the faculty of Fisheries and the faculty of Veterinary Science, and perhaps other faculty, will be housed in this Darmaga campus once it is completed. This is a distinct advantage to the pond research project as it will be accessible to specialists not only in fisheries but other related faculties.

2 Baseline Research

This PD/A CRSP research site started operation in September 1983 and terminated in August 1987. During this period, this research site has kept on schedule with its assigned research using tilapia as experimental fish and monitoring the various parameters required for the study. During the period, cycles 1, 2 and 3 of the Research Plan were completed as scheduled. There is one modification in that at a later stage *Tilapia nilotica* was replaced by *Clarias batrachus*, the former species being of low priority while catfish is a valued species in the country.

The participants in the host country found the research techniques to be good. They were particularly happy over the in-depth knowledge of the assigned expatriate RA in matters of water analysis. The research participants at this site submitted the completed data on time. However, at the time of the visit, they regretted that there had been no feedback on the analyzed data from this project as well as data from other project sites from the DAST of the PD/A CRSP.

### 3 Site Specific Research

Because of some divergence in research priority of the country to that of the global goal, the Indonesia project had to undertake a number of site specific research subprojects. As mentioned above, the work on Clarias was pursued, especially seed production, because of public demand. Additional work was done on minimizing the effects of carbon deficiency in the pond water supply due to excessive leaching, on nitrate and ammonia depletion in ponds fertilized by chicken manure, and on developing Clarias broodstock under experimental pond conditions, among others.

There was no preplanned schedule to pursue these specific research projects, but they were done with the available time of the research staff. The quality of research techniques employed was dependent on the equipment available, but the acquisitions from the CRSP program helped upgrade the quality of research techniques. Being a diversified rather than unified research effort, there was no systematic data collection and management of the site-specific studies.

### 4 Linkages

#### a USAID Mission

There is no direct linkage of this research project with that of USAID Mission in the country. However, the U.S. lead agency (Michigan State University) staff assigned to the project always made it a point to touch base and to constantly consult as necessary with the country USAID Mission and particularly with the Agriculture Development Officer who covers fisheries in this Mission. There has

been no direct support by the USAID Mission and in some cases the concerned officers in the Mission even had the opinion that the objectives of this project were of low priority so that the Mission would rather carry out other projects involving priority areas under the country program

b Country Agencies

Fisheries research agencies of the country such as the Research Coordinating Center for Fisheries (RCCF) of the Agency for Agricultural Research and Development (AARD), and the Directorate General of Fisheries (DGF) were aware of the presence of the foreign aquaculture specialists in the country and invited them as resource persons in some of their activities. However, on a project-to-project basis, there were no established linkages nor cooperative activities. It appears that competitive rivalries have always existed among local agencies in similar fields so the involvement of the local host country agencies in fisheries has kept away closer linkages.

5 Summary Comments

The operation of the project has been smooth and satisfactory during its existence. Coordination provided by the host country PI and the U S lead agency PI was harmonious during the project duration. This resulted in achieving the required schedules of the research plan on time. There were minor problems in the assignment of personnel at some stages but these were subsequently resolved. It was surmised that there could have been more exposure of host country participants to training, especially abroad, as well as to scientific meetings so that the counterpart participant could take over and carry on the work and write the appropriate reports after the foreign agency staff left the project.

It is unfortunate that there is no active linkage of this research project with the USAID Mission in the country considering that the project is hard pressed for funds. Under more favorable circumstances, the Aid Mission could have contributed even a small amount of funds at strategic periods when this was most needed. However, the lack of

understanding or indifference of officers concerned in the Mission has prevented this from happening

B2 PANAMA - No information available on this country's program as it was terminated and no site visit could be conducted

B3 PHILIPPINES University of the Philippines in the Visayas  
University of Hawaii

Site Visit April 14-16, 1988, by Dr Philip Helfrich, Mr Kenneth Osborn, and Dr Hermunio Rabanal

1 Background

a Project Personnel

Host Country Personnel

Dr J Carreon, Formerly Host Country Principal Investigator  
(by correspondence only)

Dr R Fortes, Formerly Host Country Research Associate

Ms Z Feliciano, Formerly Host Country Chemical Engineer

Ms E Pudadera, Formerly Host Country Research Assistant

Ms C Gempis, Formerly Host Country Research Assistant

Ms R Janeo, Formerly Host Country Laboratory Technician

Ms J Jaspe, Formerly Host Country General Staff

U S Lead Agency Personnel, None, as the Project terminated in March 1987

b Logistics

The host country agency in the University of the Philippines in the Visayas (UPV) established the Brackishwater Aquaculture Center at Leganes, Iloilo Province, Philippines. When the PD/A CRSP Research Program was initiated in the country with the UPV as host agency, the funds required for the research were provided in this center. The necessary counterparts, the host country PI, RA and research assistants, as well as general staff were assigned. These local staff worked and collaborated with the U S lead agency staff from the University of Hawaii. The ponds for use were adequate, and this was one of two sites in the global project which uses brackish water (the other was Panama). The local staff were adequate and were further

augmented by graduate students from UPV. There was an existing biological and chemical laboratory and a wet laboratory in the center plus facilities for hatchery work if required. Electrical power was available and additional advice from specialists in related disciplines in the University were provided as needed.

## 2 Baseline Research

The country participants interviewed all claimed that the collection and compilation of data for the baseline research plan was done in a timely schedule. There was some resistance at the beginning to adopt completely the suggested protocol as there was a desire to modify the protocol to adapt to local conditions. However, this was subsequently reconciled.

There were adequately trained staff as well as those who could easily be trained to perform the work required. With only brief hands-on training, the host country participants easily performed the sampling and analysis required consistent with work plan specifications. This was further reinforced by graduate students as well as undergraduates whose contributions were helpful in the work. The quality of research technique recommended was considered good, but some physical problems like maintenance of pond depth and some instrumental defects occurred (e.g., the equipment for nitrogen and total phosphorus analysis). There was specialization of the work load among the involved staff even at the beginning of the research.

While raw data submission was on time, its transmission to the Central Data Manager could not be verified, this being the sole prerogative of the U.S. PI, and neither was there any feedback from the Manager for any analyzed or synthesized data for this project.

At a later stage, however, when conflict of personalities started between the U.S. PI and RA on the one hand, and the host country RA on the other, compilation and submission of data bogged down with each group blaming the other for delays and hiding of collected data. This was a considerable handicap to the smooth functioning of the project up to its termination in March 1987.

### 3 Site-specific Research

Of completed experiments in the CRSP ponds, at least six are classified under special projects. These include the following:

- 1) Sorbed and soil solution P in relation to P fertilization in brackish water ponds
- 2) Studies on the application of teaseed cake for the selective elimination of finfishes in shrimp ponds
- 3) The effect of paddlewheel aeration on ammonia and carbon dioxide removal in intensive pond culture
- 4) The water quality dynamics in brackishwater shrimp ponds with artificial aeration and circulation
- 5) The feeding rhythm of milkfish and prawn
- 6) Effect of water exchange rates on nutrient levels and productivity of brackishwater ponds

These special projects were not performed according to preplanned schedules, but they were dependent on the available facilities and staff to work on them. While not directly contributing to the CRSP data, all of them are still tangentially relevant to the PD/A CRSP research objective. Research procedures used in the CRSP projects were likewise adopted with these special projects. Data and results obtained were written by the involved researchers and contributed to the regional fisheries meeting or sent to appropriate journals for publication.

### 4 Linkages

#### a USAID Country Mission

The PD/A CRSP participants' relationship to the USAID Mission can be considered neutral with each one conducting its affairs in aquaculture independent of the other. However, the CRSP participants made it a point to inform the USAID Mission of their activities and any CRSP personnel coming

into the country always touched base with the Mission. There were suggestions for possible additional support from the AID Mission, in addition to available CRSP funds, but the Mission has taken the posture that its thrust in the country is somewhat different from that of the CRSP. It is noted, however, that the Aid Mission officers in the country undergo frequent changes and it is always advisable to submit requests for AID projects including that for the PD/A CRSP.

b Country Agencies

The participants of this research project have established contacts with other country agencies involved in fisheries and related fields, but these were limited mainly to informational aspects. The Philippine Council of Agricultural Research and Resources Development (PCARRD), now renamed Philippine Council for Aquaculture and Marine Research and Development, (PCAMRD), the International Center for Living Aquatic Resources Management (ICLARM), and the Southeast Asian Fisheries Development Center/Aquaculture Department (SEAFDEC/AQD) are frequently consulted by participants of this project. However, there is no direct collaboration in actual research as each one carries out its own research independently.

5 Summary Comments

The PD/A CRSP project in the Philippines started off very smoothly and successfully. There was harmonious cooperation between the U.S. participants and the host country participants and the initial cycles were quickly completed and submitted on schedule. However, toward the middle and later stages of this project, a personal conflict developed between the host country RA and the U.S. RA. This produced adverse effects towards the termination of the project. It is gratifying, however, that cycles 1, 2 and 3 were successfully completed and the data were sent to the Central Analysis Unit for processing. Since the projects had to be terminated for budgetary reasons, the problem of personnel conflicts have become academic.

## APPENDIX A

### CRITERIA FOR PROJECT REVIEWS

- A What is the present status of the project with respect to
- 1 Accomplishment of the baseline research plan
    - staying on schedule
    - quality of research techniques (e g , sampling and analysis) and consistency with work plan specifications
    - data management (i e , record keeping and data analysis)
  - 2 Accomplishment of site-specific research objectives
    - schedule
    - quality of research techniques
    - data management
  - 3 Reporting and dissemination of information
  - 4 Relationship between U S Principal Investigator/contracting institution and field personnel
  - 5 Relationship between U S and host country participants (e g , training and institution building activities)
  - 6 Relationship between CRSP participants (U S and Host Country) and USAID Mission staff, CRSP participants and representatives of other in-country programs and projects
  - 7 Relationship between project personnel and program management (i e , the Program Management Office, Board of Directors and Technical Committee)
  - 8 Benefits to the U S institution
  - 9 Contribution to program goals
- B What is the potential for project achievement relative to the above nine points?



