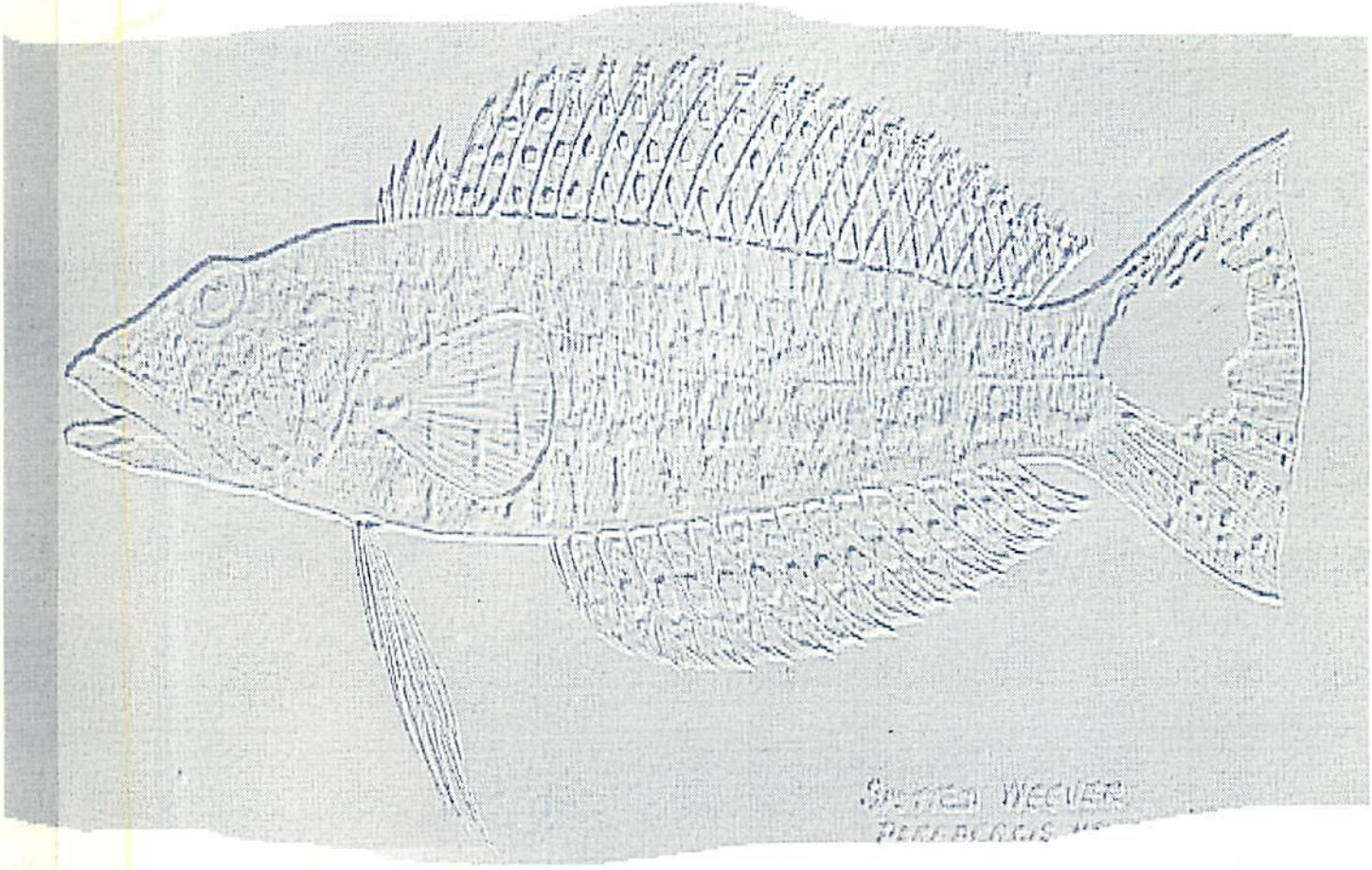
ICLARM

1995 Operational Plan



ICLARM
International Center for Living
Aquatic Resources Management

ICLARM 1995 OPERATIONAL PLAN

INTERNATIONAL CENTER FOR LIVING AQUATIC
RESOURCES MANAGEMENT

MCPO Box 2631, 0718 Makati, Metro Manila, Philippines
Telephones: 818-9283, 818-0466, 817-5255, 817-5163
Cable: ICLARM MANILA; Telex (ETPI) ICLARM PN, 4900010376 ICL UI (USA)
FAX: (63-2) 816-3183; E-MAIL: (INTERNET) ICLARM@CGNET.COM

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1995

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Foreword

The ICLARM 1995 Operational Plan describes the work program of the Center. It is developed within the framework of the 1994-1998 Medium-Term Plan which itself arose from an intense planning and priority-setting process resulting in the 1992 Strategic Plan. The purpose of this Operational Plan is to give partners, donors, natural resource decisionmakers and other interested stakeholders a summary of ICLARM's activities for 1995. In addition, the Plan includes a summary of progress made by each project during 1994.

As ICLARM enters the second year of its 1994-1998 Medium-Term Plan, we face an increasing and urgent need for improved scientific and technical knowledge and policy insight to underpin the management of living aquatic resources. Since ICLARM developed its Strategic Plan in 1992 the sense of urgency has heightened, driven by the public and global recognition that natural fisheries and aquatic resources, though renewable, are limited and frequently already heavily impacted by human use.

ICLARM recognizes the vital contribution living aquatic resources make to food security in the developing world. Our work program, encompassing international research and related activities and much conducted in partnership with national research institutions, is designed to provide the basis for improving the production and management of living aquatic resources for sustainable benefits of present and future generations of low-income users in developing countries.

MERYL J. WILLIAMS
Director General

Overview

ICLARM's mission is to improve the sustainable management of living aquatic resources for the benefit of low-income peoples in the developing world through international research, research partnerships, education and communication.

ICLARM is the only international strategic research institute for living aquatic resource management, having been established in 1975. In 1992, ICLARM was admitted to the Consultative Group on International Agricultural Research (CGIAR), a global system of 16 research centers supported by more than 40 government and nongovernment donors and cosponsored by the World Bank, the Food and Agriculture Organization (FAO) of the United Nations and the United Nations Development Programme (UNDP) (Fig. 1).

ICLARM has its headquarters in Manila, Republic of the Philippines, and field research stations in the Solomon Islands, Bangladesh, Malawi and Central Luzon (Philippines). The Center is governed by a 12-person Board of Trustees (Table 1), including three ex-officio officers - a representative of the Director General of the FAO, a representative of the Philippine Department of Agriculture and the Director General of ICLARM.

In 1994, ICLARM was supported by 17 donors.

The work program priorities for 1995 result from the priorities of the 1994-1998 Medium-Term Plan and new research issues arising from three main emerging forces: the revitalization of the CGIAR and its new vision, emphasizing food security through international public good research; the increasing urgency to find better ways to manage living aquatic resources sustainably; and the global attention to conservation and use of biological resources generated by the International Convention on Biological Diversity.

The overall priorities of the 1994-1998 Medium-Term Plan were based on an assessment of the numbers of beneficiaries of research, the likely research impact, its potential for uptake, achieving objectives, spillover benefits and potential alternative research suppliers and partners.

Based on their realized or potential productivity and the factors described above, three aquatic resource systems are emphasized: coastal estuaries and lagoons; coral reefs; and inland small-scale ponds, including rice flood waters.

During planning and selection of specific projects, research projects and related activities are tested against six guiding principles:

- sustainability;
- equity;
- gender role in development;
- participation;
- systems approach; and
- anticipatory research.

Information and administrative services complement the research program. ICLARM's full work program and structure consist of the following:

- Director General and Office of the Director General

- Inland Aquatic Resource Systems Program
  - Fish Productivity Thrust
  - Integrated Resource Management Thrust

- Coastal and Coral Reef Resource Systems Program
  - Dynamics of Resource Systems Thrust
  - Management of Resource Systems in a Social Context Thrust
  - Improving Coral Reef Productivity Thrust

- Fisheries Co-Management Unit

- Research Networks
  - Asian Fisheries Social Science Research Network
  - International Network on Genetics in Aquaculture

- Information Division
  - Publications
  - Library

- Management Services Division
  - Finance and Accounting Unit
  - Human Resources Unit
  - Project Management Unit
  - General Administrative Unit

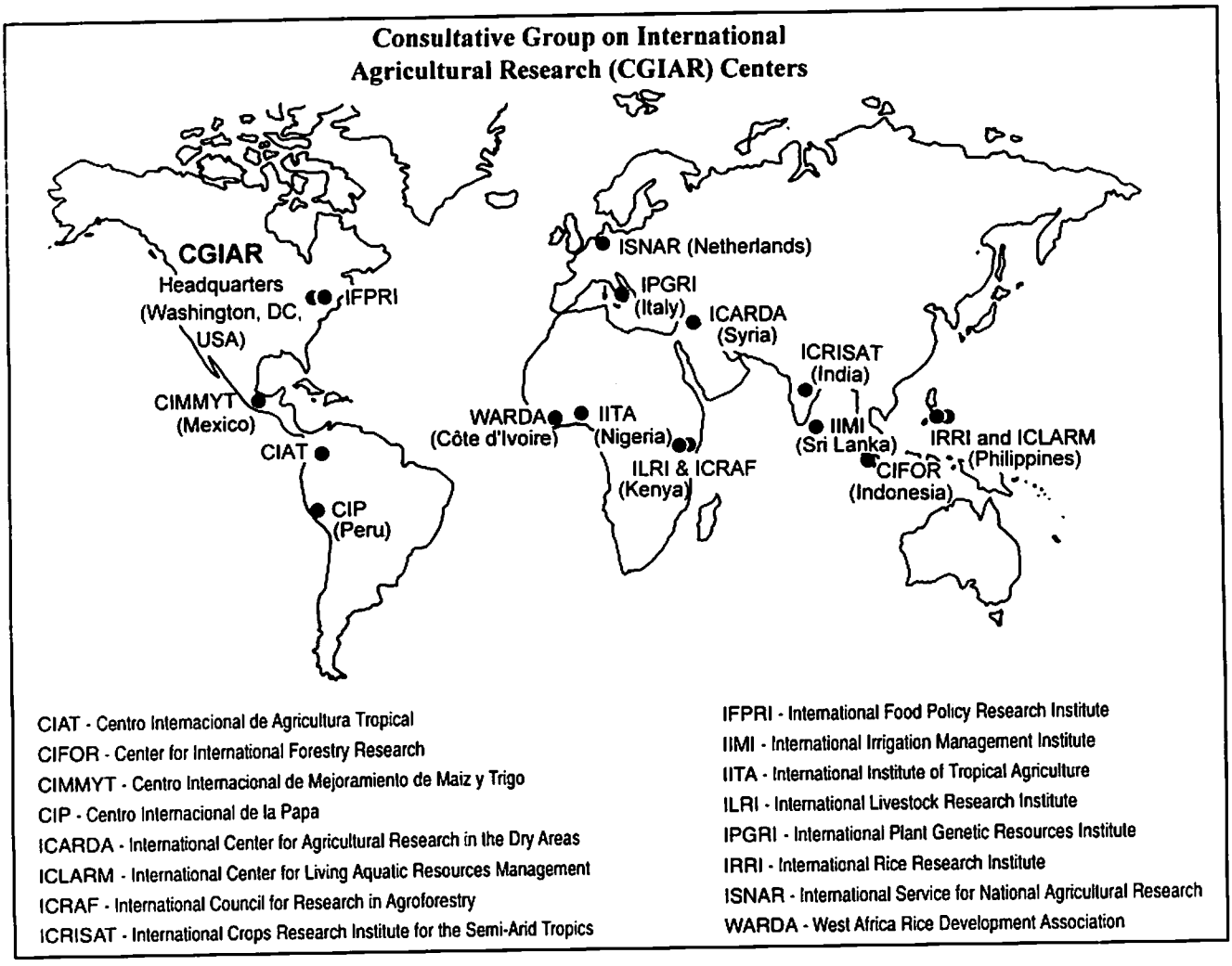
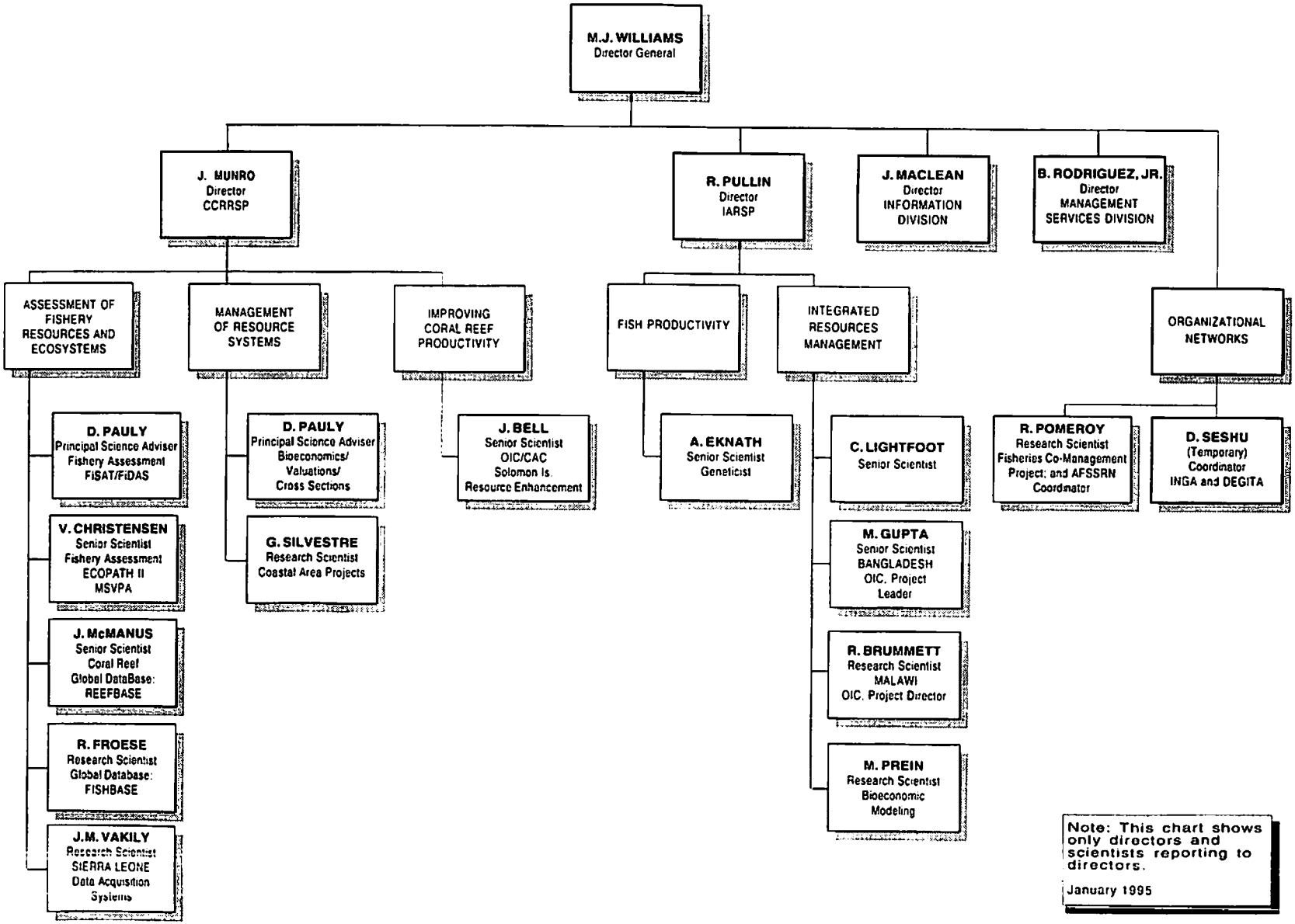


Fig.1. The Consultative Group on International Agricultural Research (CGIAR) is an informal association of 41 public and private sector donors that supports a network of 16 international agricultural research centers. The group was established in 1971.

Table 1. Members of the ICLARM Board of Trustees.

John L. Dillon (Chair)
Dayton Alverson
Nyle Brady
Barry Keith Filshie
Masaru Fujiya
Zimani David Kadzamira
Jacqueline M. McGlade
Britha Helene Mikkelsen
Benedict P. Satia
Roberto S. Sebastian (ex-officio)
Serge M. Garcia (ex-officio)
Meryl J. Williams (ex-officio)

ICLARM Organizational Chart



Note: This chart shows only directors and scientists reporting to directors.

January 1995

INLAND AQUATIC RESOURCE SYSTEMS PROGRAM

Program Objective

To foster the sustainable use of inland aquatic resource systems by poor farmers, raising their incomes, improving the nutritional status of their families and communities and increasing the supply of safe and affordable freshwater farmed fish produce.

This objective is being pursued in two interactive thrusts:

- Fish Productivity - To develop new tilapia and carp breeds to be farmed in ponds and rice floodwaters by resource-poor farmers.

- Integrated Resources Management - To develop sustainable integrated agriculture-aquaculture farming systems for resource-poor farmers.

In addition, the IARSP has two program-wide activities: the Network of Tropical Aquaculture Scientists (NTAS) and plans for commissioning reviews on inland aquatic resource systems.

1. Program-Wide Activities

1.1 *Network of Tropical Aquaculture Scientists (NTAS)*

ICLARM Staff : Dr. Roger S.V. Pullin, Ms. Mary Ann P. Bimbao

Collaborating Institutions : -

Donors : ICLARM core funds

Duration : Continuous from July 1987

Objectives

- To enhance communication among aquaculture scientists working in the tropics, especially in genetics, integrated agriculture-aquaculture farming systems and coastal aquaculture.

- To facilitate increased output by these scientists by assisting them in information and database searches, research and methods, data analysis and interpretation, and by publishing some of the research findings of members in the *Aquabyte* section of *Naga, the ICLARM Quarterly*.

Background and Justification

Aquaculture scientists in tropical developing countries often lack critical information for their research activities. They tend to work in isolation using outdated research methods and approaches. They are not well informed on the status of aquaculture development, ongoing research by fellow scientists, and recent publications and results. This lack of awareness reflects the high costs of communication and information, particularly books and technical reports. Tropical aquaculture scientists therefore need a mechanism to exchange information, results and ideas: a need that can be served by a network.

The responses to a questionnaire sent to NTAS members in 1992 indicated that many members feel well served by the NTAS and *Aquabyte* and would like to continue their membership. Results from this questionnaire were used to publish, in 1993, the first full NTAS Directory with detailed information on members' fields of interest, and listing of all contact addresses and numbers (telephone, fax, telex and e-mail, if available). Feedback received from members about the NTAS Directory is that they find it useful for information exchange, particularly among scientists with common research interests. Some suggested that the next edition of the NTAS Directory should be made available for distribution on diskettes.

The NTAS attracts members with research interests that are mostly guided by the same principles that guide ICLARM's work. Published articles and news items reflect this.

1994 Results

NTAS membership rose from 469 to 556 during the year. The demand for the membership directory in 1994 was so high that supplies are exhausted.

Scores Against Principles

1.	Sustainability	n/a
2.	Equity	H
3.	Gender	H
4.	Participation	M
5.	Systems approach	n/a
6.	Anticipatory approach	n/a

Expected Outputs in 1995

- Four issues of the *Aquabyte* section of *Naga, the ICLARM Quarterly*, with articles, news items, letters, photoessays, and thesis abstracts sent in by members.

- Free computerized literature searches, supply of published material unobtainable from reprint requests, and providing communication links among research scientists.

- A new edition of the NTAS Directory will be prepared for distribution on diskette.

- A survey of NTAS members' views on the desirability of forming working groups with special interests.

1.2 *Reviews on Inland Aquatic Resource Systems*

ICLARM Staff : Dr. Roger S.V. Pullin

Collaborating Institutions : -

Donors : To be identified

Duration : Continuous from 1995

Objectives

- To define strategic research agendas (and ICLARM's possible future contributions to these) for aquaculture and fisheries development in inland aquatic resource systems other than that chosen for the 1994-98 MTP period: ponds and rice floodwaters. The systems to be reviewed include reservoirs, small lakes, floodplains and wastewaters.

Background and Justification

Given its limited budget, ICLARM chose, for the 1994-98 MTP period, to focus the work of its Inland Aquatic Resource Systems Program (IARSP) on the resource system for which the most pressing needs and opportunities could be seen with respect to resource-poor farmers: i.e., ponds and rice floodwaters. This was based upon the priority setting done in ICLARM's strategic planning. However, other inland aquatic resource systems (reservoirs, small lakes, floodplains and wastewaters) have potential for fish production and livelihood,

and strategic research agendas are needed for this, with ICLARM's possible roles clarified for future MTP periods. This can be done through commissioned reviews.

Scores Against Principles

1.	Sustainability	H
2.	Equity	H
3.	Gender	L
4.	Participation	L
5.	Systems approach	H
6.	Anticipatory approach	H

Expected Outputs in 1995

- Proposals for donors to fund commissioned reviews on one of the additional aquatic resource systems listed above; reservoirs or wastewaters will be the priority.

2. Fish Productivity Thrust

2.1 *Genetic Improvement of Farmed Tilapias (GIFT)-Phase II*

ICLARM Staff : Dr. Ambekar E. Eknath, Dr. Roger S.V. Pullin, Ms. Belen O. Acosta, Ms. Marietta P. de Vera, Ms. Madeleine Dalusung, Ms. Ravelina R. Velasco, Ms. Carmela Janagap, Mr. Hernando Bolivar, Mr. Gaspar Bimbao, Ms. Ma. Josephine France Rius

Collaborating Institutions : The Philippine Bureau of Fisheries and Aquatic Resources (BFAR) and Department of Agriculture; the Freshwater Aquaculture Center of the Central Luzon State University (FAC/CLSU); the Philippine Bureau of Agricultural Statistics; and the Institute of Aquaculture Research of Norway (AKVAFORSK) through the Norwegian Center for International Agricultural Development

Donor : United Nations Development Programme

Duration : 1993-1997

Objectives

- To develop improved breeds of tilapia and provide those fish breeds to national testing programs and thence to fish farmers.

