

PN-ABD-113



**International Center for Living Aquatic  
Resources Management**

PH-11-113

# **ICLARM REPORT 1988**

## **ICLARM STATEMENT OF PURPOSE**

ICLARM is organized exclusively for charitable, educational, and scientific purposes; and in furtherance of these purposes, ICLARM is to establish, maintain, and operate an international aquatic resources center designed to pursue ... the following objectives:

To conduct directly and to assist others in conducting research on fish and other aquatic organisms, on all phases of fish production, management, preservation, distribution, and utilization with a view to assisting the peoples of the world in rationally developing their aquatic resources to meet their nutritive and economic needs;

To improve the efficiency and productivity of culture and capture fisheries through coordinated research, education and training, development and extension programs;

To upgrade the social, economic, and nutritional status of peoples in the less-developed areas of the world through improvement of small-scale rural subsistence and market fisheries;

To work toward the development of labor-intensive systems to aid employment and of low energy systems to minimize capital and cost requirements;

To publish and disseminate research findings and recommendations of the Center; and

To organize or hold periodic conferences, forums, and seminars, whether international, regional, local, or otherwise, for the purposes of discussing current problems.

ICLARM Articles of Incorporation  
1977, Manila, Philippines

# **ICLARM REPORT 1988**

**Edited by**

**Jay L. Maclean  
and  
Leticia B. Dizon**

**1989**

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*Cover:* Women are often the main or exclusive operatives in postharvest fish handling and marketing. Here a mixture of tilapia species (*Sarotherodon melanotheron*, *Sarotherodon galilaeus* and *Tilapia zillii*) are being scaled for sale after harvest by gillnetters from Weija Lake near Accra, Ghana. Photo by R.S.V. Pullin.

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## INTRODUCTION

### Managing aquatic and coastal resources on the "Planet of the Year"

In 1987, ICLARM began moulding a plan for the Center's activities over the years 1988 to 1992. The published plan (copies of which are available from ICLARM on request) was more than a list of activities that would lead to improved aquatic resource management; it also was a reflection of how ICLARM views the issues of the immediate future in tropical developing countries. Very briefly these were - and are - the following issues:

In aquatic resource management, the need of managers for information on the state of their fisheries and other coastal resources is becoming increasingly critical. Laissez-faire attitudes are being replaced by concern as evidence mounts that irreversible environmental changes are resulting from those attitudes; changes that are likely to affect managers and their constituents in the pocket and (even) in the stomach. Changes in family and community social structure are also likely results. Planning for sustained, rather than diminishing resources is now the guideline worldwide.

Even without quantitative information, many issues stand out clearly. Whether or not a fishery is showing obvious signs of depletion, the effects of too many fishermen are obvious. This "Malthusian" overfishing, a term coined by Dr. Daniel Pauly of ICLARM, describes the usual situation throughout the tropics. In fishery after fishery, the available stocks are being divided amongst more and more fishermen, and catches are now being measured by the hatful more than by the netful. Illegal fishing methods like blast fishing are increasingly devastating reef habitats in many tropical countries. Such practices are tantamount to harvesting the fruit by blowing up the fruit trees and would seem obviously shortsighted but they are sometimes used in desperation. The issues here are socioeconomic in nature.

Onshore activities are also to blame for degradation of fishing grounds. Logging, mining, agricultural practices, etc., are affecting coastal waters. Integrated coastal area management is needed, rather than unisectoral planning as commonly done, where indeed there is planning at all.

In aquaculture, ICLARM's other major focus, the need for sustainable production systems in harmony with the environment and in synergy with agriculture and fisheries is becoming clearer. This also requires management of resources to develop better breeds of fish for use in such



systems. In the past, indiscriminate introductions of fish species have spread diseases, harmed natural habitats and caused genetic changes in wild and farmed fish populations. Nowhere is the issue more urgent than in Africa, where the various tilapia species that could supply genetic resources for maintaining or improving broodstock in many countries, have been transferred and mixed, such that wild or pure genetic resources needed for future breeding research may have become irreversibly changed or lost. ICLARM can foresee a time in the not too distant future when requests from African aquaculturists for broodstock of tilapias from their countries will have to be sent to international "gene banks". There are precedents for such an approach. In 1988, at the suggestion of Oxfam, the International Rice Research Institute (IRRI) was able to send to Cambodia seeds of a number of that country's rice varieties which were stored in IRRI's germplasm bank. The rice varieties had become extinct in Cambodia during the recent war years when some two million hectares were abandoned or left fallow; their crops had all been eaten. IRRI is also now supplying Philippine rice breeders with seeds of their traditional rice varieties which had been abandoned in favor of newer varieties.

ICLARM's five-year plan (1988-1992) includes construction of a modest aquaculture genetics research facility so that the Center can begin to take a leadership role in the conservation of important fish genetic resources, especially those from freshwater such as the tilapias.

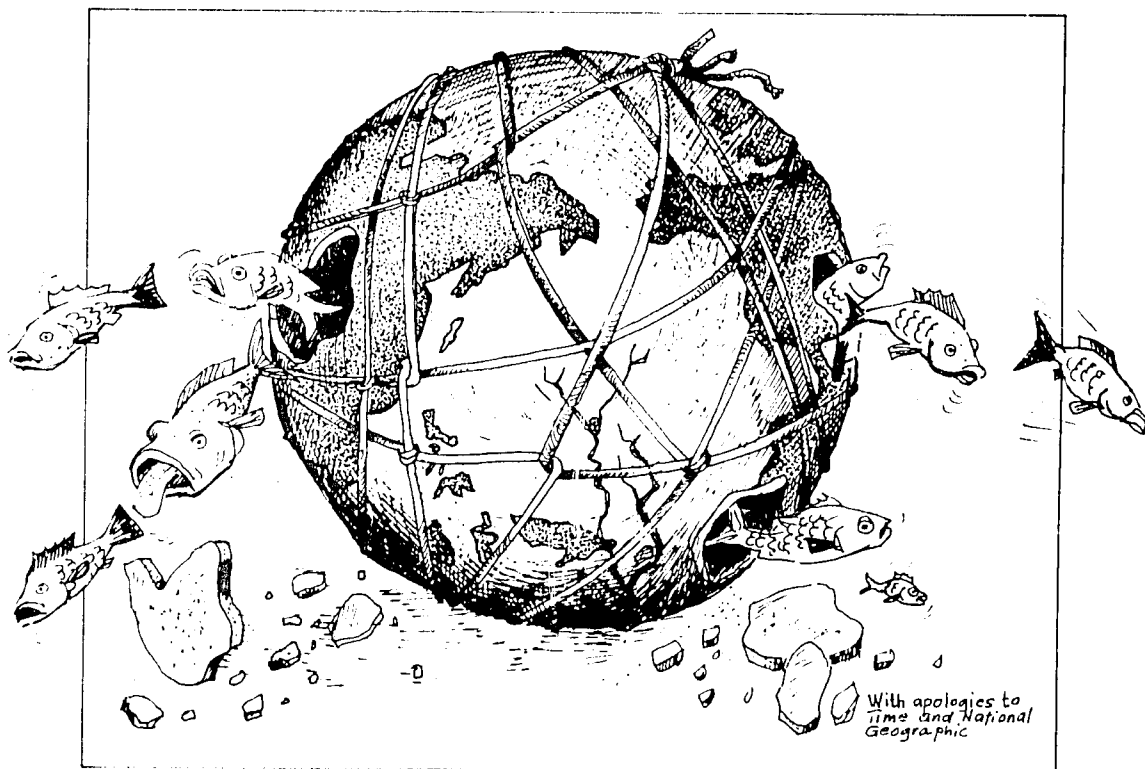
Aquaculture, particularly the intensive 'feedlot' systems typical of the 'North', can have serious adverse environmental impacts such as water pollution. However, integrated farming in which agricultural residues and even human excreta can be recycled, turns potential pollutants into productive assets. ICLARM views the development of such systems as of immense benefit in rural areas and is engaged in a long-term research program that seeks to understand the basis of fish production in integrated farming systems.