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Oregon  
State  
University

February 28, 1989

Dr. Kenneth K. Chew  
 School of Fisheries, WH-10  
 University of Washington  
 Seattle, WA 98195

Dear Ken:

Following are our comments on the CRSP responses to the recommendations made by the External Evaluation Panel (EEP) in their report dated March 22, 1985:

**RECOMMENDATION:**

At least two members be added to the Executive Council from participating Host Country Institutions.

**CRSP RESPONSE AND COMMENT:**

The CRSP response to the EEP report was that the Board of Directors (BOD) (formerly the Executive Council) elected not to modify their existing structure for fear the change would contradict the spirit of the Memorandum of Understanding between Auburn University, the University of California, Davis, and the Consortium for International Fisheries and Aquaculture Development (CIFAD). The BOD also was concerned that the financial and logistical implications of the change would reduce opportunities for the BOD to work closely with the Management Entity (ME) to act on policy and funding matters.

Comment: The reasons for not altering the structure of the BOD are still valid. Since the EEP report was filed, the CRSP has endured budget reductions of 18% and 13.5%. As a consequence, three of the six host country projects have been eliminated. Expansion of the BOD to include two members from participating Host Country Institutions is not advisable or financially possible at this time.

**RECOMMENDATION:**

The Technical Advisory Committee be strengthened by adding two members with expertise in some of the following fields: data processing/management, pond ecosystems, brackish water ecosystems, shrimp pond aquaculture.

**CRSP RESPONSE AND COMMENT:**

The CRSP response was that it would replace the Technical Advisory Committee with a Technical Committee composed of all U.S. and host country Principal Investigators plus three at-large members

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appointed by the BOD Subcommittees on Work Plans, Technical Progress, Budgets, and Materials and Methods would be organized from the Technical Committee. These subcommittees would prepare materials for consideration by the assembled Technical Committee at its annual meeting. The Technical Committee would make recommendations to the BOD on virtually all aspects of CRSP technical activities.

Comment. The Technical Committee and the four subcommittees have been organized and are functioning as proposed. Also, the three members of the former Technical Advisory Committee were appointed to the Technical Committee as at-large members. However, due to financial constraints placed on the ME, the BOD elected at their October 9, 1987 meeting to use the at-large members in an ad hoc role. The Program Manager from USAID/Washington concurred with this action. Funds are not available at this time to add two at-large members to the Technical Committee. We have added expertise in soils (Dr. Claude Boyd), brackish water ecosystems (Dr. Bryan Duncan), pond ecosystems (Dr. James Szyper), shrimp pond aquaculture (Dr. David Teichert-Coddington), and data processing and management (Dr. Kevin Hopkins). We have also added new concerns in soils and composting covered by Drs. Tom Popma and Claude Boyd. These new additions have greatly strengthened our program and fulfilled the recommendation made by the EEP.

**RECOMMENDATION:**

The Research Team be formed as described in the proposal and that it be made a functional element of the program.

**CRSP RESPONSE AND COMMENT:**

The CRSP response was satisfactory and needs no further comment.

**RECOMMENDATION:**

The administrative chain be abbreviated and communications with field projects be improved to permit quicker technical backstopping.

**CRSP RESPONSE AND COMMENT:**

The CRSP response was satisfactory and needs no further comment.

**RECOMMENDATION:**

The research planning schedule be amended from an annual to a biennial exercise to allow thorough analysis of results before planning subsequent research.

**CRSP RESPONSE AND COMMENT:**

The CRSP response was to agree to shift to a biennial research planning schedule, with the Technical Committee meeting on an annual basis. Work plans would only be finalized in alternate years.

Comment These schedules have been accomplished For example, the current CRSP Work Plan is for the period of September 1, 1987 to August 31, 1989. A meeting of the Technical Committee was held in October, 1988, and another meeting is planned for May, 1989 Our normal procedure is for the Technical Committee to meet at least once each year, usually in conjunction with the CRSP annual meeting.

RECOMMENDATION:

Peripheral activities (extension, demonstration, training) be restricted and unauthorized deviations from core research be prevented to safeguard the central research objectives of the program.

CRSP RESPONSE AND COMMENT:

The CRSP response was satisfactory and needs no further comment.

RECOMMENDATION:

The Central Data Management System be made operational on an urgent basis and the work of integration of data and development of theoretical models of pond productivity be initiated immediately.

CRSP RESPONSE AND COMMENT:

The CRSP response was that the Central Data Management System was operational, that the ME had added a Data Base Manager to its staff, and that a Data Synthesis Team had been appointed.

Comment: The actions described in the CRSP response have all taken place. In addition, the problems of refining templates and receiving and verifying data from seven CRSP projects in six countries have been overcome. As of May, 1988, all of the CRSP data available from field stations have been received, verified, and made available to the Data Synthesis Team. Management of CRSP data is kept current on a daily basis. The Data Synthesis Team published its first conceptual model of an aquaculture pond as part the Pond Dynamics/Aquaculture CRSP Continuation Plan in May, 1987. The Fourth CRSP Work Plan outlines procedures for the development of descriptive and mechanistic models to simulate pond processes. Plans and a timetable for the drafting of a manual of pond management practices also are presented. The gap between the accumulation of field data and the interpretation of results has been narrowed significantly.

RECOMMENDATION:

The Research Team reexamine and amend where necessary standard methods for chlorophyll determination, wind measurement and analysis of organic manures.

## CRSP RESPONSE AND COMMENT:

The CRSP responded that the recently issued (July 1985) Third Work Plan addressed these and other methods, and that the newly appointed Materials and Methods Subcommittee of the Technical Committee was responsible for continuous review of research methodology.

Comment: At the meeting of the Technical Committee in January, 1988, further review of research methodology resulted in the following changes: Measurements to be omitted were: Maximum and minimum temperature at the top and bottom of ponds on a weekly basis, total hardness, nitrate-nitrite nitrogen, orthophosphate, chlorophyll b and c, and salinity. Measurements to be added were: Dark bottle respiration, calculated whole-pond respiration, corrected and uncorrected chlorophyll a, suspended solids, total volatile solids, chemical oxygen demand, seepage rate, watershed area, and diel studies (intensive oxygen sampling). Diel study data are taken six times daily and include: Cumulative wind speed and solar radiation, and measurements of pH, alkalinity, temperature, and dissolved oxygen at the top, mid level, and bottom of each pond. In addition, the following Pond Dynamics/Aquaculture Collaborative Research Data Report was issued August 20, 1987, and gives details of standardized methodology for CRSP research:

Egna, H.S., N. Brown, and M. Leslie (eds.) 1987. Volume one. General reference: site descriptions, materials and methods for the global experiment. Pond Dynamics/Aquacult. Collabor. Res. Data Rep., Program Manage. Off., Off. Inter. Agric., Oreg. State Univ., Corvallis. 84 p.

## RECOMMENDATION:

The Research Team specify standard methods for chemical analyses of brackish water and ensure additional documentation of soil chemistry and benthic productivity in both freshwater and brackish water ponds.

## CRSP RESPONSE AND COMMENT:

The CRSP response and current comment for this recommendation is the same as that given for the previous recommendation. We continue to use the Standard Methods for the Examination of Water and Waste Water (APHA most recent addition) for methodology and experimental procedures.

## RECOMMENDATION.

The Research Team ensure uniformity of the test species *Tilapia nilotica* among projects by identifying a common source and verifying genetic makeup using standardized electrophoretic tests.

## CRSP RESPONSE AND COMMENT:

The CRSP response was that a study of the genetic diversity among Tilapia nilotica stocks used in CRSP research was planned as part of the U.S. Research Component.

Comment: A research contract to study the genetic diversity of tilapia used at the seven CRSP research projects was awarded to scientists at Auburn University. In their study, 38 enzyme loci were examined in seven populations of Oreochromis niloticus (Tilapia nilotica) using starch-gel electrophoresis. The researchers found little genetic divergence among the populations, and there was a high level of genetic variability within populations. Reference to their summary is:

Abdelhamid, A.A., K.G. Norgren, R.O. Smitherman, and R.A. Dunham. 1988. Genetic homogeneity of Oreochromis niloticus (Tilapia nilotica) in Africa, Central America, and Southeast Asia. PD/A CRSP, Fifth Admin. Rep. 1987, Office Inter. Res. Devel., Oreg. State Univ., Corvallis. 49 p., + Append.

## RECOMMENDATION:

The projects retain full-time Host Country technicians to assist with water analyses where counterpart staff are not qualified or personnel turnover rate is problematical.

## CRSP RESPONSE AND COMMENT:

The CRSP response was satisfactory and needs no further comment.

## RECOMMENDATION:

The Management Entity initiate consultations with USAID (Washington, D.C.) and USAID Country Missions to encourage provision of additional logistic support to U.S. field staff and to ensure continued commitment to ongoing projects by USAID Missions as Mission staff personnel change.

## CRSP RESPONSE AND COMMENT:

The CRSP response indicated that the ME would pledge to continue to work closely with USAID (Washington) to prevent problems from arising, and to work diligently to resolve problems that do arise.

Comment: Since the EEP report was filed, the PD/A CRSP has received a \$30,000 buy-in from the USAID Mission in Thailand. The PD/A CRSP was recently (January 1989) awarded a Basic Ordering Agreement (BOA) to facilitate the placement of delivery orders by USAID Missions for specific requirements related to the basic CRSP research grant. This BOA will provide a mechanism for the CRSP to respond quickly and directly to Mission needs, and should foster cooperative relations between the two entities.

## RECOMMENDATION:

The Management Entity establish a Technical Information Service (titles, abstracts, information searches) for field projects to overcome problems of isolation and to enhance the professional expertise and development of field staff.

## CRSP RESPONSE AND COMMENT:

The CRSP response was satisfactory and needs no further comment.

## RECOMMENDATION:

Increased interaction among field projects be encouraged through site visits and/or workshops under the guidance of the Technical Advisory Committee.