- To strengthen national institutions in aquaculture genetics research.

- To establish a mechanism for international exchange and evaluation of improved breeds and research methods.

Background and Justification

The GIFT project is a major strategic research initiative in applied genetics, breeding, and germplasm improvement in tropical aquaculture. The Nile tilapia *(Oreochromis niloticus)* has been chosen as a model species for the GIFT project because of its worldwide importance in aquaculture and short generation time. However, this work, by providing useful methodologies, is expected to have similar benefits for other finfish species, especially carps. The planned program of collaborative research, training and information dissemination will strengthen the capacity of national institutions to carry out relevant research and to apply the findings in evolving self-sustainable national fish breeding programs.

The GIFT project has already demonstrated that documentation, evaluation and use in selective breeding programs of fish genetic resources can result in rapid genetic gain. This had not been previously demonstrated in tropical aquaculture to any significant extent.

The ICLARM-coordinated International Network on Genetics in Aquaculture (INGA) (see Special Projects section) and its regional project "Dissemination and Evaluation of Genetically Improved Tilapia in Asia" (DEGITA) (see Special Projects section) have resulted largely from the research successes of the GIFT project.

Scores Against Principles

1.	Sustainability	H
2.	Equity	H
3.	Gender	M
4.	Participation	H
5.	Systems approach	H
6.	Anticipatory approach	H

1994 Results

This year, fifth generation experiments were started. All results from previous generations have shown consistent mean growth superiority of GIFT strain in relation to control groups. On-farm trials were conducted and significant yield differences between the GIFT and local strains were observed.

Expanded on-farm trials were initiated as part of a socioeconomic impact assessment study under the auspices of DEGITA and the Philippine Tilapia Industry Development Program.

A fourth expanded experiment to estimate genetic variation for age- and size-at-first spawning was initiated and several other approaches to record sexual maturation in tilapias are being reviewed.

Screening of new Nile tilapia germplasm for stress tolerance (cold temperature and salt) was inconclusive due to loss of data in these environments from tag loss, flooding and accidental pesticide poisoning.

Cryopreservation and maintenance of live germplasm were continued. These activities have become more demanding in terms of resources. Clearer directions for this activity are needed including the replication of collections elsewhere.

A socioeconomic benchmark survey of Philippine tilapia farming was completed and data analysis is in progress. Training of farmer cooperators in monitoring of on-farm performance of improved breeds was continued.

Substantial progress was made in assisting the Philippine National Tilapia Breeding Program. Dispersal of fish through Regional Outreach Stations of the Philippine Department of Agriculture proceeded as planned. Continuous scientific and technical support were provided by the GIFT staff.

The contributions of the GIFT team to INGA activities included assistance in organizing the first INGA Steering Committee Meeting and in the preparation of draft Standard Research Methodologies and Reporting Procedures for Evaluation of Fish Genetic Materials and the Manual of Procedures, used in the GIFT project for possible adoption by other national programs; distribution of germplasm and improved breeds to Asian INGA member countries - Bangladesh, China and Indonesia and Vietnam; and organization of a study visit for three Indian scientists actively involved in the India rohu (*Labeo rohita*) breeding program.

Construction of dedicated research facilities began in March 1994. However, the work was slowed considerably by frequent heavy rains.

Expected Outputs in 1995

- Further selection for growth of the GIFT breed of tilapia, with estimation of genetic gains.
- A report on the socioeconomics of tilapia farming in the Philippines.
- Completion of new dedicated research facilities at BFAR-FAC/CLSU by mid-year.
- Commencement of a series of commissioned reviews on high priority areas of tilapia genetic research: saltwater and cold tolerance; disease and parasite resistance; and tolerance of low water quality.
- Continuation of database management and germplasm conservation (live fish and cryopreserved spermatozoa).
- Planning new research on sexual maturation, growth and metabolism.
- Commencing training in quantitative genetics for the GIFT project staff and collaborators.
- Plans for future work on Asian and African carps.

2.2 *Comparison of the Nutritional Energetics of Two Nile Tilapia Strains: an Experimental GIFT Strain and the Widely Farmed Thai Chitlada Strain*

ICLARM Staff	:	Dr. Roger S.V. Pullin, Dr. Ambekar E. Eknath
Collaborating Institutions	:	Asian Institute of Technology (AIT), Bangkok, Thailand
Donor	:	Overseas Development Administration, (ODA) [holdback funds]
Duration	:	April 1995-April 1997

Objectives

- To determine whether the phytoplankton filtration efficiency/digestibility of the GIFT strain is higher than for the Chitlada strain.

- To determine whether the GIFT strain can absorb more nutrients from natural food and low quality farm-made feeds than the Chitlada strain, by enhanced digestive efficiency.

- To determine whether the GIFT strain can tolerate low dissolved oxygen (DO) and recover more quickly from low DO stress than the Chitlada strain.

- To determine whether the GIFT strain can grow well on low quality feeds, such as duckweed, in static and in recirculatory water systems.

- To compare the growth of the GIFT and Chitlada strains in fertilized ponds with and without supplementary feeds.

- To evaluate resource partitioning between the two strains when they are grown in polyculture with carp species that are commonly farmed in Asia.

Background and Justification

The Genetic Improvement of Farmed Tilapia (GIFT) project has developed an improved strain of Nile tilapia for low-cost sustainable aquaculture. It grows 60% faster and has 50% higher survival than some strains currently farmed in the Philippines. Additional trials have commenced in other Asian countries. The development of a fast growing tilapia strain is encouraging. However, it is important to assess the nutritional, physiological or behavioral basis of its superiority over other strains. This project will evaluate the nutritional energetics of the GIFT strain of Nile tilapia in direct comparison with the Thai Chitlada strain.

There are several abiotic and biotic factors that affect growth and survival of fish. Provided that major abiotic factors such as temperature, pH, alkalinity and toxic concentrations of ammonia and nitrite are within optimal/tolerable ranges, acquisition of feed resources and the ability to tolerate (and to grow in) relatively low DO concentrations are important factors in small-scale aquaculture. The basis for the superior growth performance of the GIFT strain might derive from enhanced nutrient intake and/or low DO tolerance.

Scores Against Principles

1.	Sustainability	H
2.	Equity	H
3.	Gender	M
4.	Participation	L
5.	Systems approach	H
6.	Anticipatory approach	H

Expected Outputs in 1995

- GIFT Nile tilapia grown to maturity at AIT and their progeny raised in parallel with stocks of the Chitlada strain to produce fish with the same rearing history for use in comparative experiments.

- Parallel experiments started to evaluate the digestibility of selected feedstuffs (phytoplankton, green fodder, low-quality farm-made pelleted feeds and high-quality commercial pelleted feeds.

- Two strains grown under different DO concentrations over three months to evaluate effects of DO on their feed intake and growth.

- Resource partitioning of the two strains of fish in monoculture and polyculture (with common carp, silver barb, rohu) pond systems assessed.

2.3 *Research on the Tilapia Genetic Resources of Ghana for Their Future Conservation and Management in Fisheries and Aquaculture*

ICLARM Staff	:	Dr. Roger S.V. Pullin, Dr. Durvasula V. Seshu, Ms. Ma. Christine Casal
Collaborating Institutions	:	The Institute of Aquatic Biology (IAB), Accra, Ghana; the Zoologisches Institut and Zoologisches Museum, Universität Hamburg (UH), Germany
Donor	:	Bundesministerium für Wirstchaftliche Zusammernarbeit (BMZ)/ Deutsche Gesellschaft für Technische Zusammenarbeit, GmbH (GTZ)
Duration	:	1991-1996

Objectives

- To determine the status of the tilapia genetic resources of Ghana with a view to future conservation of their biodiversity and their management.

- To demonstrate the use of appropriate methods for such documentation in tropical developing countries.

- To analyze and interpret all information gained so as to formulate guidelines for the management of fish genetic resources in Ghana and a national breeding program to develop inland aquaculture and to publish

these in a form appropriate for use by policymakers, scientists and extension organizations.

- To strengthen the capabilities of IAB and Ghanaian scientists and administrators in fish genetic resources research and management.

- To disseminate the results as widely as possible by means of workshops and publications.

Background and Justification

Many African countries are seeking to develop their fisheries and aquaculture to improve the livelihood of rural people and to provide their growing rural and urban populations with more animal protein. The genetic resources of African fish are of major importance in these efforts towards sustainable development. In this proposal, Ghana, with its fast-growing population, is taken as an example of this situation, from which lessons can be learned that are applicable in other African countries.

Ghana currently produces annually about 308,000 t of fish from all capture fisheries including about 55,000 t from the Volta Lake and 1,150 t from reservoirs. There may be some scope for growth in inland fisheries but the marine fisheries are judged to be already exploited at the maximum sustainable levels. Fish production from aquaculture in Ghana is currently only about 330 t/year. The extent of freshwater and brackishwater sites in Ghana (lakes reservoirs, lagoons and farm ponds) suggests that inland aquaculture has considerable scope for growth. This is also indicated by land/water capability studies undertaken by FAO.

The tilapia (genera *Oreochromis, Sarotherodon* and *Tilapia*) are the most important fishes for future aquaculture development in Ghana and throughout Africa. Currently the tilapia stocks in Ghana are considered to be "pure" and of great importance to tilapia culture worldwide.

This project complements the activities of Ghanaian institutions in the ICLARM-coordinated International Network on Genetics in Aquaculture (INGA) one of which (Ghana) is a founder member.

Scores Against Principles

1.	Sustainability	H
2.	Equity	L
3.	Gender	M
4.	Participation	L
5.	Systems approach	L
6.	Anticipatory approach	H

1994 Results

The project was extended for a further two years, July 1994 - June 1996. A planning meeting for the extension was held at UH in October 1994. Activities were continued, aimed at developing field serological techniques for identifying tilapia pure species and hybrids. The principal methods used are: agglutination assays of erythrocytes, using lectins; allozyme electrophoresis of muscle proteins; polyacrylamide gel electrophoresis (PAGE) of general muscle proteins and parvalbumins; isoelectric focusing (IEF) of proteins; and double diffusion tests. All these techniques were applied to identify genetic markers for tilapia species (in Ghana) except the double diffusion test, and yielded genetic markers for groups of species and individual species. Among the lectins tested, a *Limulus polyphemus* (LPA) (horseshoe crab) lectin distinguished *Tilapia* spp. from *Oreochromis* and *Sarotherodon* spp. by its negative reaction with erythrocytes of *Tilapia* spp. Among *Tilapia* spp., *T. zillii* was distinguished from *T. guineensis* and *T. dageti* by the positive reaction of *T. zillii* with SBA (*Glycine maximus*/soybean) lectin and its negative reaction with the other two.

By allozyme electrophoresis, monomorphic loci with species-specific alleles have been found for the identification of the three most important Tilapia species *(T. zillii, T. dageti,* and *T. guineensis)*. Five of the loci are AHD-1, MDH-1, LDH-1, SDH-1 and Alpha GDPH-1.

By PAGE, species-specific electropherogram patterns and subunits with estimated molecular weights have been identified. For example, Parvalbumin subunits with molecular weight of 13.5 and 20 KD were found to be specific for *T. zillii*. For *T. dageti* and *T. guineensis,* subunits of 18 and 24KD, respectively, were species-specific. These and other distinguishing markers will be further studied to provide inputs to the production of a manual on tilapia characterization.

Expected Outputs in 1995

- Continued work on monoclonal antibodies and a biochemical key for genetic characterization of Ghanaian tilapias, based on blood, hemoglobins, erythrocyte membranes and, subject to exploratory results, leucocytes.

- Commencement of testing of the biochemical key and development of a field kit for tilapia characterization.

- Organizational work for the project's African regional workshop planned for 1996.

- Commencement of work on a technical handbook for tilapia characterization for assisting national researchers.

3. Integrated Resources Management Thrust

3.1 *Integrated Resources Management (IRM) Group and Development of RESTORE Software*

ICLARM Staff	:	Dr. Clive Lightfoot, Dr. Mark Prein, Mr. Jens Peter Tang Dalsgaard, Ms. Mary Ann P. Bimbao, Ms. Teresita Lopez, Mr. Farlyz Villanueva, Ms. Emma Luisa A. Orencia
Collaborating Institutions	:	International Institute of Rural Reconstruction (IIRR), Cavite, Philippines; ICLARM outreach teams and national collaborators in Bangladesh, Malawi and Vietnam
Donors	:	ICLARM core funds, Danish International Development Assistance
Duration	:	1991-1998

Objectives

- To improve the way farmers manage their land and water resources through integration of aquaculture and agriculture.
- To develop participatory research procedures for farmers to integrate aquaculture into their farming systems.
- To develop participatory research methods for enhancing farmers' natural resources management skills.
- To develop an analytical framework, including customized software, for monitoring the impact of integration on households, assessing the sustainability of integrated farming systems and providing direct feedback to farmers.

Background and Justification

Developing integrated agriculture-aquaculture (IAA) farming systems is not the same today as it was 10 years ago when ICLARM first undertook this kind of research. Much has been learned and development imperatives have changed. The pursuit of maximum commodity yields has now given way to exploring sustainable management of natural resources. The concentration on

systems developed at research stations has given way to farmer participation in technology development.

Resource-poor farmers are the target and very few of them culture fish. Ways are needed to integrate fish farming on resource-poor farms, not solely to produce more fish, but as part of a strategy to develop sustainable farming systems.

A farmer participatory research protocol that brings farmers and scientists together to transform existing farming systems of resource-poor farmers into IAA farming systems is the aim of ICLARM's integrated resources management (IRM) approach. This transformation process is guided by a set of 'sustainability indicators' to ensure that the farming systems developed are ecologically and economically sustainable and that many resource-poor farmers can adopt them.

Scores Against Principles

1.	Sustainability	H
2.	Equity	H
3.	Gender	M
4.	Participation	H
5.	Systems approach	H
6.	Anticipatory approach	H

1994 Results

The IRM group continued the development of the RESTORE software (Research Tools for Natural Resource Monitoring and Evaluation), with data collection and analysis. The conversion of Philippine and ICLARM outreach datasets into RESTORE spreadsheet versions has continued. Spreadsheet templates in EXCEL and a draft manual are available for distribution. A database version of RESTORE, using ACCESS, has begun with programming for data transfer routines between EXCEL and ACCESS versions.

Dry season 1994 data were collected from 14 farmers cooperating with the International Institute for Rural Reconstruction (IIRR) in Cavite, Philippines. The data were analyzed and shared with farmers in an Impact/Planning workshop for the wet season 1994. The results showed that, although there was much variability for the majority of farmers, positive changes occurred in three out of four sustainability indicators (recycling, profit-cost ratio, and capacity). Diversity remained about the same, ranging from around 15 to 20 cultivated species per farm. This will improve shortly as more fruit trees, vegetables and catfish are being integrated this coming season.

RESTORE data collection was expanded to include non-integrated farms as well as rice-fish integrated farms in Antique and Nueva Ecija provinces, Philippines, and the training of enumerators has started. Questionnaires on household socioeconomics and nutrition were developed and pretested for an exploratory study of three RESTORE farmer cooperators.

Data from 39 farmers were gathered to enable a comparative study of 1991 and 1993 RESTORE data sets. A Vietnamese counterpart, Mr. Sanh, worked on the data at ICLARM in October.

Expected Outputs in 1995

- New research partnerships in African and Asian ecoregions at ICLARM's main outreach research sites and at collaborative sites of other research partners.
- National staff trained in the IRM approach and the use of RESTORE software.
- Clarification of indicators for assessing the sustainability of IAA farming systems.
- Publication of an operational description of the "Integrated Resource Management" approach to IAA research and development, with case studies from the IRM group outreach sites.
- Preparation of a field manual of farmer participatory field methods, targeted at ICLARM collaborators and other national researchers.
- Publication of IRM participatory tools for natural resources management in agriculture in the FAO 'Farm Systems Management Series'.
- Production of diskettes for a beta test of an ACCESS-based program of the RESTORE software.
- Development of EXCEL-based spreadsheet templates for assessing the impact of IAA farming systems on household nutrition and income.

3.2 *Development of Sustainability Indicators for Integrated Agriculture-Aquaculture Farming Systems*

ICLARM Staff	:	Dr. Mark Prein, Dr. Clive Lightfoot, Ms. Sherlyn Bienvenida
Collaborating Institutions	:	University of Kassel (GHK), Germany; national institutions in the Philippines and Vietnam.

Donor : Bundesministerium für Wirstchaftliche Zusammernarbeit (BMZ)/ Deutsche Gesellschaft für Technische Zusammenarbeit, GmbH (GTZ)

Duration : October 1994-September 1996

Objectives

- To develop and test a set of sustainability indicators for evaluating the performance of integrated agriculture-aquaculture (IAA) on small farms.
- To formulate a range of simulation models of IAA systems at different levels of integration.
- To disseminate results through a workshop, ICLARM publications and peer-reviewed journals.
- To train national and project staff at appropriate ICLARM work sites in the application of tools for participatory monitoring and evaluation (PME) of system integration.

Background and Justification

ICLARM's "Integrated Resources Management" (IRM) approach (see p. 12) explores how aquaculture can transform farming systems through integrated management of bioresources, so as to improve total farm productivity and sustainability. Bioeconomic and ecological models can provide sustainability indicators for system transformations. Socioeconomic impact of, and constraints to, the adoption of integrated agriculture-aquaculture (IAA) by resource-poor farmers must also be identified, along with policy implications.

To study IAA possibilities on small farms requires a systems perspective in which not only the fishpond *per se* is studied, but also the natural resource systems that provide resources for and are affected by a farming household's activities. In tropical developing countries, many of these natural resources have been degraded through farming practices.

Data on the economic, ecological and nutritional benefits of IAA are still scarce. Moreover, for determination of sustainability, clear definitions, criteria and quantitative indicators are lacking. If IAA systems are to be successfully disseminated in the future, tools for measurement of their sustainability must be available to assist the development process.

Indicators such as enterprise diversity, bioresource recycling, biological productivity, and economic efficiency have been suggested as hypothetical

indicators of overall farm performance. Such indicators are themselves governed by a multitude of variables interacting on farms and their surrounding biogeographic and sociocultural environment. The indicators are derived from data collected in the course of participatory monitoring and evaluation.

To validate and refine the indicators, two simultaneous approaches are proposed. One is to conduct multivariate statistical analyses of farm data and indicators. The other is to formulate steady-state and dynamic simulation models of farms based on detailed environmental and farm data.

1994 Results

The project leader and nationally recruited staff were hired and visits were made to the University of Kassel and to CGIAR's Ecoregional Approaches meeting at ISNAR in December.

Scores Against Principles

1.	Sustainability	H
2.	Equity	M
3.	Gender	L
4.	Participation	H
5.	Systems approach	H
6.	Anticipatory approach	H

Expected Outputs in 1995

- Formulation of model types and procedures.
- Training workshops in the Philippines (March) and Malawi (May) or Vietnam (to be decided), subject to in-country conditions and resources.
- Listing of hypothesized indicators and data requirements.
- Testing of a first set of models.

3.3 *A Modeling Approach to the Determination of Ecological Sustainability in Integrated Agriculture-Aquaculture Farming Systems*

ICLARM Staff : Mr. Jens Peter Tang Dalsgaard, Dr. Clive Lightfoot, Dr. Mark Prein, Mr. Roberto Oficial

Collaborating Institutions	:	Royal Veterinary and Agricultural University, Denmark; University of the Philippines at Los Baños, Laguna, Philippines; the International Institute of Rural Reconstruction, Cavite, Philippines
Donor	:	Danish International Development Assistance
Duration	:	1994-1995

Objective

- To model and analyze the characteristics of rice-based agroecosystems in order to identify chief system properties that may serve as quantifiable indicators of the ecological state and ecological sustainability of the systems

Background and Justification

ICLARM's Inland Aquatic Resource Systems Program has chosen to focus on ponds and rice floodwaters for strategic research on integrated resources management and sustainability for its first 5-year period (1994-98). IRRI and ICLARM are also discussing how to collaborate more on rice-fish systems research. ICLARM's work stresses the ecological basis of sustainability and the ecology of rice-based farming systems that could incorporate aquaculture. This project aims to produce ecological models of these systems to indicate their prospects, including sustainability, based on mainstream ecological rather than conventional agricultural descriptors.

Scores Against Principles

1.	Sustainability	H
2.	Equity	L
3.	Gender	L
4.	Participation	M
5.	Systems approach	H
6.	Anticipatory aspects	H

1994 Results

A research assistant was hired and began fieldwork in May. The development of modified version of ECOPATH II, for steady state agroecosystem modeling, was initiated at the North Sea Center in July by Dr. Villy Christensen and Mr. Jens Peter Dalsgaard. Also an exploratory paper on ecological sustainability indicators was presented at the Asian Farming Systems Symposium.

Expected Outputs in 1995

- Completion of field work.
- revised version of a previously (1993) presented paper on ecological sustainability in farming systems analysis will be published by "Ecological Engineering, the Journal of Ecotechnology."
- Construction of steady-state models from data collected from four Philippine rice-based smallholder agroecosystems (1994-1995).
- Further adaptation of the ECOPATH II software for agroecosystems analysis and the incorporation of this additional facility into future versions of ECOPATH.
- Preparation of journal papers describing the results.

3.4 *Sustainable Aquaculture Development for Poverty Alleviation and Improved Nutrition in Bangladesh*

ICLARM Staff	:	Dr. Modadugu V. Gupta, Dr. Clive Lightfoot, Dr. Roger S.V. Pullin, Ms. Mary Ann P. Bimbao
Collaborating Institutions	:	Fisheries Research Institute, Mymensingh; Bangladesh Agricultural Research Council, Dhaka
Donor	:	USAID
Duration	:	June 1993-May 1995

Objective

- To assist the national research institutions of Bangladesh in the development and dissemination of sustainable, low external input aquaculture practices that integrate with other farming activities.