Why should one worry about how these aquaculture systems work as long as they do work? Consider an example of the consequence of not having such knowledge. The wildfire spread of shrimp farming in developing countries, pioneered in Taiwan, began in 1988 to be followed by the rapid spread of shrimp diseases and losses, again led by Taiwan. This example is simply another manifestation of the fundamental problem of aquaculture - putting up the building before laying the foundations; development racing ahead of the basic research needed to support it.

### *One year later*

One year into ICLARM's five-year plan period, the Center finds that, around the world, pressures to manage renewable resources on a sustainable basis are gathering momentum rapidly. Towards the end of 1988, major influential magazines such as *Time*, *Newsweek* and *National Geographic* turned their attention to the global environment. Regional journals have followed suit. So suddenly did this concerted effort occur in contrast to the creeping, chronic growth of the malaise, that one was

reminded of a school of fish suddenly turning in unison in response to a danger that perhaps only a few of the fish perceived. Perhaps the most significant difference between past popular articles and the present series is the realization that there are strong connections between climate and factories, forests, floods and fishes.



This drawing by ICLARM staff artist Jun Espiritu, which depicts the effects of a crumbling world environment on fish, was an amalgam of illustrations on the covers of issues of *Time* and *National Geographic* that dealt with environmental problems. We added the fish and featured the drawing in an editorial in *Naga*, The ICLARM Quarterly, January 1989.

Readers will not be surprised to learn that in 1988 ICLARM decided to establish a new program - the Coastal Area Management Program - for the same reasons enunciated by the popular press for its flurry of articles on this topic: the accelerating deterioration of the environment and the consequences of such deterioration. This new program of ICLARM, which will complement the Center's long-established programs in Aquaculture and Resource Management, is built upon the ongoing ASEAN/US Coastal Resources Management Project implemented by ICLARM in cooperation with national groups in Southeast Asia. Through the new Program, ICLARM will expand its activities in this field from the present ASEAN context towards a global perspective of the issues. Formation of the new Coastal Area Management Program was announced by ICLARM's Board of Trustees at its December 1988 meeting.

Unlike the probably ephemeral attention being given by the press towards the "planet of the year" (*Time* magazine, 2 January 1989), ICLARM's new Program in this coastal resources field is but a

strengthening of an existing thrust; that is, a firmer commitment in an area in which the Center already has activities. The considerable activities in the coastal resources management project in 1988 are recorded together with ICLARM's fish stock assessment work in the Resource Assessment and Management section of this report.

However, one year into the Center's five-year plan period, ICLARM is still striving to convince donors of the need for facilities to lead and coordinate strategic research on fish genetics and integrated farming systems. Nevertheless, much progress was made in this field in 1988 as reported in the Aquaculture section of this report. Moreover, our Coastal Aquaculture Centre, located in Solomon Islands (ICLARM's only aquaculture research facility to date), has flourished and is well on target for achieving its objectives of developing aquaculture technology for coastal dwellers. The Centre is concentrating initially on giant clam culture for island communities.

Overall, we report that our five-year plan moulded in 1987 will become enlarged somewhat on the resource management side from 1989, while delays are appearing on the aquaculture side as we fall somewhat behind schedule in developing the proposed genetics and integrated farming systems facilities.

### *Donors satisfied*

The Center's efforts to date are not unappreciated. We know that our publications are well used, thanks to citation analysis we carried out during the year; some publications are even used as tertiary text books. Kind letters from satisfied trainees and users of our various information services and networks testify to their value. New ICLARM methodologies, software and research thrusts are being taken up in many countries.

Now two of the Center's major donors have reported their satisfaction. An external review of ICLARM's activities was carried out for the Australian International Development Assistance Bureau and the United States Agency for International Development in March 1988.

Their report stated that ICLARM's "mode of operation has been interactive, effective and because of the small size of ICLARM, highly cost-effective" and that "the staff has been stable, competent, highly professional and resourceful."

The review also noted that "the Information Services are highly regarded by many Asian countries and scientists and are a highly visible success for ICLARM. The benefits of several research projects are considered of considerable importance to the end users, namely national governments and fishermen, both in the Stock Assessment Program and the Aquaculture Program. Highlights have been the ELEFAN model for stock assessment of tropical fish stocks and the data base on tilapia and carp. Effective research networks have been established in the Stock Assessment and the Aquaculture Programs as well as workshops to disseminate the research results of ICLARM."

In the following two pages are highlights of the Center's 1988 activities.

## **SOME ACHIEVEMENTS, 1988**

ICLARM's programs are built around long-term research. Achievements along the way are small peaks before the distant summit. Some of these peaks during 1988 are summarized here.

### **Resource Assessment and Management**

- Release of the Compleat ELEFAN software, a 12-diskette package for the analysis of tropical fish population dynamics, distributed to over 100 users in over 50 countries (see p. 43).
- Design of an interactive database for documentation of the ecology, biology and uses of exploited or cultivated tropical and subtropical fishes (see p. 44-45).
- Successful completion of a project on the management of small pelagic fishes in the Philippines (see p. 41-42).
- Identification of a base, *modus operandi*, future collaborators and supporters of the planned ICLARM regional office in Latin America (see p. 39-40).
- Holding of a record number of training courses in fish stock assessment, fisheries management, coastal resources management and remote sensing/geographic information systems. The sites were in Mozambique, Solomon Islands, Bangladesh, Indonesia and Singapore, respectively (see p. 10-11).
- Publication of "coastal profiles" on the Upper South of Thailand and Singapore, providing a basis for the development of coastal zone management plans (see p. 28-37).
- Conclusion of a Memorandum of Understanding concerning joint research and educational activities with the Department of Fishery Biology and of Benthic Ecology of the Institut für Meereskunde, Kiel University, Kiel, Federal Republic of Germany (see p. 44 and 72).

### **Aquaculture**

- Startup of new tilapia genetic improvement research, with the first ever direct transfer of new germplasm from Africa to tropical Asia (see p. 67-70).
- Publication and distribution to developing countries of a major review of tilapia genetic resources (see p. 74).
- Completion of new integrated farming research facilities and initiation of research and training (including a Master's degree program) in Malawi (see p. 79-83).

- An Asian regional workshop to review the state-of-the-art of rice-fish culture; and subsequent advances in rice-fish culture technology through research using new systems of planting and fish refuges (see p. 78)
- Successful outcome of a project to provide alternative livelihood for persons displaced by reservoir construction in West Java, Indonesia; over 1,200 such families now produce over 20% of the fresh fish for the Bandung district (see p. 84-86).
- Publication and distribution to developing countries of a major review on Research and Education for the Development of Integrated Crop-Livestock-Fish Farming Systems in the Tropics (see p. 51).
- Completion of the first phase of construction of ICLARM's Coastal Aquaculture Centre, Solomon Islands, and successful spawning of giant clams, and transfer of juveniles to ocean nurseries (see p. 53-56).
- Establishment of a Network of Tropical Aquaculture Scientists with over 200 members from 50 countries, having its own international newsletter, 'Aquabyte' (see p. 64).
- Hiring of a fulltime French Project Officer to prepare ICLARM's first technical publications in French and to develop and expand technical cooperation with Francophone countries (see p. 65-66).
- Publication and distribution of the Proceedings of the Second International Symposium on Tilapias in Aquaculture (ISTA II) and conclusion of an agreement to hold the next symposium in this series in Côte d'Ivoire in 1991 - potentially the largest ever aquaculture gathering in Africa.
- Widespread adoption of Program publications as research and graduate teaching texts, notably a carp hatchery manual and reference work on detrital foodchains in aquaculture.