## CRSP RESPONSE AND COMMENT:

The CRSP response was to recognize that this is an excellent recommendation, but funding constraints prevent it from being carried out.

Comment: When the budget cuts of 1986 and 1987 forced the PD/A CRSP to reduce its research effort from seven projects in six countries to three projects in three countries, closer interactions among field projects became essential. Currently, CRSP investigators from the University of Michigan, Michigan State University, and the University of Hawaii interact in the planning for and conduct of research with Host Country representatives in Thailand. Likewise, Auburn University, Oregon State University, and the University of Arkansas at Pine Bluff work jointly with Host Country staffs in Rwanda. Similar relations exist between Auburn University and the University of Hawaii in their relations with their Honduran counterparts. These interactions are shared at CRSP annual meetings and at meetings of the Technical Committee. The ME office has weekly telephone contact with the U.S. Principal Investigators; and monthly contact via letter/FAX with all overseas U.S. staff.

## RECOMMENDATION:

USAID consider a modest increase in budget to: a) strengthen collaborative research at U.S. universities, b) increase input by U.S. Principal Investigators in support of field projects, c) hire laboratory technicians for chemical analyses, d) strengthen the two apparently underfunded projects in Honduras and Panama, e) fund interproject workshops, and f) provide a technical information service.

## CRSP RESPONSE AND COMMENT:

With the exception of eliminating Panama from the CRSP response, there are no further comments.

PD-ABR-545

**TITLE XII**  
**COLLABORATIVE RESEARCH SUPPORT PROGRAM**  
**POND DYNAMICS/AQUACULTURE**

Management Review



**Pond Dynamics/Aquaculture CRSP Management Entity**  
**Office of International Research and Development**  
**Oregon State University, Snell Hall 400**  
**Corvallis, Oregon 97331-1641**

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ADMINISTRATIVE MANAGEMENT REVIEW  
POND DYNAMICS AQUACULTURE CRSP - MEETING AT  
KONA, HAWAII, JANUARY 11-15, 1988

Review Team (S&T/AGR)

Richard Neal - (S&T/AGR) AID Member

William Fred Johnson - BIFAD Staff Member

I Background

A.I.D. is required to conduct periodical administrative management reviews of its contract/grant programs. The last management review of the Pond Dynamics/Aquaculture CRSP was conducted in March 1985 by representatives of A.I.D. (Tejpal Gill) and of BIFAD (W. Fred Johnson) and a consultant. That review was in preparation for the first Triennial Review for a proposed three-year extension of the CRSP. The review, together with the evaluation by the External Evaluation Panel (EEP) of the CRSP, provided guidance for the Triennial Review conducted jointly by the JCARD CRSP Panel and A.I.D.'s Agriculture Sector Council Sub-Committee.

The joint group recommended and BIFAD concurred in a three-year extension of the CRSP. A.I.D. approved this action and authorized funding for the period 1986-1989. The current administrative management review, thus, is a first step in the procedure of reviews and evaluations for the second proposed three-year extension of the Aquaculture CRSP (1989-1992). A scope of work for this management review is attached. Particular issues that were identified for review are:

- Effect of the reorganized plan of operation (3 sites) on the global objectives of the CRSP.
- Comprehension by researchers of the global program concept and the pursuit of the global objectives in research being conducted

Organization, functions, and responsibilities of the various entities in the CRSP, (the Management Entity (ME); The Board, the Technical Committee (TC), and the EEP) vis-a-vis the CRSP Guidelines

An additional prominent and critical issue that faces the entire CRSP is what site should be selected as an alternative to the Panama site lost when the U.S. CRSP team was forced to leave Panama, as required of U.S. assistance personnel by the Panamanian government (December, 1987).

The balance of the current review process will take place in 1988. The EEP of the CRSP is currently conducting its evaluation which will include visits to all field sites. A joint review by the newly organized BIFAD/JCARD Sub-Committee on Agricultural Research and Technology Transfer and the A.I.D. Agricultural Sector Council Sub-Committee will be scheduled for the Fall of 1988.

## II. Previous Administrative Management Review

A brief summary of the observations and suggestions made by the last administrative management review team is presented here to provide some orientation concerning the history of this CRSP.

The team noted satisfactory progress and a lack of serious administrative/management problems. Further it noted the CRSP ME had been responsive to CRSP Guidelines and had taken steps to conform to the latest Guidelines where differences were apparent. More specific recommendations were made by the review team on the following topics:

- (1) modification of the structure and functions of the Board of Directors,
- (2) replacement of the technical advisory committee with a broader based technical committee with an expanded role,
- (3) improvement of the annual work plan and calendar of events,
- (4) addition of a full-time deputy to the office of the ME,
- (5) clarification of the goal of the CRSP,
- (6) identification in greater detail of the uses of university matching funds, and
- (7) strengthening of the U.S. research component

In the opinion of the current review team, the CRSP has responded appropriately to these recommendations with two exceptions. The exceptions are, firstly, the Board of Directors has not been enlarged as suggested, and secondly the U.S. research has become the analytical arm of the CRSP rather than a separate biological or physical research component as suggested. In view of severe budgetary reductions imposed on the CRSP, it is the opinion of this team that the ME and Board have acted responsibly in these matters and that decisions made have been beneficial to the goals of the CRSP.

### III Observations and Suggestions

#### A Reorganization of the Aquaculture CRSP

Because of severe budget cuts in FY 1986 and 1987, the Aquaculture CRSP has had to drastically cut back its operations. Proposals for the reorganization were submitted to two meetings of the joint JCARD Panel on CRSPs and the Agricultural Sector Council Sub-Committee the first in December 1986, and the second at the end of January 1987. The revised plan submitted in January 1987 was accepted

This plan called for reduction in the number of country sites from six (Thailand, the Philippines, Indonesia, Rwanda, Honduras, and Panama) to three (Panama, Thailand, and Rwanda). This maintained a CRSP presence in each of the three continents originally selected. The research program was successfully modified to reflect these changes without changing the objectives or research emphasis of the program.

Several additional concerns must be addressed by the reorganized CRSP in 1988. In November, 1987 CRSP researchers in Panama were ordered by A I D to leave the country because of political strains between the U S and Panama. Thus, research at one of three sites was discontinued. The program in Thailand involving three institutions has not yet fully integrated the activities of Michigan State and Hawaii. A new Director, Dr. Howard Horton, was appointed during 1987. Further data analysis and synthesis of results of the global program are far behind schedule. The review team was alerted early on to these major problems facing the CRSP.

#### B. The Global Plan

On the basis of presentations made by field researchers, at the meeting, a serious lack of focus on the global plan became apparent. Their contributions to the global research were not communicated, giving the impression of three separate research activities. The first stage of the CRSP was designed to collect standardized data on variables affecting the dynamics of ponds treated with standardized inputs, and to measure results in terms of the influence on the dynamics of the pond. This first phase has been completed, or is nearly completed. The data collected are being analyzed in the U S. by a special team.

Research activities have entered the second phase, following an agreed set of research priority foci, although some discretion in the research to be undertaken at each country site is allowed as long as the research is focused on the global objective. Herein lies a critical problem. Some research apparently relates more to the needs of the country than to the global objectives of the CRSP.

While some site-specific research may be necessary to keep host countries and USAID Missions satisfied, the majority of research activity must be global in nature (generally agreed in this CRSP to be at least 75%) New research activities have become highly site specific, especially in Rwanda and Panama where there is a heavy orientation toward Research activities with local applications There was a concensus of the review team, the Board, and the EEP that responsibility for correcting the direction of research rests squarely on the shoulders of the ME, i.e. the Director. The ME must assure that the global focus is maintained. Of course, the ME should use the TC, the Board, and the EEP to assist with this task.

Individual and collective meetings with the Director, the Board, the EEP and the TC enabled the review team to clarify roles and to emphasize the need to adhere to the global plan. The evaluation by the EEP, which is just getting underway, will identify specific scientific weaknesses and make recommendations in this respect. The EEP, the TC, and the ME will need to continue to relate research in the three countries to aquaculture in other countries with similar environments around the globe. This will be the litmus test of their program

#### C Management Entity and Board of Directors

A new ME team (Director and Assistant Director) has taken over during the past year The Director has been on the job for less than a year, contributing 50% of his time to this position. The Director has no previous CRSP experience. It is understandable that the new management team has not yet had adequate experience to absorb the complexities of a world-wide program that is undergoing tremendous adjustment and is entering a new research phase. Therefore, this review is timely, in that it provides an opportunity for orientation of the new team, not only with regard to its responsibilities but also its authority, and the role and responsibilities of the various other CRSP entities.

We found the Board members fully cognizant of the global concept of the CRSP, and aware of the management problems facing the CRSP and the need to focus the research on the global objectives. However, the Board had been unsure of its authority with the ME. A joint meeting with the Board and ME was held to clarify their respective functions and responsibilities The review team observed that an aggressive leadership role in management of the CRSP on the part of the ME is essential and critical for assuring that country research be maintained with the perspective of the Global Plan, and that this would require that the functions and roles of the EEP, the TC, and the Board be recognized and fully utilized

It is recommended that the Director play a more active role in directing this CRSP. The CRSP is probably facing its most critical test of survival during this triennial review with funding reductions, reorganization, loss of a critical research site, data analysis and new leadership. Without strong, positive leadership to resolve problems quickly and effectively this CRSP will compare unfavorably with other programs. The Board should provide its encouragement and support to the ME in the rapid resolution of critical issues. We were impressed with the resoluteness of the Board to do this.

#### D. Coordination of Research in Thailand

When this CRSP was reorganized to work in three countries rather than six, the decision was made to continue the participation of all five U.S. universities rather than reducing the number of U.S. participants. The success of the reorganization to conform to budget cuts is dependent upon improved allocation and uses of funds. The crucial test of the decision regarding U.S. participants is in Thailand where Michigan, and Michigan State Universities and the University of Hawaii plan to conduct a joint, cooperative program to address CRSP goals.