Background and Justification

Fish is an important source of animal protein for the people of Bangladesh but is in short and diminishing supply. The country has vast water resources some of which are presently under- or unutilized. Available capital intensive aquaculture technologies are not suitable for adoption by resource-poor farmers. Hence, the project has been assisting the national research and development institutions and a number of NGOs in developing low-external input, low-cost,

integrated agriculture-aquaculture (IAA) practices that could be sustained by the rural poor, using mostly on-farm resources.

This has required on-station research; farmer participatory research; dissemination of the technologies developed through training government and NGO extension workers; training of scientists in IAA research; assisting in preparation of trainers' training manuals; and conducting impact studies for feedback to research.

Dissemination of results is done in collaboration with NGOs, which provide feedback from different agroecological regions. The project also addresses gender issues through the involvement of women in pond aquaculture, through which they contribute to household income, resulting in their empowerment. This work is expected to benefit not only resource-poor rural households but also to contribute to increasing the availability of affordable fish in urban areas and indeed throughout the country.

Scores Against Principles

1.	Sustainability	H
2.	Equity	H
3.	Gender	H
4.	Participation	H
5.	Systems approach	M
6.	Anticipatory approach	H

1994 Results

This project developed further some low-input, low-cost aquaculture technologies which are being transferred to and tested in different agroecological zones of the country. Over 3,500 farmers managing 828 ponds are participating in these studies; 57% are women.

Wild germplasm of silver barb (*Puntius gonionotus*) was brought to Bangladesh from Indonesia and Thailand for selective breeding. Two crosslines were produced and their performance is being studied.

A survey of hatcheries and nurseries was completed, to identify the constraints for production of the seed of silver barb which has proven to be an excellent species for culture in ponds and ricefields.

A survey was completed at one of the research sites to assess the impact of research on adoption of integrated systems and the impact on fish production and incomes. This showed not only that all the farmers had taken to aquaculture compared to only 8% of farmers practising fish culture during the preresearch

period. Fish production has increased from about 300 kg/ha during the preproject period to 2,575 and 1,320 kg/ha among farmers who participated in the research and those who did not, respectively.

Studies were undertaken for assessing the feasibility of culturing fish in deeply flooded ricelands during the wet season, alternating with rice farming during dry season. Farmers obtained fish production of 700-1,600 kg/ha in four months rearing. These results hold promise for bringing large tracts of flooded ricelands under fish culture in Bangladesh.

A pilot program was initiated, in collaboration with an NGO, for involving landless people in integrated rice-fish farming in large size plots (up to 15 ha). wherein landowners grow rice and the landless groups grow fish.

A survey was initiated to assess the factors affecting: farmers' decision to adopt or reject integrated rice-fish farming practices, management practices followed by the adopters; production and benefits obtained and problems if any in adopting integration.

A national workshop on "Broodstock Management and Opportunities for Genetic Improvement of Cultivated Species" was organized and attended by hatchery managers, scientists, planners and administrators. The workshop produced recommendations to the Government for imposing restrictions on the hatcheries on use of inferior and small broodfish for seed production. Two further workshops on "Technology Transfer through NGOs and Feedback to Research", were attended by senior government officials and NGOs.

A large number of training programs, farmers' rallies and study tours were organized (see National Research Support section).

Expected Outputs in 1995

- Consolidating and reporting results.
- Finalization of proposals to continue this work from a broader perspective, including nutritional impacts and livelihood.

3.5 *Research to Develop Guidelines in Bangladesh for Wider Use in Researching Local Organizational Change in the Design and Introduction of Aquaculture Technologies*

ICLARM Staff : Dr. Clive Lightfoot, Dr. Modadugu V. Gupta

Collaborating Institutions : Overseas Development Institute (ODI), London, various NGOs in Bangladesh

Donor : Overseas Development Administration (ODA) [Holdback funds]

Duration : March 1994-March 1996

Objectives

- To identify the types of NGO/government agency/international research center (here ICLARM) coalitions most appropriate for identifying and addressing clients' needs in aquaculture.

- To seek mechanisms that will allow such coalitions to sustain themselves by identifying and meeting partners' expectations and constraints, and by establishing means of undertaking necessary course corrections.

- To develop models and procedures that might be adapted by ICLARM to other country contexts.

Background and Justification

Present evidence suggests that NGOs and government agencies are not yet well positioned for two-way 'experiential' participation between farmers and researchers in integrated agriculture-aquaculture (IAA) work. Many agencies, including ICLARM, are now in the process of setting aside traditional ideas about top-down 'transfer of technology' in favor of participatory, 'farmer first', two-way learning models.

These models, if successful, could become the dominant paradigm for the future. Although the idea of farmer participation in research is now fairly well established, it tends to be mainly one-way and consultative: i.e., researchers bring in ideas which they adapt with the farmers, rather than responding to farmer-generated technical needs. Furthermore, the samples of farmers encountered by researchers are often biased towards larger-scale, better-off categories and attempts by outsiders to understand 'farmer-generated' problems can sometimes be complicated by farmers' abilities to anticipate 'available' agendas over real needs.

This project aims to contribute to the development of a 'learning mode' in which technological needs are genuinely identified at the farmer level. ICLARM's long-standing collaborative relationships in Bangladesh with NGOs and government agencies, through which IAA systems have been studied, modified and extended, provide a suitable setting for this case study and methodological project.

Scores Against Principles

1.	Sustainability	H
2.	Equity	H
3.	Gender	H
4.	Participation	H
5.	Systems approach	H
6.	Anticipatory approach	H

1994 Results

Substantive work commenced in April 1994. The ODI consultant, Dr. David Lewis, visited ICLARM Headquarters and Dhaka for discussions with ICLARM staff, government officials and NGO staff. Dr. Khaled Ehsan, who has considerable experience of social science issues in Bangladesh, joined the project in July and began work with NGOs, government staff and farmers on the constraints that they face in this work and opportunities for positive change. A further focus of his activities is assessment of mechanisms for the selection, by NGOs, of the households with whom they will undertake aquaculture activities.

Expected Outputs in 1995

- Identification of appropriate institutional arrangements (especially those linking NGOs and public agencies) to test, adapt and provide feedback on technologies developed by ICLARM.
- Reports on the introduction and adaptation of IAA technology in rural Bangladesh, through a workshop involving all collaborators.
- Commencement of work on a training and resource kit, including a training video, to be completed in 1996.

3.6 *Aquaculture Development in Africa: Learning from the Past and Implementing Research Results on Small-Scale Farms*

ICLARM Staff : Dr. Randall Brummett, Dr. Reg Noble, Mr. Daniel Jamu, Mr. Fredson Chikafumbwa, Ms. Emma Kambewa, Ms. Chipo Jamu, Dr. Roger Pullin, Dr. Clive Lightfoot, Dr. Eric Worby, Mr. Jens Peter Tang Dalsgaard

Collaborating Institutions : Malawi Fisheries Department, Malawi Department of Research and Environmental Affairs, University of Malawi, Malawi-German Fisheries and Aquaculture Development

Project, Central and Northern Regions Fish Farming Project, Aquaculture for Local Community Development

Donor : Bundesministerium für Wirstchaftliche Zusammenarbeit (BMZ)/ Deutsche Gesellschaft für Technische Zusammenarbeit, GmbH (GTZ)

Duration : 1986-1994

Objectives

- To develop, through collaborative research conducted at Malawi's National Aquaculture Center (NAC) with African biological and social scientists, aquaculture technologies approrpiate to the prevailing conditions in rural Africa.

- To strengthen aquaculture research, training and extension through information exchange and research collaboration with African institutions.

- To assess the constraints to, potential for, and impact of, low-input integrated aquaculture by conducting on-farm, farmer-participatory research and development.

1994 Results

From April 1994, on-station research was concentrated on refining and testing the PondSim model for simulating, on the research station, conditions in smallholder ponds. In 1994 three cycles of research were completed using PondSim with the PondSim model on-station results. All gave results within 10% of those obtained by farmer cooperators. PondSim-based research also included polyculture experiments with indigenous species *Oreochromis shiranus* and *Barbus spp.*; differential utilization of weedy ponds by juvenile and adult *Tilapia rendalli* harvesting intervals for production of *T. rendalli* fingerlings in single ponds using indigenous technology; and production and genetic erosion associated with traditional partial-harvesting systems for *O. shiranus.*

On-farm collaborative research continued throughout the year, emphasizing monitoring and evaluation of integrated pond-crop systems and their impact on the whole farm system. The results demonstrate that ponds do have a significant effect on the cash economy of farming families which is further emphasized when incomes of unit areas of land are compared rather than whole farms.

To increase the potential impact and widen the target group for integrated agriculture-aquaculture, ICLARM conducted trials of the technical and economic

feasibility of fish farming systems based on ponds which hold water only during the rainy season (December through April). Farmers in the test group were satisfied with their results despite the drought-induced shortness of the growing season. Average net profit of the system was $743 per hectare of pond surface. Even before the end of the experiment, two neighboring farmers constructed ponds and purchased fingerlings from project participants in response to the generally perceived success of the venture.

Partial harvesting systems might overcome the necessity of removing all the fish from the pond and increase overall yield at the same time. ICLARM compared hook-and-line, basket traps and the reed fence for their effectiveness in managing *O. shiranus* partial harvest systems. Partial harvesting did not affect overall yield, but spread out the harvest over a longer period. Ponds fished with hook-and-line one afternoon per week yielded almost 1,000 kg/ha/264 days. Ponds fished with two basket traps produced 660 kg/ha and ponds "seined" twice on one day per week with the reed fence produced 720 kg/ha. Unfished ponds produced nearly 800 kg/ha. The fish taken by hook-and-line averaged 18.4 g; those taken in the traps averaged 6.3 g; and those captured by the reed fence averaged 32.6 g. The fact that partial harvesting does not decrease yield is encouraging in social systems, such as that in Southern Malaŵi, where fish are regularly removed for special occasions in between normal harvests. While there is no way to be sure of how fish will be disposed of in the rural household, the smaller weekly quantities of smaller fish might be more likely to be eaten, particularly by children, than the larger quantities of fish harvested at the end of the production cycle. In addition, the hook-and-line method is very usable by children.

The project ended in December 1994 and the senior staff, Drs. Randall Brummett and Reg Noble, are now completing a substantial Technical Report for publication. The Report documents the results of over 60 socioeconomic and biotechnical studies made by project staff over the nine years of the project, in the process of developing new technologies for rural smallholders. These have been formulated into an information kit for extension agents, research summaries for use in other projects and a wide range of peer reviewed and other publications. In all, project staff produced 115 publications and made 75 national and international presentations. Many national staff attained tertiary degrees through the project and now occupy mid-level and senior decisionmaking positions in the Malaŵian aquaculture community.

3.7 *An Aquaculture Research and Development Network for Smallholder Farms in Southern Africa*

ICLARM Staff : Dr. Randall Brummett, Dr. Reg Noble, Mr. Fredson Chikafumbwa, Dr. Roger S.V. Pullin, Dr. Clive Lightfoot.

Collaborating Institutions : Southern African Centre for Cooperation in Agricultural Research and Training (SACCAR), Food and Agriculture Organization of the United Nations (FAO), Malawi Fisheries Department, Malawi Ministry of Agriculture and Livestock Development, University of Malawi, Malawi-German Fisheries and Aquaculture Development Project (MAGFAD), Aquaculture for Local Community Development (ALCOM/FAO), Swedish Agency for Research Cooperation with Developing Countries, Zambian Department of Fisheries, Zimbabwean Department of National Parks and Wildlife Management (ZDNP).

Donor : to be identified

Duration : 1995 - 2000 (proposed)

Objectives

- Using existing farm resources, develop technologies to optimize efficient use of water and nutrients on small farms.
- Strengthen national capacity to study and develop new integrated farming systems.
- Develop farmer-participatory methods for integrating aquaculture into existing smallholder farming systems.
- Define and measure economic and ecological sustainability of integrated aquaculture.
- Identify why farmers adopt, continue or discontinue integrated agriculture-aquaculture (IAA).
- Provide more precise estimates of potential impact of IAA.

Background and Justification

Policies being adopted in Africa and much of the rest of the world aim at creating more economically and environmentally sustainable food production.

The environmental costs (of soil erosion, water pollution and bioaccumulation of pesticides, among others) and direct financial costs (in the form of subsidies) of industrialized agriculture continue to be enormous. Current smallholder farming practices in subSaharan Africa will not be able to support the continent's population. However, building up their productive capacity rather than replicating the unsustainable farming systems of industrialized agriculture, might create an environment from which more sustainable agricultural practices and rural economic security can evolve.

Rural development-oriented R & D programs and institutions have been working on the component technologies for such a strategy. Integrated pest management, integrated nutrient management and agroforestry are examples of this work. Integrated Resources Management (IRM) offers potential for reducing dependence upon external farm inputs, improving farm function and productivity, restoring degraded environments and enhancing household nutrition; making it a logical component of a more sustainable approach to farming.

The proposal for this work was approved by SACCAR and the Southern African Development Community (SADC) Council of Ministers, for submission to donors.

The project proposes to work in a strategic, cross-sectoral, collaborative and farmer-participatory mode to provide the answers to long-standing questions about how smallhold farms function and evolve. It will also build capability within SADC institutions to conduct strategic and applied research in IRM and will directly complement and strengthen the applied research, development and extension activities of existing national and regional programs (e.g., ALCOM, SADC/ICRAF and the FAO Farming Systems Programme). It aims to generate new IAA farming systems for direct use by smallholders.

Scores Against Principles

1.	Sustainability	H
2.	Equity	H
3.	Gender	M
4.	Participation	H
5.	Systems approach	H
6.	Anticipatory approach	H

Expected Outputs in 1995

- Analyses and publication of existing IRM datasets.
- Identification of farms within five target agroecosystems for farming systems evolution analysis will be identified.

- A new field data collection system.
- Identification of seconded project personnel and collaborating experiment stations in Zambia and Zimbabwe.
- Recruitment of a regional social scientist.
- Refurbishment of the library and information services at the National Aquaculture Centre (NAC), Domasi, Malawi, including CD-ROM capabilities and linkages with ALCOM, FAO and SACCAR databases.
- Publication of about 20 studies from the previous ICLARM Malawi project.
- Improvement of research facilities at the NAC: pumps, tanks and research ponds.
- Student supervision and collaborative IRM experiments.

3.8 *Research for the Future Development of Aquaculture in Ghana*

ICLARM Staff	:	Dr. Mark Prein, Dr. Clive Lightfoot, Dr. Roger Pullin, Ms. Grace Coronado
Collaborating Institutions	:	Institute of Aquatic Biology, Ghana; Ghana Rural Reconstruction Movement, Ghana; International Institute for Rural Reconstruction, Philippines; Institute of Renewable Natural Resources, University of Science and Technology, Ghana
Donor	:	Bundesministerium für Wirstchaftliche Zusammenarbeit (BMZ)/ Deutsche Gesellschaft für Technische Zusammenarbeit, GmbH (GTZ)
Duration	:	June 1991 - May 1994

Objectives

- To make firm recommendations for future aquaculture development in Ghana, especially for those species and systems appropriate to small-scale farmers.
- To provide guidelines for similar work in other countries, i.e., a comprehensive integrated approach to aquaculture development.

- To develop microcomputer software for use in such activities.

- To train Ghanaian personnel in these methods and approaches.

- To publish the results of this work and to disseminate these widely in Ghana, other developing countries and to agencies and institutions with interests in aquaculture development, particularly those working for African development.

1994 Results

The project ended in May, equipment and vehicles were handed over to the Institute of Aquatic Biology, Accra. Monitoring of 20 farms, which adopted aquaculture-agriculture integration, continued in Ghana. Droughts delayed pond operations in 1994.

At ICLARM HQ, data are still being analyzed for inclusion in the final report to donors and for publication. The results show that integrated agriculture-aquaculture is feasible within the maize-cassava farming system of the forest zone common to West Africa. Trials were conducted with smallholder farmers in the entirely denuded deciduous forest zone (but close to the coastal savanna) using the IRM approach. Considerable economic benefits were achieved, sometimes doubling farm income. These were mainly due to vegetables produced as new enterprises on the farm, enabled by the fishpond. The fish were a minor source of income. Water availability and soil quality are the main constraints to wider adoption. Theoretical nutritional benefits to the farm household in form of micronutrients (and to a lesser extent protein) were identified.

Most encouragingly, about 30 farmers, new entrants to pond management, formed an association to help each other and more farmers. This seems to be self-sustaining.

Expected Outputs in 1995

A substantial Report on the project's results will be published. Although the project has finished, ICLARM staff will maintain contact with the collaborating groups, including the new fish farmers' association and help whenever possible. Ghana's membership to INGA (see Special Projects section) affords a mechanism.

3.9 *The Economics of Integrating Fish into Rice-Based Farming Systems in Asia*

ICLARM Staff	:	Ms. Gesa Horstkotte, Dr. Clive Lightfoot, Ms. Edith Magtibay
Collaborating Institutions	:	Göttingen University, Germany; International Rice Research Institute; Antique Integrated Area Development Foundation, Inc.
Donor	:	Bundesministerium für Wirstchaftliche Zusammenarbeit (BMZ)/ Deutsche Gesellschaft für Technische Zusammenarbeit, GmbH (GTZ)
Duration	:	August 1992 - September 1995

Objectives

- To assess the profitability for small-scale farmers of rice-fish culture in irrigated lowlands.
- To evaluate the potential of fish culture as a vehicle for the introduction of environmentally sound crop technologies.
- To investigate the impact of Integrated Pest Management (IPM) on farmers' perceptions of aquatic life.

Background and Justification

One of the main reasons for the decline of integrated fish culture in ricefields is the application of toxic pesticides. The profitability of pesticide use is significantly overestimated, mainly because of various types of government subsidies. The main factor which allows for the reduction of chemical use in agricultural production is the development of IPM technologies. In addition, technical progress in aquaculture has significantly improved the potential competitiveness of fish as a farm enterprise.

Integrating fish production as an additional enterprise for small-scale farmers offers an attractive supplement to low pesticide-input rice-based farming systems. Because of the high importance of irrigated rice, a high population growth rate and a high level of pesticide use due to various types of subsidies, this scenario applies to the Philippines.

IPM has gained widespread recognition in Asia and has been declared the national pest control strategy of some countries like Indonesia and the

Philippines, but fish culture has not received sufficient attention in this context. Research in Philippine rice-growing areas can provide a case study of relevance to much of Asia.

The question of whether the policy environment, especially subsidies for pesticides, can be seen as a reason for the lack of widespread rice-fish systems has not been examined so far. The possibility of exploiting the complementarity of two production technologies such as rice-IPM and rice-fish culture is the central aspect of this project.

Scores Against Principles

1.	Sustainability	H
2.	Equity	H
3.	Gender	M
4.	Participation	H
5.	Systems approach	H
6.	Anticipatory approach	H

1994 Results

Data gathering was completed in IPM studies and inputting of data on rice-fish farming activities and food consumption has started, with monitoring to derive farming systems models.

A selected village (Catungan IV) in Antique, with favorable conditions for Aquatic Life Management (ALM), was used as a test site for feedback of rice-fish models. A survey of the FAO's IPM Program, "Farmer-Field Schools" showed that use of insecticides has dropped dramatically, but herbicides continue to be used. Farmer knowledge of ALM was not significantly enhanced by FAO's IPM training because its ecosystem analysis puts little emphasis on aquatic fauna, with the exception of the golden snail. The IPM rice-fish economics research will develop model for integrated rice-fish farming systems: analysis from qualitative and quantitative monitoring data of farmer behavior towards ALM.

Expected Outputs in 1995

- Analysis, evaluation and writing up, by August, of the results acquired from fieldwork in Antique and Nueva Ecija provinces, Philippines, and from desk studies, including literature reviews.

- Publication of a conceptual framework for exploring complementarities between Aquatic Life Management and IPM.

3.10 *New Outreach Research Sites*

ICLARM Staff	:	Dr. Roger S.V. Pullin, Dr. Clive Lightfoot, Dr. Ambekar Eknath, Dr. Mark Prein, Ms. Mary Ann P. Bimbao, Dr. John Munro, Mr. Gerry Silvestre, Ms. Miriam Balgos
Collaborating Institutions	:	International Institute of Rural Reconstruction, Cavite, Philippines; National institutions and NGOs in the Philippines and Vietnam, to be identified.
Donor	:	Not yet funded
Duration	:	To be determined

Objective

- To pursue strategic research in Integrated Resources Management (IRM) and Coastal Cross-Sections (CCS) at two new southeast Asian sites (Philippines and Vietnam) so as to generate site-specific results for sustainable aquaculture and fisheries and to provide data for regional and global syntheses.

Background and Justification

ICLARM's IRM and CCS activities are decentralized among a number of outreach sites. All these are based on prior histories of project work (Bangladesh, Malaŵi, and the Philippines). More appropriate sites are needed. The previous site used for IRM work in the Philippines (Cavite) is close to Metro Manila and is becoming industrialized. There are opportunities in the Philippines (western Samar, linking up with a large EC-funded project) and in Vietnam (Mekong Delta) to forge new collaborative relationships and to work at new sites. The data generated would be not only of site-specific relevance but would contribute to global and regional syntheses on routes to more sustainable use of natural resources. This approach can also contribute to ecoregional initiatives.

ICLARM staff have made two missions to the EC western Samar project site, funded by that project's resources, and held discussions with senior project staff and Manila EC Delegation officials towards preparing future proposals.

Scores Against Principles

1.	Sustainability	H
2.	Equity	H
3.	Gender	H
4.	Participation	H

5. Systems approach H
6. Anticipatory approach H

Expected Outputs in 1995

Plans and proposals to donors for future research work at these new sites.

COASTAL AND CORAL REEF RESOURCE SYSTEMS PROGRAM

Program Objectives

For coastal resources in general, the aim is to make advancements in fisheries management and resource use based on improved understanding of the coastal fisheries resource base, the social and economic structure of the fishing communities, and the interaction between these and other sectors.

For coral reefs, the objective is to seek ways to realize the potential of their fisheries in a sustainable manner by improving coral reef management and by increasing the productivity of selected species through aquaculture and fisheries enhancement.