## **Information**

- Commencement of a novel information service for developing-country researchers (see p. 99-101).
- The cumulative number of books distributed since ICLARM's first publication in 1980 reaches 80,000.
- The cumulative number of ICLARM contributions to the literature reaches 500.
- It was found, through an in-house analysis, that there are over 2,000 citations to ICLARM's contributions in the literature (see p. 94).

## **Social Sciences**

- Three new research teams were formed within the Asian Fisheries Social Science Research Network in 1988 in Indonesia (2) and Thailand (1) (see p. 103).

# RESOURCE ASSESSMENT AND MANAGEMENT PROGRAM

## Background

For the Cantonese-speakers of southern China and the Diaspora, 1988 was a lucky year because of the double eight or *fatt-fatt*. Indeed, 1988 was not only a "dragon" year, which happens every 12 years, but the year of the blue dragon, which happens every 60 years. The year was so lucky that it produced a baby boom, as many wanted their first-born (sons) to be born on 8 August 1988.

As mentioned in the Introduction to this Report, *Time magazine*, in an unprecedented step, nominated Earth as the "Planet of the Year," and devoted its year-end issue to a lucid analysis of the ecological disaster humankind is gradually sliding into, and of some measures needed to reverse this trend.

It is possible that this issue of *Time magazine* will be seen, a few decades hence, as a major watershed (and that hence, 1988 will be seen as a lucky year): for the first time, a major western news magazine has addressed these issues rationally, and identified the various interconnections between the external debts of various developing countries and their environmental policies, between the arms race and pollution, between population growth, poverty and deforestation, and between all these things, and the greenhouse effect and the predicted climatic changes.

The activities of ICLARM's Resource Assessment and Management Program (RAMP) cover several of these linkages. For example, those between poverty, overpopulation and overfishing on pollution and deforestation (of mangroves), all leading to coastal degradation.

The research, education and extension work conducted by RAMP staff in 1988 confirms (for the areas we covered) the diagnoses of *Time*: Planet Earth is endangered. However, we also came to realize that the global nature of the environmental threat is a blessing in disguise. It won't be possible for the marine polluters, hardwood importers and consumers of developing country proteins (the developed countries) to continue with their policies of benign neglect and voracious pillage. The climate changes will be global, affecting temperate countries more than tropical countries. Thus, there will have to be changes in the way the world economy works and in the way natural resources are managed.

This major restructuring - a global "perestroika" - will not result from a single effort however large. Rather, this restructuring will be achieved only through the efforts of a vast number of groups, NGOs,

agencies and people pushing in the same direction. ICLARM's RAMP will be among these.

In 1988, the RAMP continued to develop management methods and schemes for aquatic resources and coastal zones in the tropics, specifically for the sites where we have projects (see below).

ICLARM's five-year plan for 1988-1992 outlined a number of focal research areas for the RAMP, i.e.,

- development and implementation of multispecies models;
- development of an interactive database on tropical fisheries resources management;
- management of small-scale fisheries; and
- coastal zone management and planning.

## **Progress of Work**

### ***Development and implementation of multispecies models***

Development of stock assessment methodologies with emphasis on methods relevant to multispecies modelling is being undertaken by Ms. Astrid Jarre, who recently graduated from Kiel University. She is giving emphasis on the Peruvian upwelling ecosystem (see below). Ms. Jarre will also teach biostatistics at the Marine Science Institute, University of the Philippines.

The RAMP has submitted a proposal for survey work in Brunei to the Brunei Government, and a proposal for analysis of survey data from western Indonesia to GTZ. Positive responses are expected. The small cooperative research activity between the Institute of Marine Sciences and Limnology (National Autonomous University of Mexico) and ICLARM is continuing, and was recently boosted by visits by RAMP Director, Dr. Daniel Pauly to Mexico, and by Dr. A. Yañez-Arancibia to the ICLARM headquarters (the latter visit was funded by the Intergovernmental Oceanographic Commission, which is highly supportive of linkages of this type).

In September, the Instituto del Mar del Peru (IMARPE) and ICLARM signed a Memorandum of Understanding formalizing the cooperation between the two institutions. During his September visit to IMARPE, Dr. Pauly also agreed with IMARPE and GTZ staff on a possible continuation, in the frame of a joint IMARPE/ICLARM project to be funded by GTZ and administered by ICLARM, of some of the research and modelling activities presently conducted at IMARPE by staff of the Cooperative Peruvian-German Fisheries Research Program (PROCOPA).

Many papers were finalized for publication in ICLARM's second book of this type entitled "The Peruvian Upwelling Ecosystem: Dynamics and Interactions", co-edited by Dr. Pauly, Mr. Jaime Mendo, Dr. Peter Muck (GTZ/PROCOPA) and Ms. Isabel Tsukayama (IMARPE/PROCOPA).

The extensive time series and other information documented in this book and its predecessor, published in 1987, will serve as a basis for a multispecies simulation model of the Peruvian ecosystem to be developed by Dr. Muck and Ms. Jarre and whose economic component will be

provided by ICLARM Associate Scientist Dr. Max Agüero and his Peruvian counterpart(s).

### ***Development of an interactive database on tropical fisheries management***

The goal of this project is to develop user-friendly software to help users in developing countries gain access to the wealth of information on tropical commercial fish presently available only in difficult- or expensive-to-obtain scientific (and often grey) literature.

ICLARM's consultant on this project, Mr. Rainer Froese from Kiel University, worked with ICLARM programmers Mr. Felimon Gayanilo, Jr., Ms. Mina Soriano and other ICLARM staff on the definition of the database from mid-October to mid-December. Their comprehensive report will form the basis for the final database design in the first half of 1989, which will be followed by hiring of a research assistant who will begin identifying and entering data.

Mr. Gayanilo has developed, in cooperation with ICLARM library staff, a user-friendly shell for the UNESCO-supported CDS-ISIS library management software. This software is expected to significantly cut the training requirements of the 3,600 CDS-ISIS users throughout the world after its release in 1989.

### ***Management of small-scale fisheries***

Dr. Agüero and collaborators undertook several activities in the area of economics and management of small-scale fisheries covering research, consulting, training and planning.

The emphasis has been on modeling the various aspects of the fisheries needed for effective management. Thus, quantitative techniques have been applied to analyze the impact of alternative management schemes on the benefits that the open-water fisheries of Bangladesh can generate. Also, decision analysis techniques were applied to investigate investment and marketing strategies for the culture of groupers in the Philippines.

An improved methodology for the economic and financial evaluation of vessel investment projects has been elaborated through a Master's thesis conducted by ICLARM staff member, Ms. Abbie Cruz. A detailed economic profile for the most important gears used in the small pelagics fisheries of the Philippines is underway including the quantification of net economic benefit from small pelagic fisheries and the relative contributions of capital and labor. Finally, a socioeconomic evaluation of a \$30-million fishery project in Pasto, Colombia, was conducted under a 45-day consultancy contract with GTZ. Recently developed commercial microcomputer software was effectively applied, considerably reducing manpower and time requirements.

Another ICLARM contribution was the presentation of the interactions of Malthusian dynamics and overfishing in developing countries at the "Interdisciplinary Conference on Natural Resources



Modelling and Analysis", Halifax, Canada, 29 September to 1 October (see Fig. 1). This presentation elicited positive reactions from an audience of fisheries economists and other natural resource specialists, suggesting that we may have touched areas previously not fully grasped by researchers and policymakers in western developed countries. This theme and its links with ICLARM's coastal zone management activities will thus need some elaborating if ICLARM is to continue its positive influence on policymaking by, e.g. international donor agencies.