The integration of this project has not been without frustration and difficulties; however, the CRSP now seems to be in a position, with University of Michigan leadership and coordination to begin a fully coordinated and integrated, single project in Thailand. The review team considers that the need for careful integration and coordination of these research activities warrants personal attention and a visit to Thailand by the CRSP Director, as well as by the Board Chairman. The EEP is expected to look carefully at the scientific cohesiveness of this project and at its contribution to the global objectives.

#### E. Publications and Data Analysis

A measure of success of any research project is its contribution of information on scientific achievements to the scientific community and country users through technical and scientific publications and other means. The team was pleased to note a flow of scientific and technical publications from this CRSP and was further pleased with the technical quality and presentation of results and findings. The ME should be commended for its action in this area.

A related issue is the compilation of data in a central data base and subsequent analysis and synthesis of results of the total global program. This process was noted to be seriously lagging by the EEP in 1985. Although all components are now in place and data are

being analyzed, the process is still perceived to be behind schedule by at least a year. The management review team believes that this represents a management problem of importance for the ME. As originally envisioned, the research was to be planned utilizing results of the analysis of the integrated global program. At the end of the sixth year of the project, no such feedback has yet been possible. The review team recommends that the CRSP Director give his personal attention to the scheduling and progress of data submission by P.I.'s and to the schedule and progress of analysis by the special team. If found necessary by the Board and the ME, increased funding should be allocated to the task of analysis and synthesis of results. Sustained funding of the program is dependent upon demonstration that this is a global program and that results of value are being produced.

#### F. External Evaluation Panel

The EEP has been brought to its full strength of three persons by the addition of Dr. Herminio Rabanal. Dr. Kenneth Chew of the University of Washington agreed to serve as the Chairman. The third member of the EEP is Dr. Homer Buck of the University of Illinois.

A question arose about the utility of visits by the EEP and Director to country sites that have been dropped. The review team recommended that those sites be visited. The rationale is the importance of those countries in the global aquaculture picture, as related to the global plan. Such visits should be viewed as coordination to capitalize on previous CRSP investments in those countries by maintaining scientific linkages with them. They may well opt for a continued research relationship and will be candidates as future users of research results. Maintaining and promoting a continued interest by USAID Missions in those countries is also important. Furthermore, such visits will be excellent means for orientation of the new CRSP Director.

#### IV. Overview

By its nature, a review of this type focuses on problems and this particular review occurred at a time of stress and change for this particular CRSP.

The review team would be negligent if it did not mention the overall strengths and positive features of this CRSP. The long-range plan is sound and well-conceived, and the strategy for execution of the plan is satisfactory. Host country relationships have been excellent and host country participation is good. Although there has been departures from the global plan, the quality and execution of research have been excellent. The team was impressed at the enthusiasm and eagerness shown by P.I.'s and other CRSP participants present at the annual meeting.

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Although funding has reduced the effectiveness and scope of activities of the CRSP, particularly the U.S portion of the research, a viable operation is still feasible. The ME has managed finances well considering the severe constraints forced upon the CRSP. Any further reductions would jeopardize the goals of the CRSP. The CRSP ME and P.I 's should continue to seek AID Mission support to make the CRSP more effective.

All CRSP participants should bear in mind the original justification and purposes of this CRSP. Evaluations will continue to be based upon how well the original goals and objectives are being achieved. The ultimate responsibility for all aspects of program performance lies with the ME. Even when the ME has delegated responsibilities, the contractual responsibilities legally lie with Oregon State University and the ME. The team sees a need for stronger guidance of the CRSP by the ME and for closer adherence to the original goals of the program. Work plans for Phase IV should be updated and finalized with this team's recommendations in mind.

The team's overall analysis is that this CRSP is a strong program caught at a weak moment. The overall progress and accomplishments have been good. We see no reason that the program cannot overcome temporary snags that it is now facing and continue its important and unique contribution to aquaculture as originally planned.

**TITLE XII**  
**COLLABORATIVE RESEARCH SUPPORT PROGRAM**

**POND DYNAMICS/AQUACULTURE**

CRSP Response



**Pond Dynamics/Aquaculture CRSP Management Entity**  
**Office of International Research and Development**  
**Oregon State University, Snell Hall 400**  
**Corvallis, Oregon 97331-1641**

**CRSP RESPONSE TO RECOMMENDATIONS OF THE  
EXTERNAL EVALUATION PANEL REPORT  
AND THE USAID ADMINISTRATIVE MANAGEMENT REVIEW**

Both the External Evaluation and the USAID Management Review of the PD/A CRSP were conducted in a constructive and highly professional manner. This is the second time that the PD/A CRSP has been evaluated and reviewed since the program was initiated in September 1982. The recommendations from these two groups help the Management Entity and the CRSP research staff to focus more clearly on the strengths and weaknesses of our program as we continue to develop basic understandings and models for improving the efficiency of pond aquaculture systems.

The purpose of this section is to describe the action taken or anticipated by the CRSP in response to the specific recommendations of the External Evaluation Panel (EEP) and the USAID Management Review (MR). Although the EEP and the MR address the performance of the CRSP organization, it is implicit that the CRSP is in fact a partnership between USAID, U.S. universities, and host country institutions. The responses provided in this section are those that the CRSP can address unilaterally. However, both documents contain recommendations that transcend the CRSP organization and must also be addressed by USAID.

Response to the Recommendations of the External Evaluation Panel

The recommendations of the EEP may be found on page 3 of the EEP Report. Each of these recommendations is repeated below along with the action taken or intended by the CRSP in response to the recommendation.

**RECOMMENDATION.**

*1 That site visits by the External Evaluation Panel members be made prior to the annual meeting so that discussions at the annual meeting can eliminate some of the deficiencies recognized during a preliminary drafting of the EEP report.*

**CRSP RESPONSE**

This recommendation can easily be accommodated by the CRSP Management Entity. Our plan was to have the EEP attend a CRSP annual meeting in January 1988 to become acquainted with the program organization,

goals, activities, and personnel before they embarked on site visits to the projects in the host countries. Hopefully, this would give them an indication of what to expect and whom to interact with during their review assignments. Following their project site visits, we would like to have brought the EEP members together a second time to interact with our program personnel at the meeting of our Technical Committee in October 1988 or at our PD/A CRSP annual meeting in May 1989. As identified earlier in the EEP report, ME budget constraints eliminated this possibility.

If the EEP members are restricted to a single meeting with the collective CRSP personnel, we agree that such a meeting should take place after they have visited the research projects.

## RECOMMENDATION

*2 That the laboratory personnel (chemists, computer technicians, etc ) in host countries be placed on permanent status or provided adequate competitive salaries in order to minimize turnovers and to increase stability, continuity, and integrity of the projects*

## CRSP RESPONSE

The turnover of key laboratory personnel continues to be a serious problem facing this and other CRSPs. PD/A CRSP research personnel are acutely aware of the time and expense invested in training laboratory technicians. Our researchers are likewise aware of the critical need to maintain consistent and accurate analyses and data observations. In all cases, host country Principal Investigators (PIs) and Research Associates (RAs) are encouraged to provide the highest possible salaries for laboratory personnel. However, when faced with the recent CRSP budget reductions of 18% and 13.5%, and the paucity of research funds in our counterpart host institutions, the task of maintaining competitive salaries for our technicians becomes extremely difficult. It is equally difficult to convince the employers of laboratory technicians to place them on permanent status, when our contributions to their support are dependent on the periodic USAID obligations which cover a year's time or less.

It has been suggested that we look upon the training and placement of laboratory technicians as another product of our CRSP. This would be an acceptable compromise if there was a training component included in our PD/A CRSP grant. Without funds to cover the expense of training, the loss of laboratory technicians will continue to be a serious impediment to progress in our research.

## RECOMMENDATION

*3 That consideration be given to the potential for more effectively extending information and technologies in host countries without diminishing the primary goals and research activities. Perhaps a review of opportunities for non-mainline activities would be appropriate in light of interaction with the farmers via extension needs*

## CRSP RESPONSE

CRSP personnel recognize the need to extend the results of our pond aquaculture research at every opportunity. USAID Mission staffs in Rwanda, Honduras, and Thailand also stress the need to respond to local problems with studies and information. At the same time, we are reminded by USAID that this is a collaborative research project that requires us to maintain our focus on the global nature of our studies. In this arena of contrasting needs, we give first priority to the global experiment without sacrificing reasonable attention to local problems.

One of the primary means of extending the results of our research is through the medium of publications. To date, CRSP personnel have published some 275 reports and theses dealing with pond dynamics and aquaculture topics. During the period under review, over 20 host country special topics research projects have been conducted. Descriptions of these studies are listed in our 5th and 6th Annual Administrative Reports. One of the principal goals of our proposed 5-Year Continuation Proposal is to complete a Manual of Pond Management Guidelines. The target audiences for this manual are aquaculture producers, development planners, and aquaculture scientists. The manual will provide dependable guidelines for maximizing the efficiency of pond aquaculture systems.

As the CRSP researchers move into studies aimed at verifying the models and relationships developed through the global experiment, demonstration projects will by necessity become important research objectives that can simultaneously serve major extension needs.

## RECOMMENDATION.

*4 In the interest of morale and program stability, it is recommended that consideration be given to adjusting stipends and fringe benefits of Research Associates to levels provided to overseas personnel by other agencies*

## CRSP RESPONSE

The same financial constraints apply to this situation as in recommendation number 2 above. Principal Investigators of the collaborating U S institutions do not suppress salaries of their Research Associates for reasons other than the economics of available funds. However, CRSP administrators are aware of the social and financial problems associated with inadequate or unequal salaries and are making efforts to gain parity with expatriates supported by other U S agencies. The degree to which we can improve the economic status of our Research Associates is tied directly to the budget request submitted as part of our proposal for a 5-year continuation grant.

CRSP staff do provide unique fringe benefits for Research Associates by the provision of opportunities for special training and advanced degree work abroad. Again, the exercise of these benefits is dependent upon the funds available to the various U S research institutions.