The Program pursues its objectives through three thrusts:

- Dynamics of resource systems, including the development of tools for assessing aquatic resources and their assessment, and global documentation of fish biodiversity and coral reef systems.

- Management of marine resource systems, including development of management tools to assess the impact of fisheries sector activities on other sectors and *vice versa.*

- Improving coral reef productivity, through development and evaluation of hatchery technologies and fisheries enhancement systems.

In addition, there is a program-wide activity, the Network of Tropical Fisheries Scientists.

Introduction

The CCRRSP entered 1995 with twenty-one projects in progress, thirteen new proposals under consideration by donors and a substantial number of proposals in various formative stages. Most projects are largely or wholly financed from external sources.

New initiatives for 1994, described in detail below, included projects to develop software to describe coastal transects, to investigate pearl oyster spat collection and cultivation methods, sea cucumber ecology and cultivation, effects of protected areas on recovery of exploited stocks, training programs for

resource and ecological assessment, commercialization of giant clam farming and comparative bioeconomics of coastal aquaculture systems.

Major projects which are expected to be initiated in 1995 include work on sea cucumber cultivation and enhancement, fisheries data acquisition system for integrated coastal resources management, and studies of the scientific basis for the creation and management of marine-protected areas in the Caribbean.

1. Program-wide activity

1.1 *Network of Tropical Fisheries Scientists (NTFS)*

ICLARM Staff : Dr. Daniel Pauly, Sandra Gayosa

Collaborating Institutions : FAO/DANIDA Training Course in Tropical Fish Stock Assessment

Donor : FAO, ICLARM core funds

Duration : Continuous from April 1982

Objectives

- To enhance communication between fisheries scientists working on the assessment, conservation and management of tropical stocks.

- To enhance the output of these scientists by improving access to literature, providing free database searches, distributing manuals and other literature and publishing a regular newsletter.

Background and Justification

Progress in stock assessment work on tropical fisheries has been slow and there are very few, if at all, fisheries which are rationally managed. The reasons are obvious: the biology of fishes, the nature of the fisheries and the institutions that manage them, as well as the limited educational opportunities available to scientists.

A great constraint is the fact that scientific personnel attached to fisheries institutions are often not well-versed in the quantitative aspects of stock assessment. This is partly an effect of the lack of relevant educational support systems. Only recently has fisheries stock assessment, and fisheries science for that matter, been given due consideration in universities in tropical developing

countries. Furthermore, the avenues for information exchange are not many or are not fully utilized.

2. Dynamics of Resource Systems Thrust

2.1 Assessment of Fisheries Resources and their Ecosystems

2.1.1 *Tropical Fish Stock Assessment*

ICLARM Staff : Dr. Daniel Pauly (Project Leader), Mr. Felimon C. Gayanilo, Jr., Dr. Villy Christensen, Mr. Geronimo Silvestre, Dr. Rainer Froese, Mr. Ely Garnace, Mr. Edwin de Guzman

Collaborating Institutions : Predominantly in-house studies with informal linkages with various research institutions.

Donor : ICLARM core funds

Duration : indefinite

Objectives

- To increase our understanding of the dynamics of exploited tropical/subtropical fish communities.
- To develop stock assessment methods which are straightforward and readily applicable to tropical and subtropical stocks.
- To implement and disseminate these methods in the form of widely usable software for research and training.

Background and Justification

Stock assessment methods used in the temperate north were traditionally based on age-structured information. These data are not only difficult to obtain, but have also proven to be costly. ICLARM has been instrumental in making length-frequency-based methods available to tropical developing nations. ICLARM's prominent role in stock assessment of tropical fisheries is based on collaborations with fisheries scientists, dating back to 1978, working on length frequencies for stock assessment.

Since its inception, this project has continued to provide conceptual and methodological advances to understand and manage fisheries resource systems. New approaches and techniques developed were distributed through

computer program routines, now widely used by fisheries researchers in developing countries and increasingly in developed countries as well. One such product is the ELEFAN software, now widely used throughout the world.

In late 1989, it was agreed that a single software be developed that merges the routines in the ELEFAN and the Length-Frequency Stock Assessment (LFSA) package which would become the basic training tool for future FAO and ICLARM courses in stock assessment. The new product was named FiSAT (FAO-ICLARM Stock Assessment Tools). The package has been submitted to FAO for publication and dissemination in 1995. ICLARM has agreed to maintain and expand the capabilities of the software.

In addition to efforts to continually improve FiSAT, ICLARM is also seeking new models appropriate to tropical situations. For example, for cases where length-weight data pairs are lacking to estimate the relationship between length and weight of fishes, a new model was developed to estimate the coefficients (a, b) of the length-weight relationship from length frequencies and sample weights only.

Scores Against Principles

1.	Sustainability	H
2.	Systems approach	H
3.	Gender	M
4.	Equity	H
5.	Partnership	H
6.	Anticipatory approach	H

1994 Results

The highlight of the period was the completion of the FiSAT (FAO-ICLARM Stock Assessment Tools) software, which is the most comprehensive stock assessment package available, together with the User's Guide.

ICLARM's component of the NOAA-funded project on Climate and Eastern Ocean Systems finished and Drs. S. Opitz, E. Arias-Gonzales and D. Pauly completed a book on trophic models of coral reefs to be published by ICLARM.

Drs. D. Pauly and V. Christensen submitted a paper to *Nature* entitled "Primary production to sustain global fisheries". Additionally, Dr. Pauly and colleagues completed a report entitled *Atlas Démographique des Poissons d'eau douce d'Afrique* (ICLARM Tech. Rep. 45, in press). A book based on the JETINDOFISH data is also nearing completion.

Expected Outputs in 1995

The year 1995 will see the publication of several software packages to supplement the existing programs already in circulation:

- After final testing FiSAT will be released along with the User's Guide. A manual which describes the theoretical background of the models incorporated in the software (Gayanilo, F.C. Jr. and D. Pauly. *Theory and Practice of Tropical Fish Stock Assessment*) will also be published by FAO.

- A new software, **ABee**, for the estimation of the coefficients of the length-weight relationship will be published, first quarter of the 1995.

- Drs. Astrid Jarre-Teichmann and Villy Christensen will complete a book titled *Modeling Trophic Flows in Large Eastern Ocean Ecosystems: Temporal and Spatial Comparisons*, to be published by ICLARM.

- The software **ETAL II**, incorporating variants of the commonly used growth model, Von Bertalanffy Growth Function (VBGF), and hence complementing FiSAT, is expected to be published in 1995.

- A version of the **MAXIMS** software, which estimates food consumption from the variations in the diel stomach content of fish, is expected to be ready for publication in 1995.

- Also expected to be ready for publication in the first quarter of 1995 is the **OPUS** software for bioeconomic analysis.

- The **ECOPATH II (ver. 3.0)** is on its final stage of software development. It is expected that the software with a revised user's manual will be ready for publication by mid-1995.

2.1.2 *Modeling of Multispecies Fisheries*

ICLARM Staff	:	Dr. Villy Christensen (Project Leader), Dr. Daniel Pauly, Dr. Geronimo Silvestre, Ms. Sandra Gayosa, Mr. Edwin de Guzman, Mr. Felimon Gayanilo, Jr.
Collaborating Institutions	:	DIFMAR, Denmark, Instituto de Investigacion Pesquera, Talcahuano, Chile
Donor	:	Danish International Development Assistance, ICLARM core funds

Duration : February 1990 - January 1996

Objective

- To develop a hybrid multispecies modeling approach for management of fisheries incorporating biological interaction.

Background and Justification

In 1990, efforts were underway to take the next logical step towards a multi-species analysis through the development of a software called ECOPATH. It was originally conceived by a US scientist, Dr. J.J. Polovina, to quantify energy flow in reef ecosystems. It had an elegant simplicity which allowed it to accommodate the fact that there are usually not enough data in tropical situations to construct more complex models.

The product that emerged from the incorporation of network flow analysis, using methods developed by R.E. Ulanowicz of the University of Maryland, added flexibility and computing power to the approach now called ECOPATH II; its comprehensive manual is available in English, French and Spanish. In 1993, the significance of this development became apparent to the scientific world in the publication of a compilation of studies of ecosystems.

The approach used in describing ecosystems has found its ways to applications other than marine ecosystems, e.g., to farming systems using integrated resources management.

No methodologies exist at present for management of multispecies tropical fisheries incorporating biological interaction between fish species. Based on methods developed in temperate areas and length-based assessment methods developed for tropical application, it is intended to develop hybrid size/time based models for such management.

Scores Against Principles

1.	Sustainability	H
2.	Systems approach	H
3.	Gender	n/a
4.	Equity	n/a
5.	Partnership	M
6.	Anticipatory approach	H

1994 Results

Dr. Villy Christensen participated in the ICES Workshop to Evaluate the Potential for Stock Enhancement (19-24 May 1994, Charlottenlund Castle, Denmark). New draft versions of the trophic modeling software, ECOPATH II incorporating multiple detritus compartments and a pilot version of an ECOPATH II module for multispecies fisheries management (MSVPA), were completed.

A more versatile MS Windows-version of ECOPATH II is in preparation that will add more computing power and more flexibility to the system.

Responsibility for further development of ECOPATH II was transferred to the Tropical Fish Stock Assessment Project at the end of 1994.

Expected Outputs in 1995

A test version of the Windows-based ECOPATH III will be ready for limited distribution (to cooperators only) early in 1995.

It is intended to use the new ECOPATH modules on two or more existing data sets in 1995: Brunei Darusalam EEZ and Central Chile EEZ. Both applications are to be carried out in cooperation with scientists involved in the data acquisition. Of the two applications one is expected to be ready and documented in 1995.

2.1.3 *Climate and Eastern Ocean Systems*

ICLARM Staff	:	Dr. Daniel Pauly, Dr. Villy Christensen
Collaborating Institutions	:	Pacific Fisheries Environmental Group of the National Marine Fisheries Service (NMFS), Monterey, USA; Food and Agriculture Organization of the United Nations (FAO), Rome, Italy; Agence pour le Development en Cooperation (ORSTOM), Paris, France; Universidad Nacional Agraria (UNA), Lima, Peru; Alfred Wegener Institute for Polar and Marine Research (AWI), Bremerhaven, Germany
Duration	:	October 1992 to September 1994

Objectives

- CEOS general: To assemble key information and time series on the major eastern ocean boundary (upwelling) ecosystems of the world and to

extract, mainly through the comparative method, likely scenarios for future, biological and social consequences of global climate change on upwelling resources.

- ICLARM specific: To describe changes in the four major upwelling ecosystems of the world (Benguela Current, Canary Current, Humboldt Current and California Current) off South and North West Africa and the Americas through ECOPATH II models describing different states of these ecosystems; and to document the ichthyofauna of these upwelling ecosystems through FishBase and through preparation of synopses for the anchovies species important in each of these systems *(Engraulis capensis, E. encrasicolus, E. ringens* and *E. mordax).*

Background and Justification

The injection of millions of tonnes of greenhouse gases into the earth's atmosphere may be viewed as a gigantic experiment aimed at exploring the earth's reaction to such challenge. Unfortunately, this experiment is run without proper "controls", and hence the heated debates about the actual impact of those gases may last too long, beyond the time where the "experiment" should be called off. The international scientific community if forced, however, to address this problem in spite of the lack of scientific controls.

One way to address this is through the comparative method, a major tool in those disciplines in which experiments are hard to perform, e.g., evolutionary biology, and fisheries science.

The CEOS project is an international collaborative study of potential effects of global climate change on the living resources of the highly productive eastern ocean upwelling ecosystems and on the ecological and economic issues directly associated with such effects. A major focus of the study is the clupeoid fishes (anchovies, sardines, etc.) that are heavily exploited in these large marine ecosystems and which have recently been exhibiting episodes of collapse, rebound, or switches in dominance.

Eastern ocean upwelling ecosystems present certain advantages that may make the study of effects of climate change on marine ecosystems particularly tractable; thus the study may serve an even wider purpose as an illustration of the sorts of impact that could affect more complex marine ecosystems.

One approach to identifying trends in ecosystem processes will be through the construction of sequences of trophic models of the ecosystems using ECOPATH II and by computing the values of indices expressing their emergent properties.

1994 Results

The key results derived from ECOPATH II models of upwelling systems were presented in September 1994 in Monterey, California, at an International CEOS Workshop.

The draft of a book by Drs. A. Jarre-Teichman (former ICLARM staff) and V. Christensen entitled "Modeling trophic flows in large eastern ocean ecosystems: temporal and spatial comparisons", presenting these results has been completed and will be published in 1995 on ICLARM's Studies and Reviews series.

Also, a number of shorter CEOS contributions have been published through the *Fishbyte* section of *Naga, the ICLARM Quarterly*. One CEOS contribution authored by Dr. Pauly and published in French by ORSTOM presents a simple physiological mechanism to explain the migration of fishes along the coast of northwestern Africa.

2.1.4 *The Fish Resources of Western Indonesia: a Baseline Study of Biodiversity*

ICLARM Staff	:	Dr. Daniel Pauly, Ms. Luningning Malumay
Others	:	MFRI - Mr. Badrudin, Mr. Budihardjo; FAO - Dr. Purwito Martosubroto; IMR - Dr. Gabriella Bianchi; Consultants - Dr. John McManus, Dr. Annadel Cabanban, Dr. Jürgen Saeger
Collaborating Institutions	:	Directorate General of Fisheries (DGF) Jakarta, Indonesia; Marine Fisheries Research Institute (MFRI) Jakarta, Indonesia; Food and Agriculture Organization of the United Nations (FAO), Rome, Italy; and *R/V Fridtjof Nansen* Project, Marine Fisheries Institute (IMR), Bergen, Norway
Duration	:	One year, beginning January 1993 (extended to June 1994)

Objectives

- To assemble, standardize and analyze the detailed data collected during the Indonesian-German JETINDOFISH trawl survey along the Indian Ocean Coast of Indonesia, from early 1979 to late 1981.

- To compare the results of these surveys with those of other trawl surveys conducted in the same period in adjacent areas of western Indonesia.

- To use these analyses to define the status of the coastal fish resources of western Indonesia prior to the onset of demersal fisheries developments, and thus to provide a baseline against which future changes in biodiversity can be evaluated.

Background and Justification

Indonesian fish catches have ceased to increase as fast as they did from the 1960s to the 1980s. This is particularly true for coastal bottom fish, exploited by a wide range of small- and large-scale gears, notably trawls.

Indeed, Indonesian coastal stocks have been greatly reduced in size, with obvious consequences for the economics of the commercial fisheries, and the incomes of small-scale fishers and the fish supply to consumers.

Extensive research was conducted in Indonesia from the early 1970s to the early 1980s, especially in the form of scientific trawl surveys funded by bilateral projects to determine location, size and composition (in terms of sizes and species) of fish stocks. However, in many cases the data collected in these early surveys were analyzed only superficially and far more can be extracted from these data sets using modern database and data analysis systems.

In general, results were reported in terms of total biomass, ignoring the very different susceptibilities to exploitation of, for example, anchovies and groupers. This led to fleet investments and management regimes geared toward hgh catches of biomass, without regard to the much higher social benefits that could be obtained by selective fishing gears operated by small-scale fishers.

This eventually led to a ban of trawling in western Indonesia, and a virtual halt to related research. This project thus makes use, in the context of biodiversity, of a large, if underused database; it should serve as a model for other tropical areas where similar underused databases exist.

1994 Results

Twelve of the 16 chapters to be included on the book were completed by year's end, and it is expected that all will be complete, and the book go to press by mid-1995.

Expected Outputs in 1995

The completed work entitled "The Fish Resources of Western Indonesia: a Baseline Study of Biodiversity" (edited by D. Pauly and P. Martosubroto) will be published.

2.2 Global and National Databases for Coastal and Coral Reef Fisheries

2.2.1 *Development of a Database on Fisheries Resources (FishBase)*

ICLARM Staff : Dr. Rainer Froese (Project Leader), Dr. Maria Lourdes D. Palomares, Ms. Susan M. Luna, Ms. Crispina Binohlan, Ms. Armi Torres, Ms. Liza Agustin, Ms. Pascualita Sa-a, Ms. Emily Capuli, Mr. Rodolfo B. Reyes, Mr. Roberto Cada, Ms. Rachel Atanacio (part-time), Ms. Portia Bonilla

Collaborating Institutions : FAO, American Fisheries Society (AFS); International Game Fish Association; World Conservation Monitoring Center; Musée Royal de l'Afrique Centrale; Musée National d'Histoire Naturelle; Zoologisches Institut and Zoologisches Museum, Hambrug; Marine Resources Assessment Group (MRAG), London; EPOMEX, Universidad Autonoma de Campeche, Mexico; and several individual researchers.

Donor : European Commission

Duration : October 1988 to September 1995 (followed by permanent core support)

Objective

- To facilitate the sustainable use and conservation of fish biodiversity by making scientific information readily accessible through a computerized encyclopedia of key information.

Background and Justification

FishBase contains key information on fish populations such as nomenclature, ecology, population dynamics, aquaculture, genetics, physiology and occurrence of fishes. It was conceived as a "tool" to help fisheries researchers and managers to better understand and manage their national resources.

FishBase was designed to provide information on a very wide range of topics pertaining to the fishes in a given country. These include the current scientific name and classification, the international (FAO, AFS, FishBase) common name, its global commercial importance, and key information on life history, population dynamics. It contains more than 1,000 data fields organized in 50 tables with altogether half a million records. More than 200 procedures access this information and create a variety of outputs.

FishBase makes use of published literature (e.g., journal articles, technical reports, theses, etc.) and recent revisions of fish species or families such as those produced by FAO.

The WINMAP software, a low-level Geographic Information System (GIS) which forms part of the FishBase package, can be used to display a variety of maps based on the occurrence and abundance records in the database. This feature is specially useful in fish biodiversity research. Maps showing the global occurrence of members of an Order, Family, Subfamily, Genus or a Species can be created.

The CD-ROM version of FishBase will be distributed at nominal cost to fisheries institutions worldwide. Special emphasis will be given to developing countries, some of which will be supported in purchasing the necessary hardware and receive training on how to use FishBase and related analytical tools.

Scores Against Principles

1.	Sustainability	H
2.	Systems approach	M
3.	Gender	M
4.	Equity	H
5.	Partnership	H
6.	Anticipatory approach	H

1994 Results

As of 1994, the FishBase team has been able to incorporate more than 12,000 species extracted from more than 7,000 references, representing half of the estimated 25,000 species of fish in the world.

The FishBase Team headed by Dr. Rainer Froese was busy producing ICLARM's first CD-ROM with FishBase and additional software which was presented at the CGIAR Center's Week end of October, at a November Workshop of the Pacific Science Foundation, and at the Biodiversity Fair in Nassau in early December (in conjunction with the finalization of the Convention on Biological Diversity). FishBase has more than 1,000 fields for specific information, organized in 50 tables, with altogether half a million records. More than 200 procedures access this information to produce a variety of reports.

Finalizing the work of four years meant checking as many of these entries as possible and highlighting unchecked data. While this in itself was a huge task, the team was also burdened with the task of transferring all data from DataEase under DOS to Microsoft ACCESS under WINDOWS which is a more versatile

user interface. At the same time there was the need to produce a concise user's manual, a brochure, and a poster.

Expected Outputs in 1995

The move from a DOS (DataEase) to a Windows (Microsoft Access) database software was much more difficult than anticipated.

This move necessitated a consolidation phase, i.e., test and repair the various routines created for the Windows version. A consolidated version is expected to be ready by September 1995. For adequate performance, FishBase now requires at least a 486 PC with at least 8 megabytes of memory.

2.2.2 *ReefBase: A Global Database of Coral Reef Systems and their Resources*

ICLARM Staff : Dr. John W. McManus (Project Leader), Dr. John L. Munro, Mr. Benjamin M. Vallejo, Jr., Mr. Lambert A. Meñez, Ms. Grace U. Coronado

Collaborating Institutions : World Conservation Monitoring Center (WCMC)

Donor : European Commission

Duration : September 1993 - October 1995

Objectives

- To design a relational database for structured information on coral reefs and their resources that will serve as a computerized encyclopedia for use in reef management, conservation and research.

- To set up a network of coral reef researchers and managers who will contribute to the database.

- To collaborate with other national, regional and international databases and GIS facilities relating to reefs, and provide a means of comparing and interpreting information at the global level.

- To distribute analytical routines and develop new ones for the database that will make full use of the information and ensure appropriate interpretation and synthesis.

Background and Justification

Coral reefs are the most biodiverse ecosystems in the oceans and, at higher taxonomic levels, may be the most diverse in the world. They provide food and livelihood for many millions of coastal villagers throughout the developing world. In many areas, entry into a coral reef fishery requires very little capital investment, and reefs are often considered to be common property. This has led to a predominance of economically disadvantaged fishers entering the fisheries, who are then maintained at marginal levels of existence by competition from other entrants. The pool of such entrants tends to rise because of high population growth rates and inequitable resource distribution in general. This leads to a problem, identified as Malthusian overfishing, which involves the tendency for fishers to increasingly use fishing methods which are destructive to the environment, and to themselves. In areas where villages are adjacent to fringing reefs and shoreline coral communities, organic pollution from sewage and siltation from onshore activities often cause a rapid decline in reef viability. Decreasing resource availability leads to greater desperation, which leads to increasing reef damage, in a spiral of devastation.

Although it is now clear that there *is* a global problem, it is not possible to determine *how great* the problem is. There is no central repository of coral reef information, and no means by which coral reef data from around the world can be summarized, compared or evaluated for global trends.

The ReefBase system will serve national and international resource managers and national scientists primarily in three ways. First, by providing global and regional estimates of the status and utility of coral reefs, action will be initiated and prioritized to improve the management of critical areas. Second, the database will provide summaries of existing data on local reef systems (including resource maps and aerial images where available), and provide references for further investigation. Third, the database will facilitate the geographic comparison of coral reefs, from which generalizations about the natural states of reefs, their potential fishery production and their responses to stresses can be made.