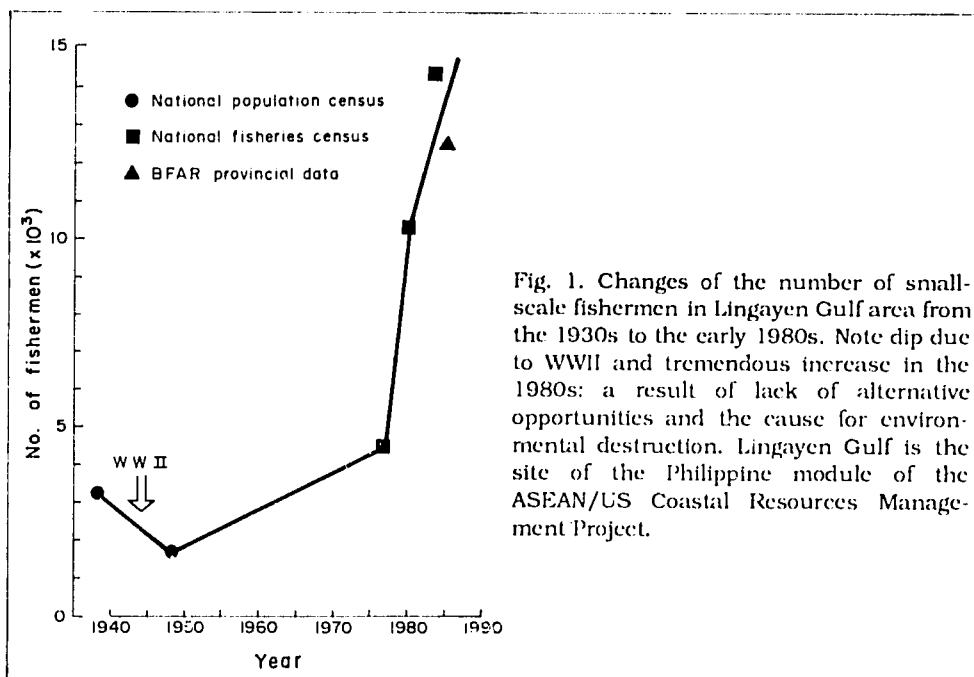


Fig. 1. Changes of the number of small-scale fishermen in Lingayen Gulf area from the 1930s to the early 1980s. Note dip due to WWII and tremendous increase in the 1980s: a result of lack of alternative opportunities and the cause for environmental destruction. Lingayen Gulf is the site of the Philippine module of the ASEAN/US Coastal Resources Management Project.

### ***Coastal zone management and planning***

ICLARM's activities in this area are executed through the ASEAN/US Coastal Resources Management Project (CRMP); see project summary starting on p. 28.

### ***Education and training***

RAMP activities in education and training involved a number of projects. During the year, the project on "Management Options for Tropical Small-Scale Fisheries" performed the following:

- A training program on "The application of microcomputers to fisheries management," given to staff of the Directorate General of Fisheries and Bangladesh Center for Advanced Studies.
- Preparation of training material for two training courses in 1989 in Latin America on the "Application of economic evaluation techniques to fishery management and investment projects in aquaculture" and "Natural resources," with financial support from IDRC and GTZ. The first training program will take place 16 January-4 February 1989, in Pasto, Colombia.

- Supervision of the Ph.D. thesis of Mr. A.K.M. Mahfuzzudin Ahmed on "A model for evaluating benefits from the use of fishery resources in the inland areas of Bangladesh," Universiti Pertanian Malaysia, and of the M.A. thesis of Ms. Abbie Cruz, on "An improved method to conduct project evaluation in a fishery," Center for Research and Communication, Manila, both of which were accepted.

Several fishery scientists visited ICLARM for training through the Network of Tropical Fisheries Scientists (NTFS). Their particulars are given in Table 1.

ICLARM scientist, Mr. Paul Dalzell completed during his free time a M. Phil. thesis on "The biology of surgeonfishes (Fam. Acanthuridae) with particular emphasis on *A. nigricauda* and *A. xanthopterus*, from northern Papua New Guinea." Mr. Dalzell submitted the thesis in late 1988 to the University of Newcastle upon Tyne, UK.

The ASEAN/US Coastal Resources Management Project conducted the following training activities:

- Third training program on Principles of Coastal Resource Management, 3-16 April, Jakarta, Indonesia.
- Training on Remote Sensing and Geographical Information System (GIS) - Application to Coastal Resources and Planning, 1-12 November, Singapore.

The training activities conducted under the Tropical Fish Stock Assessment Project involved:

- A training course on fish stock assessment at the Instituto de Investigação Pesqueira, Maputo, Mozambique, 22 February-14 March, funded by Norwegian Agency for International Development (NORAD).
- A series of four lectures at the Institute of Marine Research, Bergen, 16-18 March.
- A one-week graduate course on tropical fish stock assessment held at the Institut für Meereskunde, Kiel, Federal Republic of Germany, 20-26 June.
- A training course on the use of the Complot ELEFAN Program for analysis of length-frequency data, 5-16 December in Honiara, Solomon Islands, funded by the Australian International Development Assistance Bureau (AIDAB) via the Forum Fisheries Agency and organized and run by Mr. Felimon Gayanilo, Jr. (ICLARM) and Mr. Andrew Wright (FFA).

### **Other activities**

To support the various themes and projects discussed above, a number of important activities were continued and/or completed, viz:

- The NTFS continued to support fisheries researchers in tropical developing countries. During 1988, editorship of Fishbyte, the network newsletter, was transferred from Dr. John L. Munro, ICLARM South Pacific Office, Honiara, Solomon Islands, to Dr. Daniel Pauly, ICLARM Headquarters, Manila, Philippines.
- Development and dissemination of software through the ICLARM Software Project continued, with two new programs added.

Table 1. Fisheries scientist-trainees at ICLARM through the Network of Tropical Fisheries Scientists, 1988.

Visitor	Duration	Institution	Funding Agency	Report
1. Mr. Ahmed Hafiz	4 Jan-4 Feb	Marine Research Section Ministry of Fisheries, Malé, Maldives	UNESCO	a) Biology, population dynamics and exploitation of yellowfin ( <i>Euthynnus affinis</i> , Scombridae) with emphasis on Maldivian waters  b) The biology and growth of big-eye scad ( <i>Selar crumenophthalmus</i> , Carangidae) in Maldivian waters
2. Ms. Jintana Nugranad	3-17 Apr	Brackishwater Fish. Station Dept. of Fisheries, Thailand	Growth Studies on Cultured Marine Bivalves of Thailand, (GTZ/ICLARM Project)*	a) Preliminary report on the growth, mortality and recruitments of the Asian moon scallop <i>Amusium pleuronectes</i> in (Koh Chang-Koh Kood Area), Eastern Gulf of Thailand
3. Ms. Julita Ungson	4-19 Apr	Mariano Marcos State University (MMSU), Batac, Ilocos Norte Philippines	MMSU/ICLARM	a) The fry fishery of Ilocos Norte, Philippines
4. Dr. Shigeo Hayase	4-19 Apr	Faculty of Fisheries and Marine Science, Universiti Pertanian Malaysia	Japan Intl Cooperation Agency (JICA)	a) Population dynamics of <i>Priacanthus macracanthus</i> off Sarawak coast, South China Sea
5. Dr. Mohd. Azmi Ambak	4-19 Apr	Faculty of Fisheries and Marine Science, Universiti Pertanian Malaysia	Japan Intl Cooperation Agency (JICA)	a) Preliminary estimation of growth and mortality in <i>Nemipterus bathybius</i> (Pisces: Nemipteridae) from the coast off Sarawak South China Sea  b) The population dynamics of <i>Mystis nemurus</i> C. & V. in Cherderob Lalec, Malaysia
6. Dr. A.K. Mohd. Mohsin	4-19 Apr	Faculty of Fisheries and Marine Science, Universiti Pertanian Malaysia	Japan Intl Cooperation Agency (JICA)	a) Preliminary estimation of growth and mortality in <i>Nemipterus bathybius</i> (Pisces: Nemipteridae) from the coast off Sarawak, South China Sea  b) The population dynamics of <i>Mystis nemurus</i> C. & V. in Cherderob Lalec, Malaysia
7. Mr. Thaddeus O. Acere	16 Apr-16 Jun	Uganda Freshwater Fisheries Research Organization (UFFRO), Jinja, Uganda	Commission of European Communities (CEC)	a) Preliminary report: artisanal fisheries resources study. Project No. 5100.36.47.025, Uganda. UFFRO/ICLARM, 16 p. (co-authored with D. Pauly)  b) The controversy over Nile perch, <i>Lates niloticus</i> , in Lake Victoria, East Africa. Naga 11(4):3-5.
8. Dr. Sulaiman Al-Matar	23 Nov-15 Dec	Mariculture & Fisheries Dept Kuwait Institute of Scientific Research (KISR)	Kuwait Institute of Scientific Research (KISR)	a) A comparison of length-related and age-related growth parameters of Newaiby <i>Otolithes ruber</i> in Kuwait waters