## RECOMMENDATION

*5 That efforts be extended to enlist assistance from host country agencies in supporting and training more students. Based on discussions in Rwanda, it is suggested that the AID Mission and Ministry of Education in Kigali might be helpful in this area.*

## CRSP RESPONSE

The training aspects of our response to recommendation number 4 apply equally to this recommendation. We have received encouragement from the USAID Mission in Bangkok, Thailand, to pursue more training opportunities for their aquaculturists. Indications are that there may be funds available to support this activity. The USAID Mission in Tegucigalpa, Honduras, is also interested in fostering additional training opportunities for their constituents, although it is not clear if they will support travel abroad.

While the PD/A CRSP grant does not carry a training mandate, the involvement of students from host countries in our projects constitutes an important part of the CRSP's international outreach. Enthusiasm for our projects and for learning new skills has led some of these students to graduate school at our participating U S universities. These activities also help to promote international scientific linkages through the exchange of technical information. As a result of these contributions and interests, research capabilities have been

substantially strengthened in every developing country in which the CRSP has been active CRSP staff will continue to look for and to encourage opportunities for training of host country personnel

#### RECOMMENDATION

*6 That Research Associates be more aggressive in stating their needs and problems to the Management Entity, and that host country institutions be made more aware of how they might improve working conditions for the Research Associates in appropriate instances*

#### CRSP RESPONSE

The Management Entity office personnel are always sensitive and responsive to requests for assistance received from the Research Associates The ME office is careful to include the Research Associates on all of our mailing lists for publications and CRSP activities We maintain a monthly communication with the host country research staffs, and regularly send them copies of the table of contents from prominent U S and international journals dealing with aquaculture

While our expatriate staffs serve as vital linkages between the host country research and our ME office, we must be mindful that the Research Associates are employees of the research institutions In this respect, the ME staff should work through the appropriate university when dealing with their employees ME staff can and do act on behalf of the U S universities to help improve working conditions of the Research Associates As the official representative of the CRSP, we can make timely recommendations to host country officials for appointments, assistance, and services when appropriate

#### RECOMMENDATION

*7 Encourage the Data Analysis and Synthesis Team (DAST), which handles the data and modelling program, to be current and to ensure that the flow of information back to host country collaborators is done in a reasonable time*

#### CRSP RESPONSE

The DAST, the CRSP Board of Directors, the CRSP Technical Committee, and the ME all recognize the need to accelerate synthesis of the CRSP global data set Considerable progress has been made in the analyses

which briefly are (1) All of the data have been made available for analyses and modelling by restructuring, checking for errors, and estimating missing values, (2) Analyses of fish growth rates, effects of age and weight on fish growth rates, and factors affecting fish length-weight relationships have been completed and reported, (3) The following mechanistic models are under development and have been reported to CRSP researchers a) an ecosystem model to simulate 14 pond variables, b) a model to simulate dissolved oxygen concentration, and c) a model to analyze diurnal measurements of dissolved oxygen, pH, temperature, and alkalinity, and (4) Models for pond classification systems and for pond management techniques have been developed and are in the first stages of refinement

The CRSP Board of Directors has encouraged the CRSP PIs and the DAST to develop a workshop in which interactions and discussions on the cause and effects of the CRSP global data can be exchanged. The ME has been directed by the Board to facilitate such an exchange of information and ideas. Current planning is to hold this workshop in the fall of 1989.

#### RECOMMENDATION

*8 Due to limited resources available to the PD/A CRSP, perhaps there should be encouragement to seek out possibilities of "buy-in" programs related to and integrated with the primary objectives of present programming. An example might be a "buy-in" via AID Mission or host country organizations.*

#### CRSP RESPONSE.

On January 4, 1989, negotiations for a Basic Ordering Agreement (BOA) were completed between USAID and Oregon State University for the purpose of facilitating buy-ins by USAID Missions. Buy-ins must appropriately relate to the core activities of the CRSP grant for pond dynamics/aquaculture research. In the past, such buy-ins were discouraged by USAID. However, CRSPs are now encouraged to use the buy-in mechanism essentially as an Indefinite Quantity Contract to obtain financial assistance in collaborative efforts. PD/A CRSP staff have been made aware of the BOA and encouraged to explore all relevant possibilities for Mission buy-ins to augment our programs' broad goals.

#### RECOMMENDATION

9 *More efforts need to be made by the ME to recognize and communicate with the field RAs. There is a perception they are low on the ladder under the U.S. and host country PIs, even though they are probably the most critical to the programs.*

#### **CRSP RESPONSE.**

Our response to recommendation numbers 5 and 6 above partly answer this recommendation. Our ME office will continue to communicate as regularly and effectively as possible with the RAs. Because this concern has been voiced by the EEP on numerous occasions, we will be alert to new and more effective ways to communicate with the RAs. Because the Research Associates are employees of the contracting universities, the ME staff must be mindful to include the respective employers in our communications.

#### **RECOMMENDATION.**

10 *That the duties and importance of the EEP, and the funding of its activities, be re-evaluated.*

#### **CRSP RESPONSE**

With regard to the duties and importance of the EEP, the following statement is included in our current PD/A CRSP grant from USAID: "To keep the External Evaluation Panel advised of CRSP activities, the Management Entity provides the Panel with copies of significant CRSP documents. The Panel members also attend the Annual CRSP Meeting. Attendance at the meeting provides the Panel members with the opportunity to discuss progress with the various CRSP participants and to observe the various CRSP planning activities. Additionally, the Panel members visit overseas research sites in years coinciding with the Triennial Reviews. At the conclusion of the Review, the EEP submits a written report of its findings to the Management Entity, Board of Directors, and AID Program Manager with copies to BIFAD.

The EEP serves without compensation but receives reimbursement for all travel expenses. Additionally, the EEP members receive an honorarium during Triennial Review years." Further details regarding the general responsibilities of the EEP are listed in *Guidelines for Collaborative Research Support Program under Title XII*, prepared by William Fred Johnson, BIFAD staff, and Phillip Upchurch, University of Arizona.

The ME office agrees with the need and procedures for the EEP as listed in our USAID grant. We have been pleased with the services provided by the EEP. Their independent, collective judgements of our program have been incisive and constructive. Their interactions with our host country and U.S. collaborators have helped to strengthen our relationships and research program.

As explained in the EEP report, there were not sufficient funds available in the ME budget to finance all desired EEP activities. The EEP members were supported to attend our three-day annual meeting in Kona, Hawaii in 1988, to visit all of the research sites (Honduras, Indonesia, Philippines, Rwanda, and Thailand) during 1988, and to get together for a planning session in Los Angeles, California in 1989. Because of severe financial constraints on the ME, they were not supported to attend the two-day meeting of the Board of Directors and the Technical Committee in Corvallis, Oregon in 1988, nor were they afforded an opportunity to meet as a team to review the draft EEP report in 1989. The EEP members will be provided with an honorarium for their services during the Triennial Review year.

The decision to restrict some travel by the EEP was not made easily. In spite of augmenting our ME budget with \$32,400 of outside funds, we still have a projected deficit of about \$16,000. As responsible managers, we were forced to make savings in many areas, including the EEP. This action should not be construed as reflecting our view of the services of the EEP. On the contrary, we view the EEP as a very strong component of the PD/A CRSP.

The budget we have proposed for the 5-year continuation grant contains sufficient funds to fully support the EEP. By our conservative calculations, it requires about \$50,000 to finance an external evaluation. This includes expenses of the EEP, the Board of Directors, and the ME Director, who travel together during the Triennial Review.

#### Response to the USAID Administrative Management Review

The USAID Administrative Review (AMR) was conducted during the PD/A CRSP Annual Meeting and Technical Committee Meeting on January 11-15, 1988. While the AMR does not include a list of specific recommendations analogous to those of the EEP, it does evaluate and suggest actions on seven distinct aspects of CRSP management. The purpose of this section is to describe actions taken or anticipated in response to the suggestions in the Administrative Management Review.

## 1 Reorganization of the Aquaculture CRSP

On this subject, the AMR team was concerned that 1) Because the CRSP was ordered by USAID to leave Panama in November 1987 due to political strain between the U S and Panama, research at one of three sites was discontinued, 2) the CRSP research in Thailand had not yet fully integrated the activities of Michigan State University and the University of Hawaii, and 3) the analysis and synthesis of the global data were far behind schedule

1) The lead CRSP research group in Panama was Auburn University (AU) Since the AMR, staffs from AU, the ME, and USAID have completed negotiations to relocate the Panama CRSP to Honduras MOUs have been signed between AU and the Honduran Ministry of Natural Resources, and between AU and the Escuela Agricola Panamericana at Zamorano The PD/A CRSP has been re-established at the El Carao Aquaculture Experiment Station This is a freshwater site, and global studies following the CRSP Fourth Experimental Cycle are in progress In addition, site-specific studies in brackish water ponds are in progress The switch from Panama to Honduras was accomplished in six months Researchers plan to make up for the time lost

2) CRSP research in Thailand is now fully integrated, and The University of Michigan (UM) was designated as the lead institution The staff from the UM has completed new MOUs with the Thailand Department of Fisheries (DOF) and with the Asian Institute of Technology (AIT) These MOUs serve to accommodate research activities by staffs from all three U S universities CRSP relationships with the DOF, the AIT, and the USAID Mission are now judged to be excellent (see EEP report)

3) As of May 1988, all of the CRSP data available from field stations have been received, verified, and made available to the Data Analysis and Synthesis Team (DAST) The DAST has made considerable progress in the analysis and synthesis of these data (see CRSP response to EEP recommendation number 7) The body of data assembled by this global experiment now constitutes a powerful tool for better understanding of those factors and relationships that lead to greater efficiency in pond aquaculture The DAST is on schedule with its work plans and objectives

## 2 The Global Plan

The AMR team was concerned that there was a serious lack of focus on the global research plan The team perceived that the CRSP was functioning as three separate research activities and was losing its focus on the global objective

They held the ME responsible to see that the global focus was maintained, and looked to the EEP report to identify weaknesses and make recommendations

The ME Director and the Technical Committee Chairman continue to insist that CRSP researchers adhere to the global plan. In the current work plan (4th), hypotheses about pond dynamics are tested in different field experiments at each research location. This allows the CRSP to proceed rapidly through the testing process. Otherwise, many years of work would be required to thoroughly evaluate each hypothesis at all sites. The CRSP global experiment continues intensive sampling of pond variables during the course of each field experiment. A standard sampling protocol is used at all locations, and the standardized data are added to the CRSP Data Base to make the existing information even more comprehensive.