Scores Against Principles

1.	Sustainability	H
2.	Systems Approach	H
3.	Gender	H
4.	Equity	H
5.	Partnership	H
6.	Anticipatory Approach	H

1994 Results

In the ReefBase Project, the initial database program was completed and the set of data input screens, covering more than 50 pages, was printed out and sent to 30 reviewers worldwide for comments and suggestions. Many of the reviewers' comments were included in a major revision and expansion of the database which took place in June and July. Data were input experimentally during revisions in June, and intensive data gathering has taken place since July. Initial efforts were broadly focused, so as to determine the practicality of the chosen data fields. Information on the Pacific Ocean region was included in a report involving several international collaborators on the status of the Pacific reefs, presented in the workshop "Marine/Coastal Biodiversity in the Tropical Island Pacific Region", Hawaii, 2-4 November 1994.

Concurrent ReefBase work at the WCMC has resulted in digitized maps for a variety of reef systems, including those of Antigua and Barbuda, Belize, Cayman Islands, Cook Islands, French Polynesia, Mauritius and Rodriguez, Nauru, Niue, St. Kitts and Nevis, Saudi Arabia, Tonga and others.

Formal presentations of the ReefBase efforts were made at scientific meetings in Belize, the Philippines, Australia and Luxembourg. These presentations, combined with announcements of the ReefBase program, have generated hundreds of inquiries and offers of collaboration, leading to the establishment of the project as a *de facto* international center for information exchange on coral reefs.

In approximately three months of data searching, data on over 1200 reefs have been inputted. These data includes 600 records of bottom cover, which yield a mean of 33% hard coral coverage. This helps to confirm widespread recent speculation that coral cover worldwide is generally less than 50% on morphologically identifiable coral reefs. A search is on for older cover records, to use in determining if any long-term trends are identifiable.

Expected Outputs in 1995

The current pilot funding for ReefBase will continue until October 1995. By this time, a useful database will have been developed which will summarize certain key information on all the major reef areas of the world. This database will permit generalizations such as fisheries potentials and zonation comparisons, and will provide some capabilities for evaluating the current threats to coral reefs given qualitative and quantitative data stored in the database. The system will be distributed on a CD-ROM along with FishBase to key institutions.

2.2.3 *Fishery Database for the Development and Management of the National Fisheries off Sierra Leone*

ICLARM Staff : Dr. J.M. Vakily

Collaborating Institutions : Institute of Marine Biology and Oceanography, Fourah Bay College, University of Sierra Leone; Department of Marine Resources; West-Northwest Artisanal Fisheries and Community Development Programme

Donor : European Commission

Duration : April 1991 - September 1994

Objectives

- To evaluate the present status of the fishery of Sierra Leone and the level of exploitation in both the commercial and small-scale sector.
- To make recommendations on possible fishery management strategies
- To strengthen IMBO's capabilities to carry out research into the marine resources of Sierra Leone
- To devise a permanent system of fisheries data collection and assist in the rehabilitation of the statistical unit of the Department of Marine Resources.
- To publish the results of this work and to disseminate them in Sierra Leone, other countries bordering the Gulf of Guinea, and to agencies and institutions with interests in fisheries development, particularly those working in west African countries.
- To improve the availability of, and access to, literature in the existing library of the Department of Marine Resources.

1994 Results

Efforts were concentrated on completion of a fishery survey database system and associated users manual and technical reference manual. Although the initial application of the software system is for Sierra Leone fish resources, the system is generic and can be adopted to any fisheries summary data.

Considerable efforts were also made in supporting IMBO and the library of the Department of Fisheries. Several papers have been submitted for publication.

Expected Outputs in 1995

The project will terminate in January 1995, with the completion of a final technical report to the European Union, the Government of Sierra Leone and the host institution. Additionally the Fisheries Surveys Database System (FiDAS) user's manual and user's technical reference handbook will be completed and the software available for further use and development.

3. Management of Marine Resource Systems Thrust

3.1 *Comparative Analysis of Coastal Transects*

ICLARM Staff : Mr. Gerry Silvestre (Project Leader), Dr. Daniel Pauly, Dr. Hal McArthur (Affiliate Scientist from the University of Hawaii at Manoa), Ms. Abbie Cruz-Trinidad, Mr. Len Garces, Mr. Felimon Gayanilo, Jr.

Collaborating Institutions : University of Warwick, UK; Philippine Council for Aquatic and Marine Research and Development, Philippines; Department of Fisheries, Brunei; National University of Singapore, Singapore; Department of Fisheries, Malaysia

Donor : European Commission

Duration : January 1994 to November 1995

Objectives

- To elaborate generic coastal system types, processes and development trajectories.
- To develop selected methodologies in support of integrated management of coastal systems.
- To create generic problem/opportunity structures and management actions/ guidelines.
- To develop interactive software (SIMCOAST) to provide cross-sections and transect analysis.

- To package these results and transfer them effectively to users/beneficiaries.

Background and Justification

In many developing countries, especially in ASEAN, coastal areas are suffering considerable levels of stress due to increased demand for and conflicting uses of natural resources plus downstream effects of land-based sectors. These have led to economic losses, increased conflicts, and a significant decrease in biodiversity and the abundance of most renewable resources.

The Strategy on International Fisheries Research (SIFR) and Agenda 21 of UNCED placed high priority on integrated coastal zone management to reverse the worldwide trend of increased coastal degradation and overexploitation. While previous research on coastal management problems tackled specific resources and disciplinary areas, it is now seen as imperative to apply an integrated framework, because of the vast ecological and socioeconomic linkages created by the use of coastal resources.

A novel approach to structuring coastal management problems and solutions is being developed by this project, which is a cooperative undertaking involving ICLARM, the Ecosystems Analysis and Management Group (EAMG) of the University of Warwick, UK, and individual scientists identified by the ASEAN Subcommittee on Marine Sciences.

Scores Against Principles

1.	Sustainability	H
2.	Systems Approach	H
3.	Gender	M
4.	Equity	M
5.	Partnership	H
6.	Anticipatory Approach	H

1994 Results

Most activities were centered around ASEAN endorsement of the Project. This was granted during the ASEAN Committee on Science and Technology (COST) meeting in September. A project brochure has been produced and conceptual framework development activities are ongoing. The latter has resulted in a shift in focus to integrated coastal zone management (as underlying framework) from the original integrated coastal fisheries management underpinnings. A workplan for producing an annotated bibliography of integrated coastal zone management literature and decision-analysis works has been set

into motion. Transect description of sites in Southeast Asia has been initiated and will continue to the end of the year (together with conceptual work).

Expected Outputs in 1995

A project workshop is scheduled in June 1995 to be cohosted by the Association of Southeast Asian Marine Scientists, with proceedings to be finalized by project termination.

The conceptual framework will be jointly developed by ICLARM staff with expertise in the natural and social sciences. Additionally, transect descriptions and analyses of selected coastal sites in the ASEAN will be completed. This will involve close collaboration with technical lead persons identified by the ASEAN-COST Subcommittee on Marine Science and will lead to technical papers which will be presented during an Expert Consultation in August 1995. The foregoing will lead to a comparison of disciplinary methodologies and their relevance to the transects approach, including the identification of processes related to these issues, and the simulation of the impacts of management options on critical coastal resources. ICLARM collaborators from the University of Warwick will lead this activity.

3.2 *Lagonoy Gulf Resource and Ecological Assessment*

ICLARM Staff	:	Manila-based: Mr. Geronimo T. Silvestre (Project Leader), Mr. Cesar Z. Luna, Mr. Len R. Garces, Mr. Quintin Sia III, Mr. Marcos Jose Vega, Ms. Rowena Andrea Santos, Mr. Danilo Bonga, Ms. Maharlina Gorospe, Ms. Flordeliz Bravo, Ms. Zoraida Alojado, Mr. Romelito Garcia Bicol-based: Mr. Ronnel Dioneda, Mr. Leo Pura, Mr. Renante Albao, Ms. Karina Luth Discaya, Mr. Antonino Mendoza, Mr. Eduardo Bola, Mr. Rolando Buenaflor, Mr. Florante Bustamante, Mr. Anastacio Cante, Mr. Jose Gonzales, Jr., Mr. Jovel Tasarra
Collaborating Institutions	:	Bicol University College of Fisheries (BUCF)
Donor	:	Philippine Fisheries Sector Program; ICLARM core funds
Duration	:	July 1993 - January 1995

Objectives

The Lagonoy Gulf Resource and Ecological Assessment (LG-REA) Project aims to provide the scientific/technical information base for sustainable use and management of nearshore marine resources in Lagonoy Gulf. Specifically, the overall objectives of the LG-REA are:

- To assess the status and exploitation/utilization of the fisheries resources in Lagonoy Gulf.

- To evaluate the status and stresses/impacts on critical habitats (i.e., water quality) of consequence to the "health" of the fisheries resources.

- To elaborate feasible management options, guidelines and strategies (including investment opportunities for alternative livelihood) that maximize benefits from fisheries resource utilization and minimize sectoral conflicts and/or incompatibilities.

- To strengthen the capabilities of BUCF in research related to coastal resources management.

Background and Justification

In pursuit of project objectives, five interrelated components are being implemented (1) training (2) situational analysis, (3) capture fisheries assessment, (4) habitat assessment, and (5) integration of results and formulation and assessment of resource management options. The results of the project will serve as inputs for the coastal cross-section project (see p. 46) being implemented by ICLARM.

Scores Against Principles

1.	Sustainability	H
2.	Systems approach	M
3.	Gender	n/a
4.	Equity	M
5.	Partnership	H
6.	Anticipatory approach	H

1994 Results

The Project is proceeding satisfactorily in producing the data required for assessment of the fisheries and habitats in the area. The fisheries resources, principally small pelagics, appear to be moderately exploited. Water quality appears to be within established national standards. Reefs are in fair condition,

with the use of explosives as the major issue. Mangrove areas are down to 50% of their original coverage due to harvesting for firewood and fishpond conversion. Presentations about initial project results were made to an ADB field mission and to a Bureau of Agricultural Research Review Workshop.

Expected Outputs in 1995

- A technical monograph summarizing the results of all assessments conducted (inclusive of all primary and secondary data gathered).

- A report giving a synopsis and integration of results from the various project components and their management implications in terms of feasible options, guidelines and/or strategies.

3.3 *Rapid Assessment of Management Parameters (RAMP)*

ICLARM Staff : Dr. John W. McManus, Ms. Maharlina Gorospe

Collaborating Institutions : Coastal Resources Center (CRC), University of Rhode Islands, USA

Donor : USAID

Duration : January to June 1995

Objectives

- To develop a set of indices for the evaluation of the social, economic and political factors affecting coral reef systems.

- To develop a general approach to the rapid assessment of villages dependent on coral reefs, based on the target set of indices ("a management report card").

Background and Justification

A great deal of interest has arisen recently in the development of methods to rapidly assess the ecology and management status of coral reefs. Considerable progress has been made on ecological assessments. However, although it is widely agreed that data on the social, economic and political variables affecting reef management are essential to the evaluation of the reefs and the development of improved management strategies, there is as yet no set of guidelines for the conduct of the appropriate surveys. It is important for

national, regional and global summaries that the data be summarizable in terms of quantitative indices.

Scores Against Principles

1.	Sustainability	H
2.	Systems Approach	H
3.	Gender	H
4.	Equity	H
5.	Partnership	H
6.	Anticipatory Approach	H

Expected Outputs in 1995

The project will result in a short manual describing the variables and indices to be derived from them, as well as recommended procedures for obtaining the data in a rapid survey.

3.4 *Resource and Ecological Assessment Training for the Fisheries Sector Program of the Philippines*

ICLARM Staff : Mr. Geronimo Silvestre, Ms. Abbie Cruz-Trinidad, Mr. Len Garces, Mr. Quintin Sia, Mr. Danilo Bonga, Ms. Rowena Santos

Collaborating Institutions : Department of Agriculture, Fisheries Sector Program, Philippines Local Authorities

Donor : Fisheries Sector Program

Duration : January 1995 to May 1996

Objective

- To equip "Regional Composite Teams" with the knowledge and skills needed to implement long-term monitoring of various bays in the Philippines, including provision of training manuals, initialization of monitoring by means of a one-year data-collection program.

Background and Justification

ICLARM has previously completed resource and ecological assessments in several localities in the Philippines, leading to an awareness of the need for

continuous monitoring. The project will supply the requisite skills to implement such work.

Scores Against Principles

1.	Sustainability	H
2.	Systems approach	H
3.	Gender	n/a
4.	Equity	n/a
5.	Partnership	H
6.	Anticipatory approach	H

Expected Outputs in 1995

The project will conduct training courses in fish stock coastal habitat and water quality assessment and in socioeconomic studies, followed by a field training phase in these topics. A database will be developed to store and analyze the data acquired.

3.5 *Testing the Use of Marine Protected Areas to Manage Fisheries for Tropical Coral Reef Invertebrates - Anarvon Islands*

ICLARM Staff : Dr J. Bell (Project Leader), Mr. M. Gervis, M. Lincoln-Smith (Consultant), N. Kile (Solomon Islands Ministry of Agriculture and Fisheries)

Collaborating Institutions : Great Barrier Reef Marine Park Authority (GBRMPA), Solomon Islands Ministry of Agriculture and Fisheries (SIMAF), Solomon Islands Ministry of Forests, Environment and Conservation (SIMFEC)

Donor : Australian Centre for International Agricultural Research (ACIAR); The Nature Conservancy (TNC)

Duration : 3.5 years, October 1994 - March 1998

Objective

- To test the hypothesis that abundances of commercial tropical invertebrates will increase on coral reefs closed to fishing, and that the average sizes of individuals in reserves will be greater than those in fished areas.

Background and Justification

This study is being done in conjunction with a proposed marine conservation area of 83 km^2 at the Arnarvon Islands, Solomon Islands. TNC has negotiated a 3-year closure to fishing within this area for trochus, sea cucumbers, giant clams and spiny lobsters with the traditional users. GBRMPA has provided assistance with the statistical design of a monitoring program to assess the effect of the closure. This monitoring program is based on a "Before vs After, Impact vs. Control" design. In this particular case, abundances of all species are estimated from six transects at each of four sites at two islands within three "control" areas, and within the proposed Arnarvon Islands Marine Conservation Area (MCA). Such estimates will be made three times prior to dedication of the MCA in mid-1995, and again on three occasions in 1998.

ICLARM regularly attends meetings of the Management Committee established by TNC to oversee the establishment and surveillance of the MCA. A major impact of ICLARM's initiative to monitor the effects of the MCA has been the raised awareness, both by the traditional users of the area and the Fisheries Division, of the potential value of marine protected areas in the management of coral reef fisheries.

Scores Against Principles

1.	Sustainability	H
2.	Systems approach	H
3.	Gender	n/a
4.	Equity	H
5.	Partnership	H
6.	Anticipatory approach	H

Expected Outputs in 1995

Reports will be completed on three separate sampling trips to assess variability in abundance and size of target species in the proposed MCA, and at three areas that will remain open to fishing, before the conservation area is declared in mid-1995.

3.6 *Coastal Areas Management Training*

ICLARM Staff : Ms. M.C. Balgos (Project Leader), Dr. J.L. Munro, Mr. G. Silvestre

Collaborating Institutions	:	Haribon Foundation, Philippines; Philippine Council for Aquatic and Marine Research and Development, Philippines; Department of Environment and Natural Resources, Philippines; Bureau of Fisheries and Aquatic Resources, Philippines; International Institute of Rural Reconstruction, Philippines; University of Rhode Island, USA
Donor	:	Rockefeller Brothers Fund
Duration	:	January 1995 - December 1996

Objective

- The training program seeks to develop a pool of coastal management practitioners in the Philippines from government organizations, academe, NGOs and POs, both at the national and local levels, who will work together in the formulation and implementation of an integrated coastal management plan for each region in the Philippines.

Background and Justification

This project was initiated because of the need throughout the Philippines for adequate trained manpower in Coastal Management (CM). In addition, the absence of common national goals and standards in the formulation and conduct of CM programs points to such a need.

The program design and curriculum will be developed incorporating recent approaches to coastal management such as combination of regulatory and nonregulatory techniques, use of national and local approaches in varying scales, and participatory planning and implementation. The broad-based nature of the training courses should allow room for various options, scenarios, case studies, problems, approaches and special focus.

Scores Against Principles

1.	Sustainability	H
2.	Systems Approach	H
3.	Gender	H
4.	Equity	H
5.	Partnership	H
6.	Anticipatory Approach	H

Expected Outputs in 1995

- A report on the training needs of middle level managers on coastal management in the Philippines based on the results of a training needs analysis (TNA) to be conducted in the first quarter of 1995.

- A training program design and curriculum developed during the second quarter of 1995 based on the TNA results and consultation of experts in two workshops.

- Training on course development to be conducted during the third quarter of 1995 based on the UNDP TRAIN-SEA-COAST Course Developers Workshop and on the above outputs. The participants to this workshop will come from collaborating organizations in preparation for future course development on specific areas in coastal management.

- Three pilot training courses to be held in Luzon, Visayas and Mindanao to be held during the second half of 1995.

- A Southeast Asian training network scheme in place by the end of 1995 (which is the particular responsibility of ICLARM).

- A system for documentation and postimplementation evaluation in place by the end of the year.

3.7 *Bioeconomic Modeling of Capture Fisheries*

ICLARM Staff : Dr. Jose Padilla (Postdoctoral Fellow), Dr. Daniel Pauly, Ms. Annabelle Cruz-Trinidad, Dr. Robert Pomeroy

Collaborating Institutions : -

Donor : ICLARM core funds

Duration : January 1992 - December 1994

Objectives

- To add price and cost vectors to resource-oriented analyses of multispecies tropical small-scale fisheries, thus enabling "costing" of various management options.

- To contribute to the understanding of the behavior of fishers and thus enabling various co-management schemes.

Background and Justification

Fisheries are amongst the most complex of human activities, linking people with the aquatic environment and its renewable resources. The formulation of management and development schemes must take into account the multiple objectives and multifaceted nature of the system, if meaningful and usable results are to be obtained. From a research perspective, fisheries studies must, of necessity, be interdisciplinary in nature.

Bioeconomic models, which integrate the natural and the human sides of the fishery equation, have served well in describing key elements driving the fishery, particularly biological aspects relating to the fish resource (such as population dynamics and fish ecology) and economic factors that shape human behavior in fish harvesting (such as fish supply and demand, and the investment dynamics that determine entry to and exit from the fishery). The bioeconomic modeling approach has been successful in at least two respects: (a) enabling researchers to develop analyses with considerable intuitive appeal, capturing the dynamics of both fish and fishing vessels; and (b) providing a language which can help bridge the gap between biologists, economists and others working on fishery projects.

1994 Results

Dr. Jose Padilla, a Postdoctoral Fellow, completed the concept paper for a comprehensive and generic fisheries bioeconomic model, and the software implementing this model. The software can be used for the analysis of single-species single-gear fisheries as well as multispecies and multigear fisheries. This research has involved considerable methodological development and two papers presenting new methods implemented in the software have been written and submitted to primary journals: three other papers have been presented at international conferences.

Expected Outputs in 1995

The bioeconomic modeling software currently being developed has a "modular" construction which allows additional routines to be easily incorporated. Future work will be on the development of algorithms that would: a) capture the dynamics of both resources and fisher behavior; b) allow for the explicit consideration of multiple objectives in fisheries management; and c) permit the analysis of the biological interactions in multispecies fisheries by building on the current work on multispecies virtual population analysis (MSVPA). It is also

envisioned that this bioeconomic model for capture fisheries will contribute to the development of a bioeconomic model for aquaculture systems.

3.8 *Bioeconomic Modeling of Coastal Aquaculture Systems*

ICLARM Staff : Ms. A. Cruz-Trinidad, Dr. J. Munro, Dr. J.D. Bell

Collaborating Institutions : -

Donor : ICLARM core funds

Duration : July 1995 - June 1998

Objective

- To develop bioeconomic models of coastal aquaculture systems, particularly for giant clams, with a view to optimizing growout, harvesting and marketing strategies in various Indo-Pacific locations.

Background and Justification

The aquaculture systems developed by ICLARM for various species of giant clams in the Solomon Islands offer a wide range of harvesting and marketing strategies. Optimizing the systems is therefore a major challenge. Models of the systems will be complex because costs increase with the degree of isolation while benefits are, to some degree, positively related. Mortality rates diminish with increasing size while value increases rapidly with increasing size. However, risks of catastrophic loss increase as growout times lengthen. Growth rates are highly variable within cohorts. Four different markets exist at present for the products: small clams for aquaria (5-15 cm), freshly shucked clams for sashimi (15-30 cm), live clams (25-30 cm) for specialist Southeast Asian seafood restaurants and large (>50 cm) clams, particularly for their abductor muscles, for restaurants and hotels, both in the South Pacific and at export destinations in Southeast Asia.

Expected Outputs in 1995

Initial work will involve synthesizing existing data, identifying data needs and organizing the requisite data acquisition.

4. Improving Coral Reef Productivity Thrust

4.1 Aquaculture and Resource Enhancement of Coral Reef Ecosystems

4.1.1 *Biotechnical Systems for Giant Clam Cultivation*

ICLARM Staff : Dr. J. Bell (Project Leader), Mr. M. Gervis, Mr. I. Lane, Mr. Cletus Oengpepa, Mr. Ferral Lasi, Mr. Patrick Timmy, Ms. Angela Grice, Ms. Vanessa Mattin

Collaborating Institutions : Solomon Islands Ministry of Agriculture and Fisheries

Donors : Australian Centre for International Agricultural Research (ACIAR), European Commission (EC), Pacific Development and Conservation Trust, United Nations Development Programme, FAO South Pacific Aquaculture Development Programme

Duration : Operational since 1987. This phase from January 1995 - December 1999.