\* ended May 1987

- The terminal report of the World Bank-funded project "Management of Small Pelagic Fisheries of the Philippines" was submitted in August, and the project successfully completed.
- A four-week trip through various countries of Latin America was conducted to assess their suitability as operational base for ICLARM's activities in Latin America.
- Project proposal preparation, planning and discussion with funding agencies and government authorities have taken place for a \$0.5-million project on the socioeconomic evaluation of integrated fish-farming in Bangladesh. The project has been approved by the funding agencies and is currently awaiting government clearance.
- Many publications (reports, book chapters, journal articles) were submitted and/or published. It is hoped that this new batch of publications will be as well received as the earlier publications, whose strong worldwide impact can be demonstrated via citation analysis (see p. 94).

### ***Organizational structure of the RAMP***

One problem that became increasingly apparent during 1988 was the organizational imbalance of the RAMP. The RAMP, as presently conceived, has two distinct areas of emphasis, capture fishery management and coastal zone management, the latter nominally a project of the RAMP but, in fact, having all the characteristics of a full-scale program of ICLARM.

An internal proposal, submitted in December to ICLARM's Board of Trustees, addressed this problem and proposed to divide the RAMP into two programs according to the areas of emphasis noted above.

This rearrangement, which was approved, will streamline the activities of these two interrelated areas.

### **Meetings Attended, Papers Presented**

- 12th Advisory Meeting of the Bay of Bengal Programme, Bhubaneswar, India, 11-14 January. (M. Agüero - observer)
- Expert Consultation on Rural Women in Fishing Communities, Asian Institute of Tourism, Quezon City, Philippines. Center on Integrated Rural Development for Asia and the Pacific (CIRDAP), Dhaka, Bangladesh, and National Council on Integrated Area Development (NACIAD), Manila, Philippines, 25-28 January. (A. Cruz - observer)
- Third Project Steering Committee Meeting of the ASEAN/US Coastal Resources Management Project, Kuala Lumpur, Malaysia, 2-4 February. (Chua T.E., A.T. White and B.M. Rodriguez, Jr.)
- Stock Assessment Training Course, Instituto del Investigacao Pesqueira, Maputo, Mozambique, 23 February-15 March. (D. Pauly)
- Paper presented:  
Pauly, D. A review of the stock assessment training course held at the Instituto de Investigacao Pesqueira, February-March.

- Workshop on Developing a Coastal Resources Management Strategy for Phuket. Phuket Merlin Hotel, Phuket, Thailand, 1-4 March. Organized by the Office of the National Environment Board, USAID and the University of Rhode Island. (A.T. White)
- Technical Workshop on the Environmental Management of Segara Anakan, Semarang, Indonesia, 7-9 March. (Chua T.E. and A.T. White)
- South Pacific Commission Workshop on Inshore Fishery Resources. Noumea, New Caledonia, 14-25 March. (P. Dalzell, J.L. Munro and H. Govan)
- Papers presented:
- Dalzell, P. and A.D. Lewis. Small pelagic fisheries of the South Pacific.
  - Govan, H. Giant clam resource investigations in Solomon Islands.
  - Munro, J.L. and S.T. Fakhani. Management of coastal fishery resources in the South Pacific Region.
  - Munro, J.L. Growth and mortality rates and state of exploitation of spiny lobsters in Tonga.
- Seminar on the Marine Environment: Challenges and Opportunities, Kuala Lumpur, 31 March-2 April. Organized by the Environmental Management and Research Association of Malaysia (ENSEARCH) in collaboration with the Institute of Strategic and International Studies (ISIS), PETRONAS and ESSO Production Malaysia, Inc.
- Paper presented:
- Chua, T.E. Reconciliation of coastal resource use conflicts in Southeast Asia.
- Third Training Course on Principles of Coastal Resources Management, Jakarta and Cilacap, Indonesia, 4-15 April. (A.T. White - training coordinator)
- Workshop on Sustainable Development of the Coastal Resources of Lingayen Gulf, Philippines, San Fernando, La Union, Philippines, 25-27 May. (Chua T.E., A.T. White, F.Y. Guarin, G.T. Silvestre and J.N. Paw)
- Papers presented:
- Calud, A., G. Rodriguez, R. Aruelo, G. Aguilar, E. Cinco, N. Armada and G. Silvestre. Preliminary results of a study of Lingayen Gulf municipal fisheries.
  - Ochavillo, D., H. Hernandez, S. Resma and G. Silvestre. Preliminary results of a study of commercial trawl fisheries in Lingayen Gulf.
  - White, A.T. Conceptual framework for coastal resources for planning and management in the Philippines.
  - White, A.T. The marine conservation and development program of Silliman University as an example for Lingayen Gulf.
- Workshop on Teaching and Training in Marine Science for the Year 2000 and Beyond, Division of Marine Science, UNESCO, Paris, 6-10 June. (D. Pauly)
- Paper presented:
- Cruz, A. and D. Pauly. Training and education in marine science: the view of 130 members of ICLARM's Network of Tropical Fisheries Scientists.
- Asian Fisheries Society Research Fellowship Awards Proposal Review Committee Meeting, Darwin, Australia, 13-14 June. (Chua T.E. and J.L. Maclean)
- Asian Fisheries Society Council Meeting, Darwin, Australia, 16-18 June. (Chua T.E. and J.L. Maclean)