The EEP report did not list any concerns about deviation from the global plan of research. Rather, they seemed generally pleased with the direction and accomplishments of the CRSP research at the three existing locations. Their recommendations did not list measures to improve focus on the global experiment.

### 3 Management Entity and Board of Directors

The AMR team was concerned that the research program in Thailand be fully integrated as a single project involving three U.S. universities. The team recommended that the ME Director and the Board Chairman visit Thailand to ensure the full integration of the CRSP program.

The ME Director and Dr. James Diana, PI from The University of Michigan, visited the CRSP project in Thailand in August 1987. During this visit, a draft MOU was negotiated between the UM and the DOF. This MOU was subsequently signed by both parties. Meetings were also held with key personnel from AIT, and the USAID Mission in Bangkok. Everyone agreed to the new organization of the CRSP, and recognized that this was a single project under the leadership of UM.

Development since that visit have indicated continued growth and full cooperation by all parties. An MOU has been signed between UM and the AIT for cooperative aquaculture research, with the approval of the Thailand DOF. The EEP reports that the project is strong and is fully supported by all host country parties. Because the CRSP project in Thailand was on schedule and without apparent problems, and because of financial constraints on the ME that have been mentioned previously, the ME Director did not visit the Thailand CRSP in 1988.

With the use of non-PD/A CRSP funds, the ME Assistant Director is scheduled to visit the Thailand CRSP in June 1989

## 5 Publications and Data Analysis

The AMR team was pleased with progress on the flow of scientific publications from the PD/A CRSP. Team members were concerned with progress of the DAST, and suggested that the ME Director give this problem his personal attention and consider the allocation of increased funds for analysis and synthesis.

Considerable progress has been made in the synthesis and analysis of data since the AMR review was held. The accomplishments are listed in response to the EEP recommendation number 7, but for convenience are repeated here: 1) All of the data have been made available for analyses and modelling, restructuring, checking for errors, and estimating missing values, 2) Analyses of fish growth rates, effects of age and weight on fish growth rates, and factors affecting fish length-weight relationships have been completed and reported, 3) The following mechanistic models are under development and have been reported to CRSP researchers: a) an ecosystem model to simulate 14 pond variables, b) a model to simulate dissolved oxygen concentration, and c) a model to analyze diurnal measurements of dissolved oxygen, pH, temperature, and alkalinity, and 4) models for pond classification systems and for pond management techniques have been developed and are in the first stages of refinement.

On April 11, 1988, the ME Director met with Drs. David Bathrick and Richard Neal of USAID Washington to discuss possibilities of increased funding for the DAST activities. A proposal of accelerated activities was presented along with a budget request for \$50,000 to accomplish the new synthesis and analysis goals. All agreed that the increased work was desired and merited, but supplemental funds could not be identified for this purpose. Recent budget cuts to the PD/A CRSP left no room for reallocation within the overall project.

## 6 External Evaluation Panel

The AMR team recommended that the EEP visit the sites that had been dropped from the CRSP due to budget cuts. They felt that such visits would be valuable as scientific linkages and might stimulate continued research relationships. The team believed that such visits would be an excellent means of orientation of the CRSP Director.

Arrangements were made for the EEP to visit all former CRSP sites. A visit to Panama was not possible due to termination of diplomatic relations.

between the U S and Panama On his return trip from non-CRSP business in Oman, the ME Director did visit Rwanda with the EEP Because of financial constraints, the ME Director did not accompany the EEP to the four other host country sites

## 7 Overview

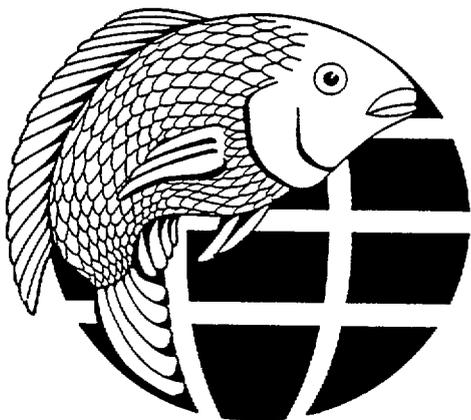
The AMR team reported that the PD/A CRSP was a strong program caught at a weak moment due to the reorganization They stated that plans for Phase IV should be updated and finalized They repeated that the ME needs to display a strong leadership to see that the CRSP global goals are accomplished The team concluded that overall progress and accomplishments have been good, and that the program should continue its important and unique contribution to global aquaculture

The CRSP Work Plan Fourth Experimental Cycle, September 1, 1987 to August 31, 1989 has been completed and distributed As reported previously, this plan incorporates the standard sampling protocol at all locations and will produce standardized observations for the CRSP Data Base

**TITLE XII**  
**COLLABORATIVE RESEARCH SUPPORT PROGRAM**

**POND DYNAMICS/AQUACULTURE**

Mission Reviews



**Pond Dynamics/Aquaculture CRSP Management Entity**  
**Office of International Research and Development**  
**Oregon State University, Snell Hall 400**  
**Corvallis, Oregon 97331-1641**

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AID/ST/AGR/RNR TGILL AID/AFR/IA WARREN RUSH (PHONE)

AID/ANE WILLIAM NANCE (PHONE) AID/LAC/CAP ELEONARD (INFO)

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ST/AGR/RNR AQUACULTURE POND DYNAMICS  
CRSP-TRIENNIAL REVIEW SITE VISITS

REF (A) STATE 320966 (B) BANGKOK 48397 (C) JAKARTA 17761  
(D) KIGALI 5263 (E) MANILA 36379 (F) PANAMA 14284 (G)  
TEGUCIGALPA 17979

1 CLEARANCE IS REQUESTED FOR TRAVEL OF THE THREE-PERSON  
TEAMS DETAILED BELOW TO CARRY OUT THE SITE VISITS FOR  
THE SECOND TRIENNIAL REVIEW OF THE POND DYNAMICS (PD)  
CRSP

RWANDA - O/A FEBRUARY 16-19 1988  
HOMER BUCK-EXTERNAL EVALUATION PANEL (EEP)  
HOWARD HORTON-CRSP MANAGEMENT ENTITY (ME)  
KENNETH OSBORN-S&T/AGR FISHERIES ADVISOR

HONDURAS O/A MARCH 9-11 1988  
KENNETH CHEW-EXTERNAL EVALUATION PANEL (EEP)  
ROBERT FRIDLEY CRSP BOARD OF DIRECTORS (BOD)  
KENNETH OSBORN-S&T/AGR FISHERIES ADVISOR

THAILAND O/A APRIL 5-9 1988 INDONESIA O/A APRIL  
10-14 1988 PHILIPPINES O/A APRIL 15-19 1988  
HERMINIO RABANAL-EXTERNAL EVALUATION PANEL (EEP)  
PHILIP HELFRICH CRSP BOARD OF DIRECTORS (BOD)  
KENNETH OSBORN S&T/AGR FISHERIES ADVISOR

2 THE PURPOSE OF THE SITE VISITS IS TO PROVIDE  
IMPORTANT INSIGHT ON THE PROGRESS AND ACCOMPLISHMENTS OF  
THE PD CRSP AS WELL AS TO IDENTIFY PROBLEMS AND  
CONSTRAINTS IF ANY FOR THE TRIENNIAL REVIEW IN ORDER  
TO PROVIDE GUIDANCE TO BIFAD AND AID FOR POSSIBLE  
EXTENSION OF THE CRSP FOR AN ADDITIONAL THREE YEAR  
PERIOD

3 THE SITE VISITS WILL PROVIDE THE OPPORTUNITY FOR  
PARTICIPATION/INPUT BY MISSIONS AND WHERE APPROPRIATE  
HOST COUNTRY INSTITUTIONS AS WELL AS THE PRESENT  
IN-COUNTRY RESEARCH PARTICIPANTS

4 MISSION COMMENTS PROVIDED IN REFS B THRU G HAVE BEEN  
EXTREMELY USEFUL IN DEVELOPING THE FOLLOWING LIST OF  
PROBLEMS AND ISSUES AND ARE GREATLY APPRECIATED

5 PROBLEMS AND ISSUES TO BE ADDRESSED DURING THE SITE  
VISITS

A PROGRESS- IS THE CRSP PROCEEDING SATISFACTORILY? IS  
IT ATTAINING ITS GOALS? IS IT FUNCTIONING AS A SINGLE  
WELL COORDINATED PROGRAM? WHAT PROVISIONS IF ANY HAVE  
BEEN MADE TO KEEP THE HOST COUNTRY INSTITUTIONS IN THESE  
COUNTRIES WHERE THERE ARE NO LONGER IN COUNTRY US  
RESEARCH ASSOCIATES INVOLVED IN THE OVERALL PROGRAM?  
ARE CHANGES NEEDED?

1 ACCOMPLISHMENTS OF THE BASELINE RESEARCH PLAN IS IT  
STAYING ON SCHEDULE? QUALITY OF RESEARCH TECHNIQUES  
(E G SAMPLING AND ANALYSIS) AND CONSISTENCY WITH WORK  
PLAN SPECIFICATIONS RECORD KEEPING DATA ANALYSIS

2 IS THE CENTRAL DATA MANAGEMENT SYSTEM OPERATING  
SMOOTHLY? ARE DATA ROUTINELY INCORPORATED INTO THE DAT  
BANK AND UTILIZED IN MODELS ON A TIMELY BASIS? ARE  
RESEARCH RESULTS BEING PUBLISHED? ARE RESULTS BEING  
FULLY INTERPRETED AND ANALYZED TO MAXIMIZE CONTRIBUTIONS  
TO THE KNOWLEDGE BASE? ARE PLANS COMPLETE AND ADEQUATE  
TO ENSURE THAT PROGRAM WILL ACHIEVE ITS GOALS?