Objectives

- To identify optimum growing conditions and husbandry methods for six species of giant clams in coastal villages.
- To train village farmers and key regional fisheries personnel in the efficient and profitable culture of giant clams.
- To develop markets for giant clams in the live seafood trade and aquarium industry.
- To maintain genetically diverse F_1 broodstock of each species of giant clam as the basis for future hatcheries throughout the Indo-Pacific.
- To supply giant clam larvae, and training in the rearing of giant clams, to countries in the Asia-Pacific region where giant clams have been overfished or extinguished.

Background and Justification

Coastal communities adjacent to coral reefs in developing countries have few opportunities to develop low-cost industries capable of generating income

and food on a sustainable basis. Giant clam farming is one option. Past research by the Micronesian Mariculture Development Center, James Cook University, the University of the Philippines and ICLARM's Coastal Aquaculture Centre (CAC) in the Solomon Islands, resulted in the development of reliable methods for the spawning and land-based larval rearing of giant clams. The ultimate goal of this research - to develop viable giant clam-farming industries for coastal villages - was, however, never realized. The CAC is completing the international research effort by developing methods to grow six species of giant clams in villages. Over the next 3-5 years, the CAC will run large-scale grow-out trials of each species at up to 20 villages to identify variability in growth and survival among sites, and to identify the most reliable husbandry methods.

This project will provide a firm basis for a sustainable increase in the productivity of coral reefs through the farming of giant clams. It will also yield robust information on the commercial viability of small-scale village giant clam farms. At the conclusion of the project, ICLARM will be in a position to provide advice to national agencies on the costs and benefits associated with farming of giant clams. The maintenance of adequate broodstock, and the delivery of larvae and grow-out technology to a variety of countries, will facilitate the continuation and expansion of giant clam farming.

Giant clam farming is particularly suitable to villagers living on coral reefs because: there is virtually no impact on the coral reef environment; the procedures tend to enhance rather than diminish genetic diversity; the farms can be designed to be economically viable at the village level; the farms have been shown to be particularly successful when run by family units; and there are a variety of markets, including sale for food, aquaria and shellcraft.

Scores Against Principles

1.	Sustainability	H
2.	Systems approach	H
3.	Gender	M
4.	Equity	H
5.	Partnership	H
6.	Anticipatory approach	H

1994 Results

Research on giant clams in 1994 resulted in increased production of seed clams for village grow-out trials. Production from the CAC's nursery increased from 82,000 in 1993 to 157,000 in 1994. In addition, the CAC supplied larvae of *T. gigas* to a Solomon Islander who produced an additional 10,500 seed clams for distribution to villages by early 1995.

The large-scale village grow-out trials of giant clams in 1994 had an increased level of participation by villagers. At 16 villages in Solomon Islands, selected farmers raised three species of giant clams in quantities sufficient to provide the majority of their household income. Previously, village grow-out trials were restricted to small quantities of one species.

The village grow-out trials conducted in 1994 yielded data on variation in growth and survival of several species of giant clams over a large spatial scale. These data have helped to identify the optimum sites for grow-out of certain species. The data have also enabled ICLARM to advise prospective village farmers about the suitability of their sites.

The 1994 grow-out trials also demonstrated that giant clams produced in villages in remote locations can be sold profitably to the aquarium industry. Therefore, ICLARM's methods for growing giant clams not only deliver benefits to village growers, they are sustainable. There is no longer any reason to harvest wild clams from coral reefs to supply the aquarium trade.

The success of several of the grow-out trials in 1994, and the availability and profitability of the markets, resulted in the successful application for funding from the EU's STABEX Program to double the number of grow-out trials in 1995.

Staff from the Fisheries Division, Ministry of Agriculture and Fisheries, and the Marine School of the College of Higher Education in Solomon Islands, were seconded to the giant clam project. These staff were integrally involved in scaling-up the village farming trials. In addition, staff from fisheries departments in Vanuatu, Fiji, Tonga and Marshall Islands visited the CAC for training or advice in village-based farming of giant clams.

Expected Outputs in 1995

- Publications documenting variability in survival and growth of two species of giant clams at numerous village farms.

- Presentation of papers at the World Aquaculture Society meeting, the Pacific Congress on Marine Science and Technology International (PACON) meeting on Sustainable Aquaculture and the Forum Fisheries Agency meeting on Management of Inshore Fisheries Resources.

- Appointment of a coordinator (EU STABEX funds) and scientist (ACIAR funds) to organize and document large-scale grow-out trials. Two trials, involving up to 20 villages, will be set up in 1995.

- Provision of training for fisheries staff from Malaysia.

4.1.2 *A Collaborative Investigation of Options for Spat Collection and Hatchery Production of Pearl Oysters in the Central-Western Pacific*

ICLARM Staff	:	Dr. J. Bell (Project Leader), Mr. M. Gervis, Mr. K. Friedman
Collaborating Institutions	:	Solomon Islands Ministry of Agriculture and Fisheries James Cook University, Australia (JCU)
Donor	:	Australian Centre for International Agricultural Research
Duration	:	November 1993 - November 1995

Objectives

- To quantify spatial and temporal variation in settlement of spat of the blacklip pearl oyster (*Pinctada margaritifera*) over a large spatial scale in Solomon Islands.
- To develop methods for rearing the spat of blacklip pearl oysters in simplified hatcheries suitable for construction in the Asia-Pacific region.
- To develop low-cost methods for growing spat to market size in village-based farms.

Background and Justification

The culture of pearls from blacklip pearl oysters has brought substantial economic benefits to native coastal communities in French Polynesia and Cook Islands. Despite intensive fishing of the species throughout the Pacific earlier this century, these countries managed to establish pearl farming industries due to the nature of their "closed" coral atoll lagoons - spat from the remnant populations were trapped within the lagoons and therefore easy to collect.

The blacklip pearl oyster also occurs throughout much of the more open coral reef habitats of the western Pacific. This project is designed to determine whether it is possible to identify areas in Solomon Islands where the wild spat of this species can be collected in sufficient numbers to establish farms for pearl oysters.

The CAC is also working to provide spat for the establishment of farms by collaborating with Dr. Paul Southgate of JCU to spawn blacklip and rear the larvae in hatcheries. Spat produced by either method will be reared in villages in a participatory research program with village farmers. The adult oysters will be the property of the villagers, and offer the opportunity to earn income through the

sale of the pearlshell, or by adding value through the culture of half pearls and pearls.

Scores Against Principles

1.	Sustainability	H
2.	System approach	M
3.	Gender	M
4.	Equity	H
5.	Partnership	H
6.	Anticipatory approach	H

1994 Results

This project has identified spatial and temporal variability in abundance of larvae of the blacklip pearl oyster, *Pinctada margaritifera*, in Solomon Islands. Abundance was greatest during the first quarter of the year, and in habitats away from the influence of turbidwater or brackishwater. The project has heightened the awareness of the value of blacklip oysters on the part of coastal villagers across much of Solomon Islands. This has had three outcomes: i) villagers now understand the reasons for the national ban on export or pearlshell and conform to it; ii) villagers safeguard wild broodstock; and iii) some villagers have started their own spat collection trials.

The project has been done in close collaboration with scientific staff and regional fisheries officers from the Fisheries Division, Ministry of Agriculture and Fisheries. Their staff are now in a strong position to provide training in the design and installation of spat collectors, the grow-out of wild spat and the maintenance of wild broodstock.

Attempts by staff from the CAC, James Cook University and the Fisheries Division to spawn blacklip pearl oysters resulted in production of small numbers of spat. These trials point to the need to place greater emphasis on the provision of suitable live algal feeds during the culture of the larvae.

Expected Outputs in 1995

- Identification of areas of greatest abundance of wild spat in Solomon Islands.
- Publication(s) on improved methods for collecting spat from the wild.
- Advances in larval rearing of the species.
- Assessment of the merit of continuing the project past the end of 1995.

4.1.3 *Cultivation and Fishery Enhancement of Tropical Sea Cucumbers*

ICLARM Staff	:	Dr. J. Bell (Project Leader), Mr. M. Gervis, Mr. C. Ramofafia
Collaborating Institutions	:	Solomon Islands Ministry of Agriculture and Fisheries
Donor	:	Australia and Pacific Science Foundation
Duration	:	April 1994 - April 1996

Objective

- To develop mass-rearing methods for selected species of tropical sea cucumbers through reliable induction of spawning, rearing of larvae and grow-out of juveniles to a size ready for stocking into the wild.

Background and Justification

Bêche-de-mer (sea cucumber) is a valuable source of income for communities in remote areas of the Indo-Pacific because it can be processed (boiled and dried) on site, it has a long shelf-life without refrigeration and it fetches a high price in Asian markets. The re-entry of China into world trade has resulted in a dramatic increase in demand for bêche-de-mer. This demand has pushed up the price of the favored species, and created a market for a wider variety of species. There is now widespread concern that recent levels of catch in the Pacific may not be sustainable.

The ability to sustain or increase the yield of sea cucumbers by "enhancing" wild stocks would be a valuable tool for managers. Enhancement involves liberating sufficient juveniles (raised in hatcheries, or caught from the wild as spat and reared to a more robust size) into the wild to ensure that there is a fairly large and constant supply of animals for capture each year. This form of management is particularly attractive where recruitment of juveniles is highly variable. Liberation of cultured juveniles could also be used to restore fisheries where the stock has been overexploited to the point where adequate recruitment is jeopardized.

There are several reasons why sea cucumbers appear to be well suited to enhancement: i) most species are restricted to particular inshore habitats; ii) sea cucumbers are low on the food chain, so availability of food is unlikely to be a limiting factor; and iii) they are conspicuous and slow-moving and therefore easy to harvest. However, there have been few successful attempts to rear the larvae of commercially valuable species of sea cucumbers. Therefore, the potential of enhancement for managing stocks of sea cucumbers in the Pacific cannot be

assessed until cost-effective methods of producing larvae *en masse* have been developed.

Scores Against Principles

1.	Sustainability	H
2.	Systems approach	H
3.	Gender	M
4.	Equity	Variable
5.	Partnership	H
6.	Anticipatory approach	H

1994 Results

This pilot study estimated growth rates of juveniles in captivity, spawning cycles of wild broodstock and the problems associated with spawning and larval rearing of selected species of tropical sea cucumbers. Rapid growth of one intertidal species *(Actinopyga mauritana)* at relatively high stocking density (7 individuals per m^2) indicates that it has potential for farming in rudimentary enclosures. Distinct periodicity in the reproductive cycle of the most valuable species in Solomon Islands, the white teatfish *(Holothuria fuscogilva)*, indicates that the production of larvae will be restricted to 3-4 months per year unless methods can be developed for maturation in captivity.

The failure of the larvae of two species *(Holothuria atra* and *Actinopyga mauritana)* to survive past 30 days, points to the difficulty in rearing the animals compared to giant clams. It also highlights the need for construction of special culture facilities, including an algal production unit. A proposal for a 5-year project to develop these methods was prepared for submission to ACIAR.

Expected Outputs in 1995

- Accommodation, algal culture facilities and office space for the new research team will be constructed and a Research Scientist and Research Associate recruited.

- Preliminary spawning trials will continue and a final report on larval rearing and growth trials will be submitted to the Australia and Pacific Science Foundation in respect of the initial phase.

SPECIAL PROJECTS

There are two social science projects of the Center, *The Asian Fisheries Social Science Research Network* and the *Fisheries Co-management project* - which do not fall into one or other of the two research areas (IARSP, CCRRSP), but which are cross-cutting. As well, institutional networking has been place outside the research program structure. Thus, the International Network on Genetics in Aquaculture and its subsidiary activities, like the social science projects, are supervised directly by the Director general.

Together these activities are termed "Special Projects." Details follow.

1. *Asian Fisheries Social Science Research Network (Phase IV)*

ICLARM Staff	:	Dr. Robert S. Pomeroy (Coordinator), Ms. Anjanette C. Trinidad
Collaborating Institutions	:	**Indonesia** - Faculty of Economics, Universitas Diponegoro (UNDIP); Central Research Institute for Fisheries (CRIFI); Research Institute for Marine Fisheries (RIMF); **Malaysia** - Faculty of Economics and Administration, Universiti Malaya (UM); Natural Resource Economics Department, Universiti Pertanian Malaysia (UPM); **Philippines** - Bureau of Fisheries and Aquatic Resources (BFAR): Freshwater Aquaculture Center, Central Luzon State University (CLSU); Economics Section, Research Division, Aquaculture Department, Southeast Asian Fisheries Development Center (SEAFDEC-AQD): Department of Agricultural Economics, College of Economics and Management, University of the Philippines at Los Baños (UPLB); Faculty of Arts and Sciences in the Visayas (UPV); **Thailand** - Fisheries Economics Research Subdivision, Department of Fisheries (DOF); Department of Agricultural and Resource Economics, Faculty of Economics and Business Administration, Kasetsart University (KU); Coastal Resources Institute, Prince of Songkla University (PSU); **Vietnam** - Ministry of Fisheries; Cantho University
Donor	:	International Development Research Centre of Canada
Duration	:	April 1994 to March 1996

Objectives

- To encourage and develop networking within and among Network institutions and countries.

- To enhance the professional capacities of the Network members through training, advanced study, and collaboration with individuals and institutions with special skills useful to the research and teaching programs.

- To support collaborative research programs in the social sciences that will generate results of value in the formulation of fisheries resource management and aquaculture systems development programs and policies.

- To promote the use of research results through more effective dissemination.

- To identify and encourage membership of additional institutions both within current Network member-countries and in new countries.

Background and Justification

The Asian Fisheries Social Science Research Network (AFSSRN) was established in 1983 to address the need to enhance domestic social science research capabilities relative to capture fisheries, coastal resource management and aquaculture in Asia. The aims of the Network are even more relevant today due to the increasing recognition of social and political factors in achieving sustainable aquatic resources development.

The AFSSRN is currently composed of 13 research teams, totalling more than 80 researchers, at universities, research institutions and government fisheries agencies in Indonesia, Malaysia, Thailand and the Philippines. In addition, two research teams have recently been formed in Vietnam. These AFSSRN member institutions have a strong commitment to social science research relative to capture fisheries, coastal resource management and aquaculture.

The scope and methods of the Network programs are taken up under five general categories related to the objectives stated above. These are: (1) Networking, (2) Education and Training, (3) Research, (4) Dissemination of Results and (5) New Members.

A more coordinated, well-defined and strategic research program has been established with Phase IV. The focus is on major themes in order to

coordinate research, training and networking activities. The priority research areas are: (1) community-based management/integrated coastal fisheries management; (2) integrated agriculture-aquaculture systems; (3) policy analysis; (4) new methodologies; and (5) sociology/anthropology.

Scores Against Principles

1.	Sustainability	M
2.	Equity	M
3.	Gender	M
4.	Participation	H
5.	Systems approach	H
6.	Anticipatory approach	H

1994 Results

Annual workplans were provided by team leaders, and four AFSSRN-Fisheries Co-management research projects in Malaysia, the Philippines, Thailand and Vietnam, respectively, were developed.

A Team Leaders' meeting was held in Taipei, Taiwan, 20 July 1994, followed by a special session on Fisheries Social Science in Asia, International Institute of Fisheries Economics and Trade, Taipei, Taiwan, 18-21 July 1994.

Two Phase IV research projects were approved:

- University of the Philippines-Visayas - Alternative Livelihood Projects for Fisherfolk in the Province of Iloilo.

- Universiti Pertanian Malaysia - Enforcement and Compliance with Fisheries Regulations in Malaysia, Philippines and Indonesia.

Also four Phase III research reports were published during the year on: rice-fish culture in the Philippines (CLSU); economic assessment of shrimp *(P. monodon)* hatchery industry in Panay Island, Philippines (SEAFDEC); enforcement and compliance with regulations in the Malaysian fishery (UPM); and estimating input demand and output supply elasticities in gillnet and seine fishing in Guimaras Strait and adjacent waters, Philippines (UPV).

National workshops by the Network members were held as follows:

- Indonesia National Workshop, "Social Science Research Methods" Bandungan, Central Java, 19-21 September 1994;

- Thailand National Workshop, "Fishing Rights Program" Hat Yai, Thailand 23-25 September 1994;

- Vietnam National Training, "Social Science Research Methods", Ministry of Fisheries, Hanoi, 3-8 October 1994;

The Coordinator visited Cambodia on 26-30 September to establish a training program and network membership.

Expected Outputs in 1995

- Implementation of new research projects by team members.

- Four national workshops focusing on research priority areas.

- One regional training course on "Transforming Research into Policy".

- Publication of research reports, AFSSRN News section in *Naga, the ICLARM Quarterly*, and a scientific article on history and impact of the AFSSRN.

- Exchange visits by team members for training and collaborative research to other member-institutions.

- A team leaders meeting.

- Training program on social science research methods in Cambodia.

- Training, curriculum development and collaborative research activities with Cantho University, Vietnam, as part of research project on "Strengthening the Institutional Capacity to Sustainable Aquaculture Development of the Southern Part of Vietnam".

- New member identification visits to Laos and Burma.

- Proposal development for a new AFSSRN initiative in the Mekong Subregion.

2. *Fisheries Co-management Project*

ICLARM Staff : Dr. Robert S. Pomeroy, Mr. Michael D. Pido, Mr. Melvin B. Carlos, Ms. Anjanette C. Trinidad, Ms. Josella M. Mayordomo, Ms. Maricel C. Gamo

Collaborating Institutions	:	**Denmark** - North Sea Centre (NSC), Hirtshals; **Vietnam** - Ministry of Fisheries; National Center for Social Sciences; Cantho University; **Thailand** - Department of Fisheries; Kasetsart University; Prince of Songkla University; Malaysia - Universiti Pertanian Malaysia; **Indonesia** - Research Institute for Marine Fisheries; Central Research Institute for Marine Fisheries; Directorate General of Fisheries; Indonesian Fisheries Socioeconomic Research Network; **Philippines** - Southeast Asian Fisheries Development Center-Aquaculture Department; University of the Philippines-College of Public Administration; Department of Environment and Natural Resources; Tambuyog Development Foundation; University of the Philippines in the Visayas; **Mozambique** - Institute for Development of Small-Scale Fisheries; **Zimbabwe** - Center for Applied Social Sciences, University of Zimbabwe; **Malawi** - Fisheries Department; **West Africa** - Programme for Integrated Development of Artisanal Fisheries; **South Pacific** - University of the South Pacific; **Carribean** - CARICOM Fisheries Resource Assessment and Management Program.
Donor	:	Danish International Development Assistance
Duration	:	April 1994 - April 1999

Objective

- To provide a set of globally or regionally applicable fisheries co-management models developed and applied in selected aquatic resource systems in selected countries and pilot sites in Asia, Africa and the Pacific, towards the goal of sustainable and equitable management of fisheries in developing countries to meet the nutritive and economic needs of poor people.

Background and Justification

There is a need for rapid and substantial evolution of existing fisheries management strategies to support sustainable resource use. There must evolve a more dynamic partnership using the capacities and interest of the local community and resource users, complemented by the ability of the national government to provide enabling legislation and administrative assistance. This partnership can be called co-management, where the national government and the community share authority and responsibility for fisheries management. Community-based management is a central element of co-management. The

amount of authority that the national government and the community have will differ and depend upon country and site-specific conditions.

The Fisheries Co-Management Research Project will conduct research in coastal, coral reef, lake and river/floodplain aquatic resource systems in countries in several regions of the world including Asia, Africa and the Pacific.

The project will systematically and comparatively document and assess models and processes of fisheries co-management implementation at national government and community/fisher organization level and their results and impacts. General principles and propositions which facilitate successful implementation of fisheries co-management strategies will be identified. The research activities will be conducted through the three components: comparative case studies of fisheries co-management strategies; country research; and information exchange.

The research project will utilize a comparative analytical approach, relying on a common research strategy and an institutional analysis research framework for use in each partner-country and resource system, in order to integrate and improve the understanding and implementation of fisheries co-management strategies.

Scores Against Principles

1.	Sustainability	H
2.	Equity	H
3.	Gender	M
4.	Participation	M
5.	Systems approach	H
6.	Anticipatory approach	H

1994 Results

Development of a database on fisheries co-management literature worldwide has begun, from which a literature-based case study analysis on fisheries co-management, using the institutional analysis research framework, is underway.

A rural rapid appraisal methodology for evaluation and documentation of traditional fisheries management systems has also been developed.

Work has begun on a database on fisheries community-based management projects in the Philippines, this has been used for initiation of evaluation of over 80 fisheries community-based management projects in the Philippines.

Several projects were initiated during the year:

- with the Ministry of Fisheries in Vietnam on a baseline socioeconomic survey of fishing households and communities and coastal fisheries management strategies;

- with Universiti Pertanian Malaysia/University of the Philippines - Visayas/Research Institute for Marine Fisheries - Indonesia on enforcement and compliance with fisheries regulations;

- with Southeast Asian Fisheries Development Center - Philippines on process documentation and impact analysis of community-based management programs;

- with the University of the Philippines - College of Public Administration on management of fisheries/aquatic resources at the local level;

- with Department of Environment and Natural Resources - Philippines on El Nido marine reserve management plan;

- with Research Institute for Marine Fisheries - Indonesia on documentation and evaluation of traditional community-based fisheries management in Bali, Indonesia;

- with the Institute for Development of Small-Scale Fisheries - Mozambique on co-management systems in fisheries in Inhassoro, Inhassoro Province;

- with Center for Applied Social Science - University of Zimbabwe on co-management of fisheries in Lake Kariba;

Development of research strategies for country research in Indonesia, Malawi, Mozambique, the Philippines, Vietnam, Zimbabwe was accomplished during the year.

A workshop on experiences and case studies on coastal resource community-based management was held in Palawan, Philippines, September 1994. A brochure on the Co-management project was published.

Expected Outputs in 1995

- Completion of fisheries co-management literature review and database.

- Completion of comparative case study analysis and fisheries co-management typology (publication).

- Completion of development of rural rapid appraisal methodology for evaluation and documentation of informal/traditional community-based fisheries management systems (publication).

- Completion of desk research on review and evaluation of fisheries community-based management strategies in the Philippines (publication).

- Initiation of desk research on review and evaluation of fisheries community-based management strategies in Vietnam and Indonesia.