- Asian Fisheries Society Workshop on Transfer of Exotic Aquatic Organisms, Darwin, Australia, 19-21 June. (Chua T.E.)  
 Paper presented:  
 Ang, K.J., R. Gopinath and T.E. Chua. The status of introduced fish species in Malaysia.
- 46th International Congress of Americanists, Amsterdam, the Netherlands/Symposium on Small-Scale Fisheries in Latin America, 4-8 July. (M. Agüero - coordinator, D. Pauly)  
 Paper presented:  
 Pauly, D. Small-scale fisheries of the neotropics: management research options.
- Second In-country Meeting for the Development of a Coastal Resources Management Plan, Desaru Beach, Johore, Malaysia, 25-28 July. (Chua T.E. and A.T. White)
- Philippine Council for Aquatic Marine Research and Development's Seminar Workshop on the Tuna and Small Pelagic Fisheries: Their Status and Prospects for Development, Zamboanga City, Philippines, 27-29 July. (P. Dalzell and R. Ganaden)  
 Papers presented:  
 Dalzell, P. and P. Corpuz. The present status of small pelagic fisheries in the Philippines.  
 Dalzell, P. and P. Corpuz. Management of Philippine small pelagic fisheries.
- Upper South, Thailand Field Tour with Office of the National Environment, URI/CRMP and USAID Bangkok, covering Phangnga, Krabi, Surat Thani, Ko Samui, Songkla and Hat Yai, 29 July-6 August. (A.T. White)
- South Pacific Commission Regional Technical Meeting on Fisheries, Noumea, New Caledonia, 1-5 August. (J.L. Munro)
- 118th Meeting of the American Fisheries Society, Toronto, Canada, 12-16 September. (D. Pauly, G. Silvestre)  
 Papers presented:  
 Pauly, D. Fisheries stock assessment: what can the north learn from the south?  
 Regier, J., J.H. Holmes and D. Pauly. Evidence for an ecosystemic Q10 and its application to assessment of the impacts of climate warming in aquatic ecosystems.  
 Silvestre, G., M. Soriano and D. Pauly. Sigmoid selection and the Beverton and Holt equation.
- World Fisheries Congress Organizational Meeting, Toronto, Canada, 12-13 September. (Chua T.E.)
- 7th Training Course of Senior Aquaculturists in Asia and the Pacific Region, FAO/UNDP-UPV-SEAFDEC-NACA, Tigbauan, Iloilo, Philippines, 15-16 September. (Chua T.E. - lectured on Pen and Cage Culture)
- International Conference on Natural Resource Modelling and Analysis, Halifax, N.S. Canada, 29 September-1 October. (D. Pauly, invited speaker)  
 Paper presented:  
 Pauly, D., G. Silvestre and I.R. Smith. On development, fisheries and dynamite: a brief review of tropical fisheries management.
- Policy Workshop on Integrated Tropical Coastal Area Management, Holiday Inn, Johore Bahru, Malaysia, 25-27 October. (Chua T.E., D. Pauly, M. Agüero, A.T. White, S.C. Guerrero, A.A. Agulto)  
 Papers presented:  
 Agüero, M. Economic considerations in evaluating options for coastal resources management.

- Chua, T.E., J.N. Paw and E. Tech. Coastal aquaculture development in the Association of Southeast Asian Nations (ASEAN): the needs for developmental planning and environmental management.
- Pauly, D. Fisheries resources management in Southeast Asia: why bother?
- White, A.T. Two community-based marine reserves: lessons for coastal management.
- Special Project Steering Committee Meeting of the ASEAN/US Coastal Resources Management Project, Temasek Hall, National University of Singapore, Singapore, 27 October. (Chua T.E. and A.T. White)
- Technical Workshop on Integrated Tropical Coastal Area Management, Temasek Hall, National University of Singapore, Singapore, 28-31 October. (Chua T.E., A.T. White, J.N. Paw, S.C. Guerrero, A.A. Agulto, G. Silvestre, M. Agüero, A. Cruz)
- Papers presented:
- Agüero, M. and A. Cruz. The economic impact of alternative investment and marketing decisions under varying conditions: a case of fish culture in the Philippines.
- Calud, A.A., E.A. Cinco and G.T. Silvestre. Assessment of the gillnet fishery of Lingayen Gulf.
- Chua T.E. ASEAN/US coastal resources management project: an attempt towards integrated planning and management of the coastal zone.
- Ochavillo, D. and G.T. Silvestre. Optimum mesh size for the trawl fisheries of Lingayen Gulf, Philippines.
- Ochavillo, D., A.A. Calud and G.T. Silvestre. Population parameters, recruitment patterns, and exploitation rates of trawl-caught fish species from Lingayen Gulf, Philippines.
- Paw, J.N. and Chua T.E. An assessment of the ecological and economic impact of mangrove conversion in Southeast Asia.
- Silvestre, G.T., N. Armada and E.A. Cinco. Assessment of the capture fisheries of Lingayen Gulf, Philippines.
- White, A.T. Coral reef management in the ASEAN/US coastal resources management project.
- Training Course on Remote Sensing and Geographic Information Systems Applications to Coastal Resources Assessment and Planning National University of Singapore, Singapore, 1-12 November. (Chua T.E. - opening/closing ceremonies; J.N. Paw - participant)
- International Foundation for Science Workshop on Fish Culture - Management Techniques and Nutrition, Brawijaya University, Malang, Indonesia, 14-19 November 1988. (Chua T.E.)
- Paper presented:
- Chua T.E., S.K. Teng and P.E. Lim. Use of growth-promoting substances in enhancing yield of estuary grouper (*Epinephelus salmoides* Maxwell) in floating cages.
- First Scientific Committee Meeting for the Preparation of the International Symposium on "Research and Small-Scale Fisheries," Paris, France, 21-22 November. (M. Agüero)
- Workshop-Symposium on Mangrove Research, Environment, Policy and Information, Sulu Hotel, Diliman, Quezon City, Philippines, 28-30 November. (J.N. Paw)
- University of the Philippines/Marine Science Institute - United Nations Development Programme Workshop on Marine Science Programs in the Philippines, Diliman, Quezon City, Philippines, 29 November-1 December. (A. Jarre, D. Pauly, A. White)

Papers presented:

Pauly, D. Key elements of the IMARPE/GTZ/NMFS/ICLARM study of the Peruvian anchoveta and its upwelling ecosystem as an example of multidisciplinary research in oceanography.

White, A. The role of social science in marine conservation programs: A Philippine case study.

Sixth Session of the Committee for the Development and Management of Fisheries in the South China Sea of the Indo-Pacific Fisheries Commission, Manila, Philippines, 6-9 December. (D. Pauly)

Presented:

Ronquillo, I. and D. Pauly. Statement on ocean science and living resource program, presented on behalf of the Intergovernmental Oceanographic Organization (IOC) and the Food and Agriculture Organization of the United Nations (FAO).

Pauly, D. Statement on behalf of ICLARM.

Asian Fisheries Society Research Award Proposal Review Committee Meeting, Taipei, Taiwan, 20-24 December. (T.E. Chua)

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Agüero, M. 1988. On natural resources management or should smokers be paid not to smoke? *Trop. Coast. Area Manage.* 3(3):7-9.

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Chia, L.S., K. Habibullah and L.M. Chou. 1988. The coastal environmental profile of Singapore. ICLARM Technical Reports 21, 92 p. International Center for Living Aquatic Resources Management, Manila, Philippines.

Chua, T.E. Management of natural resources and environment for sustainable development -- coastal resources management, Bangkok, Thailand, 31 January-16 February. United States Agency for International Development (USAID) (Consultancy Report)

Chua, T.E. and E. Kessler. 1988. East Asian seas - Editorial. *Ambio* 17(3):165.

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- Dalzell, P. and F. Arce. 1988. Summary of length-frequency data for Philippine small pelagic fishes collected by the DA-BFAR/ICLARM Small Pelagics Management Project. Vols. I and II. Dept. of Agriculture - Bureau of Fisheries and Aquatic Resources, Quezon City, Philippines, and the International Center for Living Aquatic Resources Management, Manila, Philippines. mimeo, pag. var.
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## **Resource Assessment and Management Program Project Summaries**

<b>Project Title</b>	: Tropical Fish Stock Assessment Project
<b>Cooperating Institutions</b>	: Predominantly in-house studies, with informal linkages with various research institutions.
<b>Duration</b>	: Continuous from July 1979
<b>Key Personnel</b> ICLARM	: Dr. Daniel Pauly Dr. John Munro Ms. Ma. Lourdes Palomares Ms. Mina Soriano Ms. Astrid Jarre Mr. Geronimo Silvestre*

### **Objectives**

- To increase our understanding of the dynamics of exploited tropical fish communities.
- To develop stock assessment methods which are straightforward and readily applicable to tropical stocks.