3. PROGRESS OF THE OVERALL RESEARCH PROGRAM WHAT  
HYPOTHESES ARE BEING TESTED? ARE THE MODELS THAT HAVE  
BEEN DEVELOPED APPROPRIATE AND USEFUL? WHAT CONCLUSIVE  
ADVANCEMENTS TO THE GENERAL UNDERSTANDING OF POND  
DYNAMICS HAVE BEEN MADE? WHAT ADVANCEMENTS CAN BE  
EXPECTED SOON BASED ON THE FIRST FIVE YEARS OF  
RESEARCH? ARE THE COUNTRY STUDIES INTEGRATED  
SATISFACTORILY TO FORM A SINGLE ORGANIZED APPROACH TO  
THE PROGRAM GOALS?

4 WHAT ACCOMPLISHMENTS HAVE BEEN ACHIEVED IN  
INSTITUTION BUILDING AND TRAINING OF HOST COUNTRY  
TECHNICAL RESEARCH STAFF?

B QUALITY OF WORKING RELATIONSHIPS BETWEEN AND AMONG  
HOST COUNTRY CRSP AND MISSION PERSONNEL

1 RELATIONSHIP BETWEEN U S PRINCIPAL  
INVESTIGATOR/CONTRACTING INSTITUTION AND FIELD PERSONNEL

2 RELATIONSHIP BETWEEN U S AND HOST COUNTRY  
PARTICIPANTS

3 RELATIONSHIP BETWEEN CRSP PARTICIPANTS (U S AND HOST  
COUNTRY) AND U S AID MISSION STAFF CR P PARTICIPANTS  
AND REPRESENTATIVES OF OTHER IN-COUNTRY PROGRAMS AND  
PROJECTS

C VIABILITY OF THE OPERATIONAL AND ADMINISTRATIVE  
ARRANGEMENTS OF THE CRSP

1 IS THE RELATIONSHIP BETWEEN PERSONNEL AND PROGRAM  
MANAGEMENT (I E THE PROGRAM MANAGEMENT OFFICE BOARD  
OF DIRECTORS EFFECTIVE? IS THE TECHNICAL COUNCIL  
EFFECTIVE?

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2 IS THE ORGANIZATION AND MANAGEMENT SERVING PROGRAM NEEDS? IS THE MANAGEMENT ENTITY EFFECTIVE? IS THE BOARD OF DIRECTORS EFFECTIVE? IS THE TECHNICAL COUNCIL EFFECTIVE? IS THE AID PROJECT MANAGEMENT OFFICE (ST/AGR) EFFECTIVE?

3 IS THE TECHNICAL PROGRAM FUNCTIONING AS DESCRIBED IN THE PROGRAM PROPOSAL WITH RESPECT TO WORK PLAN DATA MANAGEMENT INFORMATION DISSEMINATION AND INTERACTION AMONG PROGRAM PARTICIPANTS?

4 IS THE HOST COUNTRY RESEARCH TEAM GIVEN ADEQUATE INDEPENDENCE TO CARRY OUT NORMAL OPERATIONS WITHOUT

EXCESSIVE RED TAPE?

D RELEVANCE OF THE RESEARCH TO

- 1 HOST COUNTRY NEEDS
- 2 USAID PROGRAMS
- 3 OTHER DONOR PROGRAMS

E VALIDITY OF THE CURRENT MEMORANDA OF UNDERSTANDING (MOUs) WITH THE HOST COUNTRIES FOR EXTENSION OF THE RESPECTIVE PROJECTS FOR AN ADDITIONAL THREE YEARS (WHERE APPROPRIATE)

F RECOMMENDATIONS FOR STRENGTHENING/CONTINUING THE PROGRAM

1 DESIRABILITY OF EXTENDING THE PD-CRSP FOR AN ADDITIONAL THREE YEARS

2 CHANGES/MODIFICATIONS IN THE OVERALL PROGRAM

3 CONTRIBUTION OF SPECIFIC FIELD SITES TO THE ACHIEVEMENT OF OVERALL PROGRAM GOALS

4 OTHER RECOMMENDATIONS

5 FOR CLARIFICATION PLEASE NOTE THAT THE THREE EEP MEMBERS ARE THE EVALUATORS FOR THIS REVIEW THE CRSP ME AND BOD MEMBERS AS WELL AS THE S&T/AGR FISHERIES ADVISOR WILL ACCOMPANY THE EEP MEMBERS ON THE SITE VISITS IN THE CAPACITY OF RESOURCE PERSONS TO PROVIDE BACKGROUND INFORMATION ANSWER QUESTIONS AND OTHERWISE FACILITATE AND ASSIST IN THE REVIEW BUT THEY WILL NOT PARTICIPATE IN THE ACTUAL EVALUATION

6 THE ME OREGON STATE UNIVERSITY (HOWARD HORTON PROGRAM MANAGER) WILL PROVIDE FURTHER DETAILS ON THE IN COUNTRY TRAVEL LOGISTICS AND OTHER MATTERS RELATIVE TO SUBJECT SITE VISITS AS WELL AS BACKGROUND BRIEFING MATERIALS RELATIVE TO THE REVIEW DIRECTLY TO EACH MISSION ANY QUESTIONS MAY BE DIRECTED EITHER TO THE ME OR TO S&T/AGR/RNR

7 NO LOGISTIC OR FINANCIAL SUPPORT REQUIRED OF MISSIONS

8 PLEASE ADVISE RE TRAVEL CLEARANCES AND PROPOSED SCOPE OF WORK ATTN R NEAL ST/AGR/RNR SHULTZ

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SUBJECT ST/AGR/RNR AQUACULTURE POND DYNAMICS CRSP SECOND TRIENNAL REVIEW

1 S&T FUNDING FOR SUBJECT CRSP ACTIVITIES IN HONDURAS WAS TERMINATED AUGUST 31 1987 BECAUSE GOH AND MISSION WERE PLEASED WITH PROGRESS OF AUBURN UNIVERSITY PARTICIPATION IN AQUACULTURE PROGRAM IN HONDURAS THE USAID EXTENDED THE ACTIVITY FOR 12 MONTHS WITH PROJECT 522-0169 FUNDING ALTHOUGH MISSION AND GOH WOULD BE INTERESTED IN SEEING A FURTHER EXTENSION OF THESE ACTIVITIES IN HONDURAS THE FUTURE AVAILABILITY OF FUNDS FOR THIS PURPOSE IS VERY UNCERTAIN ANY FURTHER ACTIVITIES BEYOND AUGUST 1988 WOULD PROBABLY REQUIRE CENTRAL FUNDING

2 TENTATIVE DATES FOR SITE VISIT (LATE JANUARY 1988) ARE ACCEPTABLE TO MISSION BRIGGS

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SUBJ AQUACULTURE POND DYNAMICS CRSP

R-F STATE 320966

1 USAID/JAKARTA CONCURS WITH THE ST/AGR/RNR PROPCAL FOR THE CRSP EXTERNAL EVALUATION PANEL (EEP) TO CARRY OUT A SITE VISIT OF THE CRSP ACTIVITIES AT THE INSTITUTE OF AGRICULTURE BOGOR (IPB)

2 OVERALL THE MISSION BELIEVES THE INDONESIAN POND DYNAMICS CRSP WAS ON SCHEDULE IN ACCOMPLISHING THE OBJECTIVES OF THE CRSP AND DESPITE THE FACT THAT TILAPIA CURRENTLY HAS LITTLE COMMERCIAL IMPORTANCE IN INDONESIA IPB REMAINS INTERESTED IN CONTINUING THE RESEARCH INITIATED UNDER THE CRSP THEREFORE USAID/JAKARTA RECOMMENDS THAT ST/AGR/RNR AND THE CRSP MANAGEMENT UNIT EXAMINE THE POSSIBILITY THAT A MINIMUM OF DOLLARS 10 000 PER ANNUM COULD BE PROVIDED TO IPB TO CONTINUE THE CRSP STATE OF ART TILAPIA RESEARCH ACTIVITIES BY RESIDENT IPB STAFF AND TO ALLOW THE PRINCIPAL INVESTIGATOR AND/OR OTHER IPB CRSP ACTIVITY STAFF TO PARTICIPATE IN THE ANNUAL CRSP MEETING

USAID/JAKARTA BELIVES THIS MINIMUM INVESTMENT WOULD CONTINUE THE STRENGTHENING OF THE UNIVERSITY TIES INITIATED UNDER THE CRSP AND THE DEVELOPMENT OF STATE OF ART CULTURE TECHNOLOGY FOR COMMERCIALY IMPORTANT SPECIES OF FISH

CONNORS

*RNR*  
*Neal*

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- F) MISSION HAS NOT SPEN HOW WITH HOST COUNTRY FOR PROJEC LXTEN 100 YEAR 9 0 AND 11

- G) THE GPS MAY WANT TO OORD NATE IS ACTIVITEL WITH SOM PRILA E CTOP HFIP PRODUCES AND BEGII TC FOCUS ON EXTENDING RESEARCH R ULT MAISTO

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1 RESPONSE TO ITEMS IN REF A PARAGPAPH 2

A) THE CRSP ACCOMPLISHMENTS IN RESEARCH TRAINING AND INSTITUTIONAL BUILDING IN PANAMA HAVE BEEN VERY POSITIVE. THE TWO CRSP RESIDENT RESEARCHERS RELATE WELL TO PANAMANIAN COUNTERPARTS AND HAVE PROVEN ADEPT AT TRAINING OF THEIR COUNTERPARTS WHILE CARRYING OUT RESEARCH. THE COUNTERPARTS UNDERSTAND WELL THE PURPOSE OF THE RESEARCH, THE METHODOLOGICAL TECHNIQUES UTILIZED, AND THE EXPECTED RESULTS. THE CRSP OFFSIDE RESEARCHERS DELEGATE AUTHORITY AND ROUTE TASKS TO ALL THE COUNTERPARTS HAVE AN OPPORTUNITY TO PARTICIPATE IN HANDS ON TASKS. THE PARTICIPATORY NATURE OF THIS TYPE OF RESEARCH IS BENEFICIAL FOR INSTITUTIONAL DEVELOPMENT. FOR EXAMPLE, WHEN VISITORS REVIEW THE PROGRAM, THE PANAMANIAN COUNTERPARTS ARE EXPECTED TO HOST THE VISITOR AND EXPLAIN EVERY DETAIL OF THE RESEARCH.