- Completion of institutional analysis research framework development (publication).

- Initiation of process documentation and impact and performance analysis of co-management strategies in the Philippines.

- Development of country research strategy for Indonesia, Thailand and Vietnam.

- Completion of baseline socioeconomic survey of fishing households and communities and review of coastal fisheries management strategies in Vietnam.

- Initiation of research on fisheries rights program in Thailand.

- Initiation of research on enforcement and compliance with fisheries regulation in Malaysia, Philippines and Indonesia.

- Completion of research on the local government code and fisheries management in the Philippines.

- Workshops on experiences with community-based management in Central Visayas and Mindanao regions of the Philippines.

- Completion of El Nido Marine Reserve co-management plan in the Philippines.

- Initiation of research on evaluation and documentation of traditional community-based fisheries management systems in Indonesia.

- Fisheries co-management workshop in Denmark.

- Initiation of field research in Zimbabwe, Malawi, Mozambique and West Africa by NSC.

- Quarterly project newsletters to be produced.

3. *International Network on Genetics in Aquaculture (INGA)*

ICLARM Staff : Dr. D.V. Seshu, Research Coordinator

Collaborating Institutions : **Bangladesh** - Fisheries Research Institute, Mymensingh; **China** - Department of Aquaculture, Shanghai; **Côte d'Ivoire** - Fish Research Center, Bouaké; **Egypt** - National Aquaculture Center, Sharkia, Fish Research Center, Ismailia; **Ghana** - Fishery Division, Achimota; **India** - Central Institute of Freshwater Aquaculture, Orissa, Central Institute of Fisheries Education, Versova, Bombay; **Indonesia** - Central Research Institute for Freshwater Fisheries, Sukamandi; **Malawi** - University of Malawi, Zomba, Fisheries Department, Lilongwe; **Philippines** - Bureau of Fisheries and Aquatic Resources, Quezon City, Freshwater Aquaculture Center, Nueva Ecija, International Center for Living Aquatic Resources Management, Makati; **Thailand** - National Aquaculture Genetics Research Institute, Bangkok; **Vietnam** - Research Institute for Aquaculture, Ha Bac

Donor : ICLARM core funds; United Nations Development Programme

Duration : Ongoing, initiated August 1993

Objectives

- To promote cooperation and interaction among fish genetic improvement scientists.
- To serve as a center for information on all aspects of fish genetics.
- To strengthen national capabilities for genetic enhancement of farmed fish.

Background and Justification

The aquaculture sector, where increased production is needed, has made only modest gains from genetic research to date, particularly in tropical developed countries. Recent studies in different parts of the world have clearly demonstrated the potential for achieving substantial gains in aquaculture production through application of genetics and breeding.

Networking is a well-tested and proven mechanism to foster international cooperation in seeking solutions to problems of common interest that cut across political boundaries. The inherent advantages of the networks are that they accelerate exchange of information, experience, methods and materials; boost research efficiency; reduce research costs; and combat scientific isolation. This approach has been chosen for genetic improvement of inland cultured fish, targeted to the aquaculture systems in developing countries.

Strategy

- Exchange of methodologies and materials
- Research planning meetings and workshops
- Training
- Joint site visits
- Information dissemination
- Involvement of national systems in planning and governance.

Scores Against Principles

1.	Sustainability	M
2.	Equity	H
3.	Gender	M
4.	Systems approach	M
5.	Partnership	H
6.	Anticipatory approach	H

1994 Results

Exchange and evaluation of tilapia and carp strains through INGA led to some promising results: silver barb stocks from Thailand and Indonesia outperformed the local strain in Bangladesh; the GIFT tilapia strain from the Philippines performed better than the respective local strains in the first set of trials in Bangladesh, China and Vietnam.

Draft protocols for transfer of fish and research methodologies have been developed for use by the network member countries when conducting INGA trials.

Expected Outputs in 1995

- Analysis of first set of trials from different INGA countries.

- Further exchange of genetic material, particularly carps as per plans formulated at the first steering committee meeting.

- Finalization of research protocols.
- Review of current status of a) tilapia research development and breeding programs and b) carp research, development and breeding programs.
- Review of training needs of INGA member-countries.
- Organize second INGA steering committee meeting.
- Organize carp genetics and breeding workshop.
- Training on quantitative genetics.

4. *Dissemination and Evaluation of Genetically Improved Tilapia Species in Asia (DEGITA)*

ICLARM Staff : Dr. D.V. Seshu, Dr. Madan Mohan Dey

Cooperating Institutions : **Bangladesh** - Fisheries Research Institute; **China** - Shanghai Fisheries University; **Philippines** - Bureau of Fisheries and Aquatic Resources; **Thailand** - National Aquaculture Genetics Research Institute; **Vietnam** - Research Institute for Aquaculture 1

Donor : Asian Development Bank

Duration : June 1994-December 1996

Objectives

- To carry out detailed evaluation on the genetic and socioeconomic performance and environment impact of the improved tilapia species in Bangladesh, China, Philippines, Thailand and Vietnam.
- To increase incomes and improve the nutrition of small-scale farmers in the five selected developing countries by distributing the promising tilapia strains.
- To transfer scientific knowledge and technology of tilapia genetics in order to assist the participating countries in planning national tilapia breeding programs.

Background and Justification

Nile tilapia (*Oreochromis niloticus*) is one of the most popular farmed fish species in East and Southeast Asia. It is the second most important freshwater farmed fish in China, Philippines and Thailand -- second to carps in China, to milkfish in the Philippines and to catfish in Thailand. Nile tilapia also proved to be a suitable cultured species in other parts of Asia, particularly in Bangladesh and Vietnam, and its demand for aquaculture developent is growing fast in the region.

ICLARM, in collaboration with national aquaculture research institutes of the Philippines and the Institute of Aquaculture Research (AKVAFORSK) of Norway has developed an improved Nile tilapia strain through selective breeding that has, on an average, 50% better survival rate and 60% faster growth rate than the present farmed breeds in the Philippines. Bangladesh, China, Thailand and Vietnam have shown keen interest to evaluate this improved strain of Nile tilapia in their respective countries. It is envisaged that before disseminating the strain for commercial production, there is a need to assess its genetic performance, economic viability, social acceptability and environmental compatibility under the varied physical and socioeconomic environments prevailing in the different participating countries.

The project is being implemented as an integral part of the International Network on Genetics Aquaculture (INGA). It is targeted to make the tilapia production system more sustainable and equitable by conducting anticipatory system-based research, considering both genetic and other natural resources, in partnership with the national aquaculture research institutes of five developing countries of Asia.

To ensure sustainability, the project aims to generate location-specific Nile tilapia technology with proper consideration of the sustainable limits of natural resource systems, the resource base of tilapia farmers, and perspectives of different stakeholder groups (fish producer, consumer, middlemen, landless laborers, etc.). Socioeconomic analysis is being carried out to ensure that the technology would benefit the disadvantaged section of society, particularly the poor and women. The project is considering both the supply and demand sides of the tilapia industry, specifically future demand for tilapia, technical constraints faced by fish farmers, and comparative advantage of different ecosystems/resource bases in culturing Nile tilapia.

Scores Against Principles

1. Sustainability	M
2. Equity	H
3. Gender	H

2. Systems approach M
5. Partnership H
6. Anticipatory approach H

1994 Results

A unified approach has been developed to evaluate the performance of genetically improved tilapia strains in the five participating countries (Bangladesh, China, Philippines, Thailand and Vietnam), involving the disciplines of genetics, economics, sociology and ecology. The methodology is a combination of *ex-post* and *ex-ante* techniques, and has on-station and on-farm activities. All countries, except Thailand, have initiated on-station trials, and Vietnam has already completed the first cycle of the on-station trials. Preliminary analysis indicates the superiority of the GIFT strains over the check strains used. On-farm activities have also been initiated at various project sites representing different ecological and socioeconomic environments in Bangladesh, Philippines and Vietnam. The on-farm activities consist of: 1) analysis of agroecological and socioeconomic environments of project sites (6 sites in Bangladesh, 12 in the Philippines, and 7 in Vietnam); 2) baseline surveys of fisheries households and their farming environments (120 farmers in Bangladesh, 130 in the Philippines and 140 in Vietnam); and 3) on-farm monitoring of GIFT and local strains (60 ponds in Bangladesh, 80 in the Philippines and 5-10 per site in Vietnam). On-station trials in Thailand and on-farm activities in China and Taiwan will soon be initiated.

Expected Outputs in 1995

- Evaluation of the current socioeconomic status of tilapia farming in the five participating countries, the constraints, and prospects.
- Evaluation and analysis of the genetic performance of the improved tilapia strain in comparison to the locally popular strains.
- Assessment of existing infrastructure and institutions for distribution of improved fish breeds in the five participating countries.
- Development of a socioeconomic and environmental database for analyzing the impact of technological innovation on aquaculture.
- Analysis of baseline surveys on socioeconomic and environmental aspect of tilapia industry in the five participatory countries.

INFORMATION DIVISION

The Information Division provides publication, library and information services to staff and clients. Some information research, dealing with the impact of ICLARM's output in the literature and the performance of biological scientists in general, is also undertaken.

The activities of the Division, although they include only two projects, are described below under the broad headings Production and Library and Information Services.

Following a December 1994 external review of the Division, a program strategy is to be developed in 1995 and this is treated as a Division-wide activity.

1. Division-wide activity

1.1 *Development of a Strategic Plan for the Information Division*

ICLARM Staff : Information Division staff mainly

Collaborating Institutions : -

Donor : ICLARM core funds

Duration : 6 months in 1995

Objective

- To establish strategies and priorities for ICLARM in the areas of Information and Communication.

Background and Justification

The report of the 1992 External Review of ICLARM by the CGIAR included a recommendation to ICLARM to "spell out its strategies and plans in the information area clearly, and not expand its staffing and expenditures in this area before completing such an effort." The review panel suggested a survey of needs would be useful to this end. However, the Study on International Fishery Research Needs (SIFR) then began a global survey of information needs which is still ongoing. The CGIAR also recently gave attention to the general area and, at Centers Week 1994, endorsed a new system-wide Information Strategy.

An Information strategy for ICLARM could be produced based on the findings to date of the SIFR survey, the CGIAR Information strategy and ICLARM's Strategic Plan.

An external review of the Division was held in December 1994. The report of the review will also be used to develop the division's strategy.

Scores Against Principles

1.	Sustainability	n/a
2.	Systems approach	H
3.	Gender	n/a
4.	Equity	H
5.	Partnership	H
6.	Anticipatory approach	H

Expected Outputs in 1995

A strategy and work plan in all areas of the Center's Information activities, which may include funding and staffing requests and formation of a Publications Committee.

2. Production

2.1 *Publications and Dissemination*

ICLARM Staff : Publications Unit

Collaborating Institutions : In addition to ICLARM authors, various external authors on commission (Studies and Reviews) or providing articles (Conference Proceedings and *Naga*).

Donor : ICLARM core funds

Duration : Continuous

Objective

- Prepare and disseminate ICLARM publications as efficiently as possible.

Background and Justification

ICLARM has always published findings from its research to ensure that they are available to the widest audience, especially in developing countries.

Scores Against Principles

1.	Sustainability	n/a
2.	Systems Approach	n/a
3.	Gender	n/a
4.	Equity	H
5.	Partnership	M
6.	Anticipatory Approach	n/a

1994 Progress

The 1993 Annual Report was published in May 1994 and was available for the CGIAR mid-year meeting. The *Naga* issues for January, April, July and October were published in January, June, August, October, respectively. Other publications during the period included five Conference Proceedings, one Technical Report, one Education Series, five issues of *Newsbriefs*, one poster and 12 issues of *ICLARM Bulletin* (*Newsplash*). An in-house guide *Publishing at ICLARM* was produced in July 1994 and distributed to all scientific staff and secretaries. It will be given to all future such staff on joining the Center.

The Publications Unit of the Division was also responsible for the graphics and layout of the *Asian Fisheries Science*, the journal of the Asian Fisheries Society. In addition, reprints and a large number of workshop/conference materials (e.g., slides/overhead transparencies, programs, IDs, posters, etc.) are constantly in preparation. Further, the Division drafts various illustrations/figures for different projects and presentations that are not published, and recently the Division has also taken over the preparation of calling cards.

From sales, library exchange, and free issue, the total number of books distributed in ICLARM's seven technical series distributed since the first publication in 1980 is over 161,000. *Naga* recipients exceeded 4,000 in 1994. ICLARM books were exhibited at the Fifth International Conference on Scholarly Publishing, 6-10 May 1994, in Thessaloniki, Greece.

Expected Outputs in 1995

For 1995, the Publications Unit intends to produce an annual report; four issues of *Naga, the ICLARM Quarterly*; twelve issues of the *ICLARM Bulletin*; six to eight issues of the *ICLARM Newsbriefs*; press releases; seven technical reports; three studies and reviews; and three proceedings, one of which will be English and French versions of the tilapia conference in Côte d'Ivoire; a reprint of the directory of the Network of Tropical Aquaculture Scientists; as well as brochures.

The Publications staff will continue to do typesetting and drafting jobs for other Center staff needs, as well as posters and overheads for presentations at meetings. Books and other publications will also be distributed to recipients in free and exchange lists and subscribers. Distribution staff also handle sales through the mail and over the counter as well as the Center's photography.

The Division is a member of the ASFA (Aquatic Sciences and Fisheries Abstracts) Editorial Committee, thus helping to provide strategic guidance to access of aquatic resource literature.

The investigation of the scientific productivity and impact of scientists in the Center and other Philippine fisheries institutions by Letty Dizon will be carried through to 1995.

The Unit will also still do the layout of three issues of *Asian Fisheries Science.*

2.2 *Translation Services/Unit*

ICLARM Staff : Catherine Lhomme Binudin

Collaborating Institutions : Le Centre Technique Forestier Tropical - Département du Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CTFT/CIRAD); L'Institut Français de Recherche Scientifique pour le Développement en Coopération (ORSTOM); Centre de Recherches Océanographiques (CRO), Abidjan

Donors : French Ministry of Cooperation; French Ministry of Foreign Affairs; Centre Technique de Coopération Agricole

Duration : Continuous since 1988

Objective

- To coordinate translation activities in the languages of the countries in which ICLARM is or may be involved, to expand this capability into a structured unit in the future and to work towards the establishment of a system-wide language policy.

Background and Justification

Translations activities started in 1980 with the ICLARM translation series and were strengthened as far as French translations are concerned from 1988,

when the French government started to fund ICLARM's project of Transfer of Aquaculture Technologies from Asia to Africa. At this point and in view of language barriers present in Francophone Africa, it was deemed appropriate to give ICLARM a translation capability and to expand it in the future.

Scientific and development literature written in a *lingua franca* (English) is limited in scope. Despite false claims that English is understood the world over, said literature cannot reach all the clients and beneficiaries ICLARM would wish. NonEnglish speaking scientists, particularly in Francophone Africa, Latin America and Asia suffer from a recurring lack of material written/translated in their own language that can help them catch up and cope with the scientific developments originating mostly from scientists trained and published in the North. Scientists and other key operators of the developing countries of the South are experiencing big gaps in their scientific and technical knowledge and thus are systematically lagging behind, this partly due to their problem of accessing literature in their own language.

Against this background, a system-wide language policy needs to be formulated and implemented, and appropriate resources need to be sought.

Scores Against Principles

1.	Sustainability	H
2.	Systems approach	H
3.	Gender	n/a
4.	Equity	H
5.	Partnership	H
6.	Anticipatory approach	H

1994 Results

Work continued on translating both English and French manuscripts of ISTA III. An additional translator (English-French) was hired in July for one month, and another in September for four months to help complete the volumes.

Machine translation software was purchased during 1994 and its use evaluated for technical translations. A database of specific aquatic-resource terminologies has been built up and is now used in association with the translation software, which has made the latter much more efficient.

Other functions of the Unit during the year included translation of letters of enquiry and responses as well as liaison with French agencies on behalf of the Center. Contacts are maintained with translators and translation units of other institutions, particularly of the CGIAR.

Expected Outputs in 1995

The translation unit will continue its activities, including the translation into French of the possibly revised version of the book *A Hatchery Manual for the Common Chinese and Indian Major Carps by* V.G. Jhingran and R.S.V. Pullin.

Translation into English and French of the proceedings of ISTA III will be finished in 1995 and the book will be distributed to the conference participants and other users in Africa, Asia and Latin America as well as in Europe and the USA.

The Translation Unit will also coordinate the French version of FishBase if funds are received from AUPELF in Paris. The Translation Unit will continue to enrich its terminology database and to experiment on its translation software for maximum efficiency. The Unit also plans to increase contacts through e-mail with the Translation Divisions of other CG Centers to reflect on possible ways to optimize the translation "mission" of the centers. The Unit will expand its language capability by establishing a list of translators available on a freelance basis. Finally, the Unit will work towards (and cooperate in) the establishment of a system-wide language policy.

3 Library and Information Services

3.1 *Library Services*

ICLARM Staff : Ms. Rosalinda Temprosa, Ms. Norma Jhocson, Ms. Erlinda Gonzalez, Ms. Adelina Mendoza, Ms. Isabel Duran, Ms. Rosario Yabut, Mr. Rey Damalerio

Collaborating Institutions :

Donor : ICLARM core funds

Duration : Continuous

Objective

- To identify, collect, process, store, analyze and disseminate information relevant to the needs of the Center's management and staff and, likewise, meet the information needs of fisheries and aquatic researchers in the tropics.

Background and Justification

In September 1978, the ICLARM library (renamed the *Ian R. Smith Memorial Library and Documentation Center* in May 1990) was set up as a nucleus of information resources to help and implement the Center's goal in providing the technical information required to strengthen research on tropical aquatic resources for the benefit of economically developing countries.

To date, it has grown rapidly in pace with the proliferation of fisheries and aquatic literature not only from the tropical developing countries served by ICLARM, but also from the developed countries where much of the relevant literature is published/printed. Its growth enables the Center to provide more specialized information services.

Scores Against Principles

1.	Sustainability	n/a
2.	Systems approach	n/a
3.	Gender	n/a
4.	Equity	H
5.	Partnership	H
6.	Anticipatory approach	n/a

1994 Progress

The collection of books and monographs now totals 13,308 volumes. A total of 697 volumes of new materials was added during the year. The serials collection consists of 945 titles. This year, the library also subscribed to Current Contents 1 and 2, and received the AGRIS fisheries CD-ROM. The reprints collection has now a total of 6,084 titles and 366 items of nonbook materials.

The library made an inventory of books and monographs to determine and take stock of the following: (1) what books are rarely used; (2) books that need rebinding or repair; (3) books that should be weeded out to provide space for new acquisitions; and (4) to replace lost/missing books, if necessary. A full report of this particular task was prepared for further action.

Since the computerization of library holdings in early 1987, the maintenance and updating of the library's four (4) bibliographic databases have become routine. These databases and their total number of entries as of end of December are as follows:

LIBRI	8, 809 bibliographic records
NAGA	13, 174

RED	453
SERIE	1,203

From LIBRI database, five Acquisitions Lists (with 930 bibliographic entries) were produced and issued during the year to headquarters and overseas project research staff.

Aside from the abovementioned databases, the library also continued to monitor, check and index all incoming materials for Citation analysis Database (CAD). The IRSMLDC Book Catalogue for 1993 (870 entries) compiled by Norma Jhocson was also made available for all library users.

On information services, 284 enquiries were received in 1994. Queries received came from 60 countries/territories worldwide. The top subjects of enquiry were Finfish Culture Systems (pond culture, cage culture, etc.), General Fisheries, and Fish Biology. The Library also received 2,054 visitors during the year.

A total of 4,569 computer-retrieved titles, photocopies of 455 requested articles (4,663 pages), 135 copies of various ICLARM publications/contribution series, including brochures and several library duplicates were provided to enquirers.

The most frequently used serials in the library were: *Aquaculture*, *Science*, *Hydrobiologia*, *Marine Pollution Bulletin*, *Naga, the ICLARM Quarterly*, *Journal of Fish Biology, Coral Reefs, Greenfields, Oceanus* and *Canadian Journal of Fisheries and Aquatic Sciences.*

Instructional services on the use of ASFA CD-ROM, Current Contents on Diskette, AGRIS Fisheries CD-ROM and library databases to 522 users were also provided.

Expected Outputs in 1995

The Library will continue providing Selective Fisheries Information Service (SFIS) to enquirers worldwide. It will also continue to adopt and use current information system and technology in the efficient delivery of information services.

An initial input to Aquatic Sciences and Fisheries Abstracts (ASFA) will be submitted after the first quarter of 1995.

3.2 *Union Catalog of Fisheries Serial Holdings in Asia*

ICLARM Staff : Ms. Rosalinda Temprosa, Ms. Norma Jhocson

Collaborating Institutions : Libraries/institutions in the Asian region

Donor : Strategy on International Fisheries Research; ICLARM core funds

Duration : Continuous since September 1993

Objective

- To create a database of serial holdings in the Asian region which would facilitate easy and quick access to serial sources available in the Asian region; and promote resource sharing and active interlibrary loans

Background and Justification

This project is a part of the regional survey conducted by ICLARM on behalf of SIFR. ICLARM was asked to do a comprehensive study of non-statistical information programs and services. ICLARM is to compare serial holdings from the major sources within the region to identify gaps in the collections.

Scores Against Principles

1.	Sustainability	n/a
2.	Systems approach	n/a
3.	Gender	n/a
4.	Equity	H
5.	Partnership	H
6.	Anticipatory approach	n/a

1994 Progress

Of the 118 libraries and institutions invited to participate in the project, 57 responded. During the year, a total of 10,900 serial titles have been received from 47 participating libraries and institutions; 4,670 titles have been inputted on to the database; with the rest to be inputted after review. A status report of this project was presented during the Regional Workshop on Fishery Information and Statistics in Asia, held in Bangkok, Thailand, 18-22 January 1994.