### **Results**

Following the reorientation in 1987 of the bulk of the project activities away from methods for the analysis of length-frequency data and toward multispecies modelling, the following items were, for 1988, the main area of emphasis of the project:

- development of multispecies yield-per-recruit and mesh size optimization models;
- refinement (or development) and systematic application of (new) methods for the estimation of the food consumption of natural fish populations in the tropics; and
- improvement of existing methods for the construction of multispecies food web models.

The first line of study, mainly by Mr. G. Silvestre and Ms. Mina Soriano, led to an extremely user-friendly and versatile BASIC program now incorporated into the Compleat ELEFAN package (see p. 43). Also, a paper on mesh selection was presented by G. Silvestre at the 118th Meeting of the American Fisheries Society in September in Toronto, Canada. These two contributions and a review of this subject by G. Silvestre to be completed later, will conclude the project's work on multispecies yield-per-recruit modelling.

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\*On leave from the College of Fisheries, University of the Philippines in the Visayas.

Work on food consumption proceeds along two lines. One, mainly by Ms. M.L. Palomares, concentrates on expanding her earlier comparative study of food consumption by various fish populations to over 150 cases, to be able to derive a multivariate empirical model for predicting the relative food consumption of tropical fish population (Fig. 2). A paper on this topic, by Ms. Palomares and D. Pauly, was recently accepted by the Australian Journal of Marine and Freshwater Research. The other line of inquiry, conducted since August by Ms. Astrid Jarre, involves the development of a general model for the estimation of food consumption rates from stomach content data. The result of this work will be presented in 1989 in form of a model (with appropriate software for IBM PC and compatibles) which will accommodate not only one (as is now the case) but two feeding periods per day (as occurs in "dusk and dawn" feeders) and all combination of formulae published to date concerning food ingestion and stomach evacuation rates.

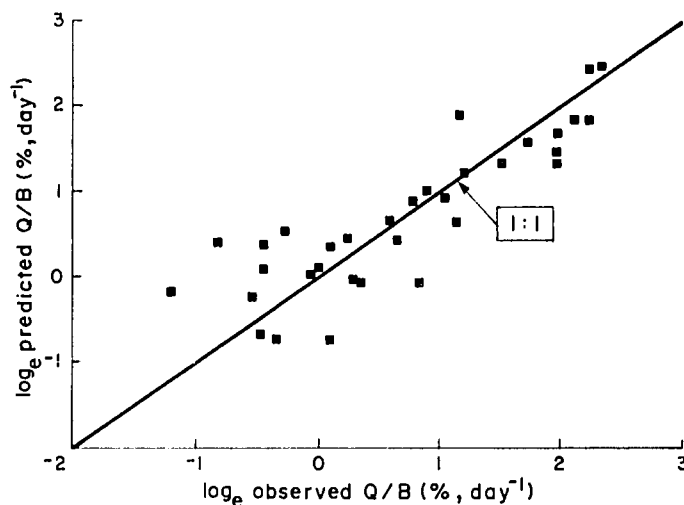


Fig. 2. Estimates of relative food consumption by a fish population ( $Q/B$ ) predicted by recently developed empirical model vs. observed values in 33 fish stocks. Note even distribution of points on both sides of the 1:1 line suggesting accuracy of predicted values.

The work on improving existing methods for the construction of food web models led in 1988 to the completion of the ECOPATH II program, a further development of the ECOPATH program of Dr. J.J. Polovina (NMFS, Honolulu, Hawaii), which is documented in a paper by D. Pauly, M. Soriano and M.L. Palomares presently in press with the Kuwait Bulletin of Marine Science. This program, which links fishery-oriented modelling with recent developments in theoretical ecology, is presently being used by Ms. Silvia Opitz of Kiel University, a Ph.D. student of D. Pauly, for modelling Caribbean coral reefs, and by Dr. J. Moreau of the Ecole Nationale Supérieure d'Agronomie, Toulouse, for modelling the ecosystem of Lake Victoria, East Africa.

Other research conducted in 1988 led to improved methods for fitting various growth curves to size-at-age and/or growth increment data (M. Soriano, D. Pauly), improvement of routines incorporated into the Compleat ELEFAN program package (F. Gayanilo) as well as to miscellaneous papers presented at various meetings by D. Pauly (see list of reports and publications, p. 17).

As a follow-up to advisory services provided to the Kingdom of Tonga in 1987, Mr. Karl Felfoldy-Ferguson of the Tonga Fisheries Division spent two weeks from 22 September at the South Pacific Office in Honiara, analyzing the catch rate and length-frequency data of the preceding year. This is expected to provide the basis for a preliminary assessment of the status of the fish stocks of the Tongatapu shelf.

<b>Project Title</b>	: Network of Tropical Fisheries Scientists
<b>Funding Institutions</b>	: FAO/DANIDA Stock Assessment Project; Norwegian Agency for International Development (NORAD)
<b>Duration</b>	: Continuous from April 1982
<b>Key Personnel</b> ICLARM	: Ms. Abbie Cruz (Network Secretary) Dr. John L. Munro (Editor, until July 1988) Dr. Daniel Pauly (Editor, from August 1988)

## 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. The technical focus is on the estimation of the biological, fisheries and socioeconomic parameters which determine the magnitude of harvests and the application of those parameters to models to arrive at scientifically-sound management measures for tropical stocks.

## Results

The network had 850 members by the end of 1988, representing an increase of 100 members from the previous year. Most of the new members were from Africa, Asia, and South America. In Africa, membership in such countries as Mozambique and Côte d'Ivoire was boosted by a training program in Mozambique, in which Dr. D. Pauly participated as lecturer, and meetings conducted in Côte d'Ivoire in relation to ISTA III. As anticipated, the tie-up with NORAD's Fridtjof Nansen project has increased membership in South and Central America and the Caribbean, by 23 members.

The editorship of Fishbyte was transferred to Dr. D. Pauly from Dr. J.L. Munro in early August, enabling ICLARM Headquarters staff to supervise the entire production of Fishbyte. Three issues were published, the second of which showcased the first contribution in Spanish. Henceforth, Fishbyte will accept and publish short articles in Spanish and French.

UNESCO continued to support the Network by donating Marine Science Reports which the Network distributes with FAO Technical Reports and Manuals and reprints free of charge to interested NTFS

members. In 1988, we began distributing reports of the FAO-UNDP Regional Fishery Support Programme in Fiji.

Eight members of the NTFS visited ICLARM in 1988, analyzed their data and wrote reports with assistance from ICLARM staff (see Table on p. i2).

A. Cruz and Dr. D. Pauly wrote a paper on the results of a UNESCO questionnaire distributed to NTFS members on the future of marine science teaching. Entitled "Training and education in marine science: the views of 130 members of ICLARM's Network of Tropical Fisheries Scientists," the paper was presented by D. Pauly at the UNESCO Workshop on Teaching and Training in Marine Sciences for the Year 2000 and Beyond held in Paris 6-10 June 1988. The paper was well received and it will be published in the workshop proceedings. A survey of the impact of the NTFS, based on another questionnaire also distributed to NTFS members was conducted by J.L. Munro who presented preliminary results in Fishbyte 6(1).



<b>Project Title</b>	:	Management-Oriented Fisheries Research Project
<b>Cooperating Institutions</b>	:	Instituto del Mar del Peru (IMARPE) and Programa Cooperativo Peruano-Aleman de Investigacion Pesquera (PROCOPA), Callao, Peru; Laboratory for Ichthyology and Coastal Systems (LICS), Limnology and Marine Science Institute, Universidad Nacional Autónoma de México (UNAM), Mexico City; Uganda Freshwater Fisheries Research Organization (UFFRO), Jinja, Uganda
<b>Duration</b>	:	Continuous from April 1982
<b>Key Personnel</b>		
IMARPE	:	Ms. Isabel Tsukayama
PROCOPA	:	Dr. H. Salzwedel
UNAM	:	Dr. A. Yañez-Arancibia
UFFRO	:	Mr. Thaddeus O. Acere
ICLARM	:	Dr. Daniel Pauly

## Objectives

- To strengthen the capabilities of the participating countries to manage their fisheries by creating stock assessment and management modules (SAMMs) in various countries and institutions. Each SAMM will develop a small nucleus of well-trained researchers.
- To train fishery scientists in the interpretation of fishery data (especially in extracting a maximum of information from available data) and in formulating implementable management options.
- To help determine, in the countries involved in the project, the basic information requirements for stock assessment and fisheries management.
- To produce well-documented reviews of the various fisheries investigated and original studies on tropical fish population dynamics.
- To help establish a dialogue between the fishery managers and the fishery biologists, and between the fisheries departments and the universities of the project's host countries.