B) WORKING RELATIONSHIPS BETWEEN PANAMANIAN COUNTERPARTS, GPSF AND MISSION PERSONNEL ARE EXCELLENT. THIS IS TRUE IN SPITE OF THE FACT THAT AT PRESENT OFFICIAL RELATIONS BETWEEN THE TWO COUNTRIES ARE STRAINED BEYOND CRSP NOR MISSION REQUIREMENTS. ON EACH OTHER ARE EXCESSIVE.

C) THE OPERATIONAL AND ADMINISTRATIVE ARRANGEMENTS BETWEEN THE CRSP AND THE USAID MISSION WORK WELL.

D) THE CRSP AS MODIFIED IS FOCUSING ON HOST COUNTRY RESEARCH NEEDS AND IS CARRYING OUT AN IMPORTANT ROLE THAT OTHER DONORS ARE NOT COVERING. AS THIS RESEARCH BECOMES MORE ADVANCED, THE CRSP WILL NEED TO BEGIN WORKING WITH THE PRIVATE SECTOR TO MOVE RESULTS FROM THE RESEARCH STATION TO FARMERS' PONDS. A CONTINUING RESEARCH PROGRAM IS NECESSARY FOR PANAMA TO IMPROVE OPERATIONS, INCREASE PRODUCTION AND MAINTAIN ITS LEADERSHIP ROLE IN AQUACULTURE RESEARCH IN LATIN AMERICA. PANAMA HAS RECIPIED OVER 200 PEOPLE FROM OTHER COUNTRIES LAST YEAR.

E) IT WOULD SEEM USEFUL FOR CRSP TO EXTEND ITS ACTIVITIES UNTIL AUGUST 31, 1992. HOWEVER, THE CRSP MUST FIRST ANALYZE THE DATA IT HAS COLLECTED DURING THE FIRST FIVE YEARS TO DETERMINE THE FUTURE AREAS OF PROGRAM FOCUS.

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PHILIPPINE RESPONSE  
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FOR R NEAL ST/AGR/RNR

E O 12356 N/A  
SUBJECT ST/AGR/RNR AQUACULTURE/POND DYNAMICS CRSP  
SECOND TRIENNIAL REVIEW

REF STATE 320966

1 ALTHOUGH ACTUAL CRSP ACTIVITIES IN THE PHILIPPINES  
TERMINATED 1ST QUARTER OF 1987 USAID PHILIPPINES FEELS  
THAT PREVIOUS CRSP ACTIVITIES WERE BENEFICIAL TO THE  
STATE OF IN-COUNTRY AQUACULTURE RESEARCH PARTICULARLY  
THE CULTURE OF TILAPIA IN BRACKISHWATER MOREOVER  
INITIAL FINDINGS IN THE RESEARCH CONDUCTED HAVE A  
BEARING ON MINIMIZING INPUT REQUIREMENTS IN LOCAL  
MILKFISH POND OPERATIONS

2 A NUMBER OF FILIPINO RESEARCHERS DID THEIR GRADUATE  
STUDIES UNDER CRSP SPONSORSHIP AND THEY NOW COMPRISE THE  
SECOND GROUP OF SCIENTISTS AT THE UNIVERSITY OF THE  
PHILIPPINES IN THE VISAYAS (UPV) BRACKISHWATER  
AQUACULTURE CENTER (BAC)

3 ALTHOUGH IMPLEMENTATION WAS INITIALLY BESET WITH  
ADMINISTRATIVE PROBLEMS WITH HOST COUNTRY COUNTERPARTS  
THESE WERE ULTIMATELY RESOLVED WITH THE ESTABLISHMENT OF  
OPERATIONAL GUIDELINES AND STAFF CHANGES AMONG  
COUNTERPART PERSONNEL

4 MISSION UNDERSTANDS THAT THE NUMBER OF CRSP SITES  
MAY HAVE TO BE LIMITED DUE TO FUNDING CONSTRAINTS BUT  
WOULD NEVERTHELESS ENCOURAGE INFORMATION EXCHANGE  
BETWEEN THE UPV-BAC AND THE CRSP S IMPLEMENTING  
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THAILAND RESPONSE  
INCOMING  
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UNCLAS BANGKOK 4879Z

ADM AID

E O 12356 11/4  
SUBJECT: T W/RR/AN AQUACULTURE POND DYNAMICS CRSP  
SECOND TRIENNIAL REVIEW

1 RESPONSES REQUESTED BY RE TEL FO LOW

2 FEETEL PARAGRAPH 2 A) THE CRP RESEARCH PROGRAM IN THAILAND HAS BEEN VERY WELL RECEIVED CRSP RESEARCH WORK HAS RESULTED IN MORE THAN 10 PUBLICATIONS WHICH HAVE BEEN PRESENTED LOCALLY AND AT INTERNATIONAL CONFERENCES ON AQUACULTURE TRAINING OF RTG DEPARTMENT OF FISHERIES (DOF) PERSONNEL HAS CONCENTRATED ON WATER QUALITY ANALYSIS AND THE USE OF MICROCOMPUTERS FOR THE ANALYSIS OF WATER QUALITY AND OTHER DATA THE CRP WORK IS HIGHLY REGARDED BY RTG DEPARTMENT OF FISHERIES DOF OFFICIALS AS HAVING CONTRIBUTED TECHNICALLY TO ENHANCEMENT OF R/S ARCH CAPABILITY IN AQUACULTURE

3 FEETEL PARAGRAPH 2 B) MISSION CONSIDERS WORKING RELATIONSHIP AMONG CRSP RTG AND MISSOURI PERSONNEL TO BE A PARTICULAR STRENGTH OF THE PROGRAM HERE AND HAS CONCURRENTLY CITED THIS RELATIONSHIP AS BEING KEY TO CRSP PERFORMANCE IN THAILAND

4 FEETEL PARAGRAPH 2 C) OUR UNDERSTANDING IS THAT THE MOU SIGNED BETWEEN UNIVERSITY OF MICHIGAN (UM) AND THE DOF AND THE SUB AGREEMENTS AMONG MICHIGAN STATE UNIVERSITY (MSU) AND UNIVERSITY OF HAWAII (UH) HAVE CLARIFIED REMAINING ISSUES RELATED TO IN-COUNTRY COSTS DISBURSEMENT AND ACCOUNTABILITY BELIEVE THIS RELATIONSHIP WHILE PERMANENT TO DEVELOP INITIALLY WILL PERMIT EXCHANGE TRANSFER OF TECHNOLOGY AMONG COOPERATING INSTITUTIONS USAID/THAILAND IS PLEASED BY THE ORGANIZATIONAL RELATIONSHIPS BEING FORMED AND THE STRENGTH OF THE COMMITMENT OF PARTICIPATING INSTITUTIONS

5 FEETEL PARAGRAPH 2 D) USAID/THAILAND BELIEVES THE RESEARCH WORK TO BE HIGHLY RELEVANT TO HOST COUNTRY AND OTHER DONOR PROGRAMS EVIDENCE OF THIS FACT IS HIGH LEVEL SUPPORT TO AID IMPLEMENT IN THE CRSP PROGRAM FURTHERMORE BELIEVE THE CRSP WORK TO BE WELL INTEGRATED WITH OTHER DONOR PROGRAM (IDRC ODA) WITH THE RECENT INTEGRATION OF SOME CRSP WORK AT THE ASIAN INSTITUTE OF TECHNOLOGY (AIT) THERE IS NOW GREATER POTENTIAL FOR A GROWING IMPACT

6 FEETEL PARAGRAPH 2 E) MISSION WOULD STRONGLY SUPPORT A CONTINUATION OF THIS CRP FOR A THREE YEAR PERIOD (1991-1993) AT THIS POINT WE BELIEVE THE DIVIDENDS TO ONLY INCREASE IN THE FUTURE WHILE IT IS DIFFICULT TO PROJECT AT THIS POINT WE CAN ENVISAGE THAT DIRECT WORK WITH THE DOF WOULD DECLINE DURING A

THE YEAR EXERCISES PIFIED WITH CORRESPONDING GREATER DAILY WORK AT AIT THIS IS NOT TO DOWNRIDE DOF OR ITS SUPPORT RATHER TO FOCUS ON THE RESEARCH ROLE IN AIN AQUACULTURE AND THE IMPACT OF THE RESEARCH EFFORT BY CONTINUING TO WORK WITH AIT RATHER THAN SOLELY WITH A HOST COUNTRY FINANCIAL SUPPORT WOULD SECURE THAT FINANCIAL RESOURCES WILL CONTINUE TO BE LIMITED WORK AT AIT WILL HAVE A GREATER POTENTIAL PAYOFF FOR THE REGION

7 FEETEL PARAGRAPH 2 (F) WHILE THE MODIFIED MOJ IS NEW WE SEE NO REASON WHY IT WOULD NOT REMAIN IN EFFECT AND BE EFFECTIVE DURING AN EXTENDED PERIOD OF THIS CRSP

8 FEETEL PARAGRAPH 2 (G) BELIEVE MISSOURI'S CONTINUED ENTHUSIASTIC SUPPORT FOR THIS CRP IS WELL KNOWN

9 MISSION AGREES WITH VISIT TO THAILAND IN LATE FEBRUARY BROWN

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PD-ABR-54

**TITLE XII**  
**COLLABORATIVE RESEARCH SUPPORT PROGRAM**  
**POND DYNAMICS/AQUACULTURE**

CRSP Publications



**Pond Dynamics/Aquaculture CRSP Management Entity**  
**Office of International Research and Development**  
**Oregon State University, Snell Hall 400**  
**Corvallis, Oregon 97331-1641**

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Collaborative Research Support Program  
As of 12/88

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