Expected Outputs in 1995

ICLARM will make the Union Catalog available on diskette and hard copy in 1995. The database, projected to be around 10Mbytes, is currently conceived to be distributed on 4 to 5 3.25" HD disks which will include the royalty-free DataEase runtime module. An installation routine will be developed for hard disk setup and easy-to-follow menu will be provided for data retrieval. More importantly, it will contain modules to selectively export data to dBase, FoxBase, Lotus 1-2-3 and CDS/ISIS (i.e., ISO 2709) formats.

3.3 *Asian Fisheries Bibliography (pre-proposal stage now)*

ICLARM Staff : Ms. Rosalinda Temprosa, Mr. Jay Maclean

Collaborating Institutions : Libraries in the Asian region

Donor : To be identified

Duration : 12 months

Objective

- To improve access to aquatic resource research information by creating an ongoing bibliography of aquatic resource literature in the Asian region which would, a) be available virtually free to all; b) link with ASFA (Aquatic Sciences and Fisheries Abstracts).

Background and Justification

For the foreseeable future, the only major bibliographic tool for aquatic resource literature will be ASFA, which has the limitations of being very expensive and thus poorly used in developing countries, and having patchy coverage of Asian literature.

This project would bring together the computerized monographic holdings of libraries around the Indo-Pacific onto a single database which would be updated regularly and disseminated. It would also assist and encourage other libraries to organize or computerize their monographic holdings (as the Union Catalogue project is doing for serial holdings).

Scores Against Principles

1.	Sustainability	H/M
2.	Systems approach	n/a
3.	Gender	n/a
4.	Equity	H
5.	Partnership	H
6.	Anticipatory approach	L

Expected Outputs in 1995

If funded in 1995, some two months programming would be done to enable duplicate records to be handled (using CDS-ISIS); may be done by contract. A routine for regular input and dissemination would be developed. By end 1995, the system could be operational. Some training for new inputting centers could be also arranged.

MANAGEMENT SERVICES DIVISION

The Management Services Division plays a critical role in the operations of the entire Center. Much of the Center's success in attaining its objectives and fulfilling its mission depends on the Division's ability to provide the Center's management, staff and organizational units the support services they require to carry out their own work programs.

In general, the Division's responsibilities include:

- Delivering high quality and timely services to Center management, individual staff, organizational units and other stakeholders (trustees, donors, etc.),
- Developing, implementing and maintaining systems for the effective and efficient management of Center resources, and
- Establishing systems for effective communications within the Center.

In order to carry out these responsibilities, the Division is organized into the following key functional units:

1. **Finance and Accounting:** This unit is responsible for managing the Center's financial resources for the purpose of ensuring that these resources are available for the Center's operations.
2. **Project Support:** This unit is primarily responsible for providing Project Leaders and Program Directors with the management support required for them to accomplish their work programs.
3. **Human Resources Management:** This unit is responsible for providing ICLARM Management and managers with the systems and services required to manage the center's human resources.
4. **Administrative Services:** This unit is responsible for the delivery of services required for the day-to-day operations of the Center.

Although each unit within the division is aware of its operating responsibilities, Division management has established several strategic concerns which it would like the entire division to focus on in 1995 in anticipation of further growth and possibly more changes in coming years. These strategic concerns are:

- Communication
- Cash flow management
- Staff development
- Management information
- Accountability

In formulating the Division's work program for 1995, the work plans for each unit were linked with the principal concerns of the Division-- service delivery, systems efficiency and effective communications. In addition, each unit has been tasked with addressing specific components of the Division's strategic concerns.

1. Finance and Accounting Unit

1.1 *Cash Flow Management*

ICLARM Staff : Finance & Accounting Staff

Duration : 12 months or ongoing

Objective

- To improve the cash flow situation of the Center.

Background and Justification

The unit is being tasked with taking a leadership role in addressing this strategic concern of the division. The unit, with the participation of other MSD units, will review all transactions and procedures that have a direct or potential impact on the Center's cash flows. The purpose of this review will be to generate a comprehensive report on all transactions and procedures affecting cash flow and recommended action plan to improve cash flow and financial efficiencies.

We anticipate that the recommended action plan will cover:

- proposed new policies and procedures;
- amendments to existing policies and procedures;
- development of implementing guidelines;
- development of additional systems and reports or amendments to existing systems and reports;
- an implementation schedule.

1994 Progress

To strengthen the Center's ability to manage its cash flows in an environment characterized by insufficient working capital and continuing funding uncertainties and unpredictability, the Finance and Accounting Unit has been able to generate daily cash position reports and a monthly projected cash flow statement. These reports should, together with corresponding improvements in the Center's project planning and management capabilities, contribute significantly to better cash flow management.

In addition to generating these reports, the Finance and Accounting Unit has implemented in 1994 a variety of measures aimed directly at improving cash flow. These include:

- additional control measures on staff advances;
- more aggressive management of these advances (e.g., monthly statements of outstanding advances and direct follow-up with staff, projects and collaborating institutions to have these advances liquidated or returned);
- aggressive follow-up and collection efforts of donor grant disbursements;
- negotiations with donors for advanced release of restricted grant funds; and
- negotiations with CGIAR Secretariat and Citibank for standby or liquidating loans.

All these measures, however, are short-term in nature and have been undertaken only to survive on a month-to-month basis. One long-term solution to ICLARM's chronic cash flow problems is the improvement of the Center's working capital through budgeted surpluses over several years. Another solution is to improve internal controls and to negotiate with donors to convince them to provide ICLARM with advance payments on grant contracts.

1995 Expected Output

The report on the review and recommendations should be ready by 15 May 1995. Follow-up action is expected throughout the year as a result of these recommendations. It is expected for this review to address internal controls and to recommend additional guidelines for managing projects and negotiating grants.

1.2 *Financial Reporting*

ICLARM Staff : Finance and Accounting Staff

Duration : 12 Months or ongoing

Objective

- To ensure the generation of high quality and relevant financial reports in aid of management.

Background and Justification

Financial information is critically important for ICLARM managers, at all levels, to adequately carry out their responsibilities and for ICLARM projects and units to meet their objectives. The Finance and Accounting Unit should therefore focus its efforts on regularly generating high quality and relevant financial reports. The term "high quality" implies accuracy and thoroughness. The term "relevant" implies usefulness in decision-making and timeliness.

1994 Results

- Centerwide monthly financial reports which were generated regularly in 1993 continued into 1994. The unit was able to improve the submission of these reports to the Director of MSD and the Director General from the 10th of each month to the 5th of each month. Since May 1994, these reports generally were submitted no later than the 2nd of each month.

- Monthly project and unit budget status reports have also been generated consistently since the first quarter of 1994. The formats of these reports have also undergone changes in response to comments and suggestions made by Project Leaders and Program Directors. The object of these changes was to make the reports more user-friendly for budget management purposes. Improvements in the format and accuracy of these reports are expected to continue into 1995.

- Financial reporting to donors has continued. Ninety per cent (90%) or more of donor deadlines for the submission of these reports have been met. Favorable feedback on financial reporting have been received from UNDP and IDRC.

Communication between project leaders/program directors and the MSD concerning the format and accuracy of the budget status reports has resulted in positive steps being taken to make the reports more useful for project and program management purposes. Such communication should continue. In

addition, budget management responsibilities of project leaders and program directors should be established.

1995 Expected Output

For 1995, the Finance and Accounting Unit is tasked with the following:

- To generate a catalogue of all financial and other management reports currently generated by unit. In this catalogue, the purpose, nature and format for each report will be described along with a schedule and distribution list. (Due end-February 1995).

- To identify existing financial reports that need to be improved or new reports that need to be developed as well as a prioritization and schedule for the development and delivery of these reports. (Due end-May 1995).

- To have a project or unit budget status reports available on the Center-ide LAN. (Due end-August 1995).

1.3 *Integration of Field Office Accounting and Reporting*

ICLARM Staff : Finance and Accounting Staff, Field Office Staff

Duration : 12 Months or ongoing

Objective

- To improve the quality of ICLARM financial statements.

- To better manage total Center resources.

Background and Justification

At present, fund disbursements made to field project offices (Solomon Islands, Bangladesh and Malawi) are carried on HQ books as advances for project funding purposes. These advances are liquidated as the field project offices submit their monthly expense reports to HQ. Unfortunately, the Center has experienced delays not only in the submission of expense reports by the project field office staff but also in the processing of these expense reports. Given these delays, the monthly financial reports generated by the Finance and Accounting Unit are not very useful for decision-making.

Another shortcoming of the present system of accounting for field project funds is the fact that the cash balances and outstanding advances of field offices are not reflected in the monthly reports and therefore not monitored adequately.

1994 Progress

(This is a new activity - to start only in 1995)

1995 Expected Outputs

The key elements to improving the existing system are:

- To rationalize the current procedures and expense approval authorities to allow budget management responsibilities to reside where they should (i.e., with Project Leaders, Program Directors). (Guidelines on the budget management responsibilities of project managers and field office OICs to be ready by end-March 1995).

- To establish a uniform accounting and reporting system for all field offices. (Due first for the Solomon Islands -- end-July 1995, Due for Bangladesh and Malaŵi -- year-end 1995).

1.4 *Financial Data and Report Security*

ICLARM Staff : Finance and Accounting Staff

Duration : 6 Months, to start 1 April 1995

Objective

- To ensure that financial information is secured against risks of loss due to fire and other disasters.

Background and Justification

One of the major findings of the external review of ICLARM computerized systems by our external auditors was that financial data was not protected against such risks as fire and other similar disasters. They pointed out that if our records were destroyed by fire or other disaster, the Center would not be able to immediately resume financial operations due to the loss of its financial records. For this reason, they suggested and we agreed to establish a secure back up system for financial data and reports.

1995 Expected Outputs

The Unit is expected to establish, before end-June 1995, a system to safeguard the Center's financial data and reports. Such a system is expected to involve having external storage for our data as well as a well-documented back-up system.

2. Project Support Unit

2.1 *Completion of the Project Planning and Management Manual*

ICLARM Staff : Project Support Staff

Duration : Four Months, to start 1 February 1995

Objectives

- To establish a formal and uniform system for project planning and management within the Center.
- To effectively communicate the responsibilities of project managers.

Background and Justification

One of the most important needs identified by various external reviewers is the need for ICLARM to establish a project-based management system at the soonest possible time. Given the nature of funding experienced by ICLARM since the mid-80s and current trends which show that funding will continue to be restricted to specific activities, the division agrees that project-based management as the only logical way forward.

Although the Center has been practicing project-based management as a result of its large portfolio of restricted grant projects, the Division sees the need to:

- standardize and institutionalize project planning and management; and
- expand the scope of project management to include activities funded out of unrestricted grants.

The completion of the Project Planning and Management Manual by the Unit is therefore seen as a critical first step in establishing project-based management. Although a first draft is already ready, the Unit will still have to complete certain sections, circulate the manual for comments by research staff

and prepare a final draft incorporating comments and suggestions made by research staff.

1994 Progress

In 1994, the Project Support Unit compiled various forms and procedures they had been using. Gaps in procedures were also identified and a skeleton framework for project management and planning was drawn up.

1995 Expected Outputs

The final draft should be ready by end-May.

Successful implementation of the management systems described in the Manual will, however, require the following:

- Training of all staff involved in project management (See Project Management Training)
- Establishing information systems support for project management (See Project Management Information)

2.2 *Project Management Training*

ICLARM Staff : Project Support Staff, Project Leaders and Program Directors

Duration : 12 Months on going

Objectives

- To upgrade the management skills of all project leaders and other staff with project management responsibilities.

Background and Justification

See 2.1 above.

1994 Progress - (New item)

1995 Expected Outputs

The Unit, in consultation with Project Leaders, Program Directors and the Director General, should initiate the identification of external project management

training courses/programs most suitable for ICLARM's project management systems.

Once a training course is identified (Target: End-June 1995) and its design finalized, all staff with project management responsibilities should be trained. (Target Date: end-October 1995).

2.3 *Project Management Information*

ICLARM Staff : Project Support Staff, Other MSD Units

Duration : 12 Months

Objectives

- To ensure that project information is readily available to all who require such information.

Background and Justification

The availability of project management information is critical to the success of any effort to implement a project-based management system. Recognizing this, the Unit has designed such a system to support the Project Planning and Management Manual. The "Projects Database" as the system has been called aims to provide project leaders, project staff and other parties with detailed information on projects. The initial phase of the development work has been focused on organizing basic information on each project (title, start date, donor, objectives, reports, staff participation, etc.) into a database that would be made available on the Center-wide LAN.

1994 Progress

The 1994 workplans of the MIS Unit were largely determined by the needs of the other MSD units for systems design and programming (primarily database programming). The highest priority established for the unit in 1994 was to fully automate the generation of financial reports. The continuing objective of the MIS unit was to be able to develop the accounting systems to a point where managers at all levels would be able to view "live" or "real time" financial data and reports on screen.

The unit was able, thus far in 1994, to automate a number of intermediate accountaing reports which contributed significantly to the Finance and Accounting Unit's ability to generate the monthly reports very quickly after the end of each month's closing. The additional programming required to take the

automated procedures all the way through to the final reports has, however, been delayed due to the recent efforts to modify the reports in order to make them more user-friendly.

The MIS Unit has also finished the design of a Projects Database and is now in the process of programming the project information system using "Power Builder"—an object-oriented programming tool. The project information system has been designed to allow project managers to track all components of their projects—budgets, staffing, collaborative arrangements, reporting requirements and other key project components.

1995 Expected Outputs

A prototype package has been developed and distribution of the first version (for purposes of collecting all relevant data and testing its usefulness) is expected by end-April 1995. A final version with complete data should be developed by 30 June 1995. On-screen project and project-related reports should be available on the LAN by year-end 1995.

3. Human Resources Management Unit

3.1 *Performance Management Systems*

ICLARM Staff : HRM Unit Staff

Duration : Continuous

Objectives

- To ensure that the implementation of the ICLARM Performance Management System is executed smoothly.
- To support management efforts to achieve maximum staff buy-in and ownership of the system.

Background and Justification

One of ICLARM's major organizational weaknesses in recent years has been the absence of an effective institutionalized performance management system. This weakness was highlighted in the 1992 EPMR and the ICLARM Board and management have placed a very high priority on the resolution of this issue.

Toward the end of 1994, ICLARM management, in consultation with both IRS and NRS, developed implementing guidelines for such a performance management system. For this reason, efforts, in 1995, will be focused on implementing the system and in identifying ways to improve the system in order to maximize its effectivity for the Center.

1995 Expected Outputs

All HQ staff (IRS and NRS) should receive adequate training in the implementation of the system. Any revisions identified as being necessary should be incorporated into the guidelines and/or forms prior to the official implementation. (By January 1995).

Annual 1995 Performance Agreements should be prepared by all staff and agreed to by their respective supervisors. (15 March 1995).

Terms of reference for all ICLARM HQ positions should be formally updated. (May 1995).

Interim performance reviews should be conducted by supervisors by July 1995 and documented accordingly.

If necessary, updated guidelines for 1995 performance assessments and 1996 performance agreements should be prepared and be ready for issuance before the end of 1995.

. 3.2 *Personnel Policies Implementation*

ICLARM Staff : HR Manager, MSD Director, NRS Advisory Committee

Duration : Continuous

Objectives

- To communicate to ICLARM staff how personnel policies are to be implemented within the Center by developing implementing guidelines as required/requested by staff or as anticipated as necessary by ICLARM management.

- To keep the IRS and NRS Policy Manuals updated.

Background and Justification

Although Board-approved personnel policy manuals have been very helpful in establishing a greater awareness and understanding among staff of

how the Center is being managed, recent experience indicates that many of the policies will benefit from being spelled out in greater detail through implementing guidelines issued by management. In addition, ICLARM management, in the process of implementing these policies has identified the need to bring forward to the Board policy changes it felt were necessary.

The NRS Advisory Committee has also been very useful in the identification of areas requiring the articulation of such implementing guidelines and policies in need of change. In 1994, management issued implementing guidelines for Performance Management and NRS Staff Loans. Other areas requiring guidelines have also been identified. These include IRS Cash Advances and the Handling of Personnel Files. The HR Unit should be sensitive to staff and management needs in this area and take upon itself the role of actively anticipating requirements for implementing guidelines or changes to policies.

1995 Expected Outputs

The HR Unit should generate at least four sets of implementing guidelines in 1995 (at the rate of at least one each quarter).

Recommendations for changes to IRS and NRS Personnel Policy Manuals should also be prepared for management's review prior to each Board meeting.

The HR Unit should also facilitate management efforts to have staff participate in the development of implementing guidelines and changes to existing policies.

3.3 *Staff Development Programs*

ICLARM Staff : HR Staff, MSD Director, Director General, All ICLARM Staff

Duration : 12 Months

Objective

- To develop a comprehensive listing of all skills required for all positions within the Center and a corresponding set of training and development activities for a formal staff development program.

Background and Justification:

In the past, ICLARM has been content with hiring staff on fixed-term contracts with the requisite skills to perform the required task for a given activity or function.

As the organization has become more complex and ICLARM's clients more demanding, ICLARM needs to be in a position make better and more efficient use of its human resources.

While a formal staff development program complements other management initiatives in performance planning and management, it also will greatly assist the Center's staff members in coming to terms with their own career expectations and in managing their own careers.

1995 Expected Outputs

- An inventory of minimum and desired skills for each position in the Center as well as methods, if any, available to establish levels of skills.
- Available training and staff development activities which will provide these skills.
- A system for supervisors to assess the skill level and prioritize staff training and development activities for staff during the performance planning/assessment process.
- A staff training and development budget for 1996.

3.4 *Human Resources Management Information*

ICLARM Staff : HR Unit Staff, MSD Director

Duration : 12 Months

Objectives

- To establish and maintain a database of information on all ICLARM staff. To be able to generate, from this database, regular reports and answers to inquiries.

Background and Justification

In 1993, the HR Unit (called Personnel Services at that time) purchased a software package called "Rapid 201". Staff data were entered and simple reports have since then been generated. Unfortunately, the software could not generate the kind of information required by ICLARM managers without undergoing special customization that would have cost ICLARM both time and money. In the meantime, new software packages have been developed and are now being sold in the market.

Last year, ICLARM reviewed several of these available software packages and has identified some that were worth considering. Unfortunately, the decision to purchase a new software package has been deferred for budget reasons.

1995 Expected Outputs

The HR Unit should establish the basic specifications for the information system and software it requires. Such specifications will include definitions of fields it would like to see included and queries and reports that the system should be able to handle. These specifications should be ready by March 1995.

On the basis of the specifications established for the system, a new software package should be purchased and installed no later than June 1995.

All ICLARM staff data should be entered into the system by September 1995.

HR reports should be generated by the system no later than October 1995.

The system should be accessible by LAN toward the end of 1995.

3.5 *Personnel Services*

1994 Progress

The HRM Unit initially focused its attention in early 1994, on streamlining the delivery of services to individual ICLARM staff. Among the results achieved thus far for this year are the following:

- the processing and delivery of SSS and Pag-Ibig benefits for Philippine NRS were expanded and improved;

- contact with AIARC for IRS benefits was established and the ability of the HRM unit to respond to IRS requests was improved;

- a dentist was put on retainer and provided ICLARM staff with dental services at preferred rates;
- bottlenecks in the processing of hospital insurance claims of NRS were identified and resolved; and

- a staff picnic was organized.

4. Administrative Services Unit

4.1 *Review of Travel Agency Services*

ICLARM Staff : Administrative Services and Accounting and Finance Staff

Duration : Four Months, to start in the second quarter of 1995.

Objectives

- To ensure that the Center receives the best value, in terms of service and price, for its international travel budgets.

Background and Justification

The last time that a qualification of travel agencies was conducted by ICLARM was in 1989. At that time, the Center, after thoroughly reviewing proposals received by a number of travel agencies, decided to designate three agencies as authorized ICLARM travel agents from which ICLARM staff were allowed to purchase air tickets and other services. The continuing cash flow difficulties of the Center, however, have not made it possible to undertake such an exercise again given the credit terms and outstanding payables that ICLARM had with these travel agents.

A review of these existing arrangements and services is overdue.

1994 Progress

The position of Administrative Services Manager was vacant for several months in 1994 as a result of the resignation of Ms. Beng Catibayan during the first quarter of 1994. Nevertheless, the unit, under the management of Mr. Danny Mendiola, hired as Administrative Services Manager in July 1994, was able to achieve the following:

- Steps have been taken toward more proactive management of the Center's fixed assets. In coordination with the Finance and Accounting Unit, the Administrative Services Unit has started to update the inventory list of fixed assets. We expect recommendations concerning the use of these fixed assets to be made before the year-end.

- The processing of travel requests, particularly the arrangements for the purchase of air tickets, has been streamlined with the participation of secretaries. Secretaries have been made responsible for contacting and following-up with ICLARM's travel agents.

- Additional control procedures have been introduced in the use of ICLARM vehicles.

- Security and safety measures at headquarter offices have been reviewed and a list of specific recommendations have been prepared.

- Securing visas for Philippine-based IRS and their dependents has improved with the introduction of a new tracking and monitoring system.

- Work on the preparation of an Administrative Operations Manual has started. Completion is expected in early 1995.

1995 Expected Outputs

The Administrative Services Unit should be able to prepare a recommended framework for a review of travel agencies no later than April 1995.

Once approved by management, a letter soliciting proposals from reputable travel agents should be finalized and sent out. (June 1995)

All proposals made by travel agents should be analyzed and recommendations made to management by September 1995.

4.2 *HQ Office Space Expansion*

New offices on the sixth floor of the Bloomingdale Building should be ready for occupancy by April 1995.

4.3 *Costs of Communication*

ICLARM Staff : Administrative Services Staff, Finance and Accounting Staff

Duration : Four Months

Objectives

- To ensure that the Center's resources allocated for communication are used efficiently and effectively.

Background and Justification

In 1990, an exhaustive review of the costs of communication were undertaken by this unit. This activity serves merely to update the Center in terms of costs of and new technologies for communication. Such a review is necessary given the large amount of resources invested by the Center in communications.

1995 Expected Outputs

A report on the review and specific recommendations should be ready by August 1995.