## Results

ICLARM has renewed linkage with the Marine Fisheries Research Institute (BPPL) Jakarta, with a proposal for a major publication documenting the results of 12 years of research by various GTZ/DGF projects on the fishery resources of Western Indonesia. Dr. Purwito

Martosubroto of the Directorate General of Fisheries (DGF) will serve as editor, and Dr. D. Pauly as co-editor, of this planned publication.

A new stock assessment and management module was established in cooperation with the Ugandan Freshwater Fisheries Research Organization (UFFRO). Mr. T.O. Acere, Principal Scientific Officer of the UFFRO, trained in April and May via a grant from the Commission of European Communities (CEC). Two scientific publications resulted during the course of his training and these are mentioned in Table 1. The CEC grant likewise supported two major bibliographic collections: "A draft bibliography of the Nile perch (*Lates niloticus*) (Pisces: Centropomidae)" and "A draft bibliography of Lake Victoria (East Africa)" which will be later integrated into a planned volume on the ecology and fishery of Lake Victoria.

<b>Project Title</b>	: ASEAN-US Coastal Resources Management Project
<b>Duration</b>	: 4 years, beginning January 1986
<b>Cooperating Agencies</b>	: BRUNEI DARUSSALAM - Department of Fisheries (coordinating agency), Department of Forestry, Department of Town and Country Planning, Marine Department, Department of Public Works, Brunei Museum, Universiti Brunei Darussalam and Department of Agriculture; INDONESIA - Indonesian Institute of Sciences (LIPI) (coordinating agency), Directorate General of Fisheries (lead implementing agency), Research Institute for Marine Fisheries, Centre for Oceanological Research and Development, Centre for Agro-Economic Research, University of Indonesia, Bogor Agricultural University, Office of State Ministry of Demography and Life Environment; MALAYSIA - Ministry of Science, Technology and the Environment (coordinating agency), Fisheries Department (lead implementing agency), Ministry of Defence-Hydrography Section, Department of Agriculture, Drainage and Irrigation Department, Department of Town and Country Planning, Coordinating and Implementing Unit of the Prime Minister Department, Department of Geology, Department of Survey and Mapping, Universiti Pertanian Malaysia, Universiti Kebangsaan Malaysia, Universiti Sains Malaysia, Economic Planning Unit of the State Government of Johore, Forest Research Institute, Pusat Penyelidikan Ternak Air Payau, Universiti Malaya, SERES Sdn. Bhd. and Universiti Teknologi Malaysia; PHILIPPINES - Department of Science and Technology-Philippine Council for Aquatic and Marine Research and Development (coordinating agency), University of the Philippines-Marine Science Institute, UP College of Social Work and Community Development, UP Visayas College of Fisheries, Bureau of Fisheries

and Aquatic Resources and National Economic and Development Authority (NEDA) - Region 1; SINGAPORE - Science Council of Singapore (coordinating agency), Primary Production Department, National University of Singapore-Department of Zoology and Department of Geography; THAILAND - Office of the National Environment Board, Ministry of Science, Technology and Energy (coordinating agency), Department of Fisheries-Brackishwater Fisheries Division, Marine Fisheries Division and Phuket Marine Biological Center, Royal Forestry Department, Faculty of Forestry, Kasetsart University, Department of Marine Science, Chulalongkorn University and Faculty of Social Sciences and Humanities, Mahidol University.

- Key Personnel**
- |             |   |   |
|-------------|---|---|
| Brunei      | : | Awang Matdanan bin Haji Jaafar, Pengiran Sharifuddin Pengiran Haji Yusof and Dr. M.W.R.N. de Silva  |
| Darussalam  | : |   |
| Indonesia   | : | Dr. Purwito Martosubroto, Dr. Kasijan Rominiohtarto, Mr. Ben B. Abdul Malik, Dr. Subagio Soemodihardjo, Dr. Mulla Purba, Dr. Nurzali Naamin, Mr. Agus Brotosusilo, Mr. Subhat Nurhakim, Dr. Soerjono Soekanto, Mr. Budihardjo, Mr. Koesoebiono, Ir. Agustinus W. Taufik, Mr. Edi M. Amin and Mr. Zen Oemar Purba                    |
| Malaysia    | : | Dr. Abu Bakar Jaafar, Ms. Ch'ng Kim Lool, Dr. Chan Hung Tuck, Dr. Lim Poh Eng, Dr. Kam Suan Pheng, Ir. Sieh Koh Chi, Dr. Koh Hock Lye, Mr. Mohd. Zaki bin Mohd. Saad, Mr. Hamba! Hanafi, Dr. Jahara Yahaya, Dr. Wong Poh Kam, Dr. Shaharuddin bin Mohd. Said, Ir. Zamali Midun, En. Ahmad Tajuddin Hj. Kechik and En. Redzuan Yusof |
| Philippines | : | Dr. Rafael D. Guerrero III, Dr. Edgardo D. Gomez, Dr. Liana T. McManus, Ms. Adelaida Palma, Mr. Nygiel Armada, Prof. Elmer M. Ferrer, Mr. Joseph Alabanza and Dr. Roberto A. de los Reyes   |
| Singapore   | : | Mr. Leslie Cheong, Dr. Chou Loke Ming and Dr. Chia Lin Sien   |

- Thailand : Mr. Arthorn Suphapodok, Mr. Chalerm-sak Wanichsombat, Dr. Sirikul Bunpa-pong, Dr. Teerayut Poopetch, Mr. Yodchai Karnasuta, Mr. Somporn Lohsa-wadikul, Dr. Manuwadi Hungspreugs, Mr. Prawin Limpsaichol, Mrs. Nisakorn Kositratana, Dr. Sanit Aksornkoe, Dr. Choompol Ngampongsai, Dr. Pisoot Vijarnsorn, Dr. Subarn Panvisavas, Mr. Robert J. Dobias, Ms. Chandhana Indhapanya and Mr. Ilyas Baker
- ICLARM : Dr. Chua Thia-Eng (Project Coordinator, Dr. Alan T. White (Technical Advisor), Mr. James N. Paw (Project Specialist) and Ms. Flordeliz Y. Guarin (Project Specialist)

## Objectives

The goal of the CRMP is to increase existing capabilities within the Southeast Asian region to develop and implement comprehensive, multidisciplinary and environmentally sustainable coastal resources management strategies through:

- analysis, documentation and dissemination of information on trends in coastal resources development;
- increasing awareness of the importance of coastal resources management policies and identification and, where possible, strengthening of management capabilities;
- provision of technical solutions to coastal resources use conflicts; and
- promotion of institutional arrangements that bring multisectoral planning to coastal resources development.

Figs. 3 and 4 illustrate the present ills affecting coastal areas in Southeast Asia and elsewhere, and the proposed remedies, respectively.

## Results

The ASEAN-US Coastal Resources Management Project (CRMP) has started the preparations and formulation of CRM plans for the six pilot sites to which many activities were directed in 1988. Project efforts in the past year were also focused on field research activities of the six countries; organizing and conducting two training courses; holding the regional policy and technical workshops on coastal area management;

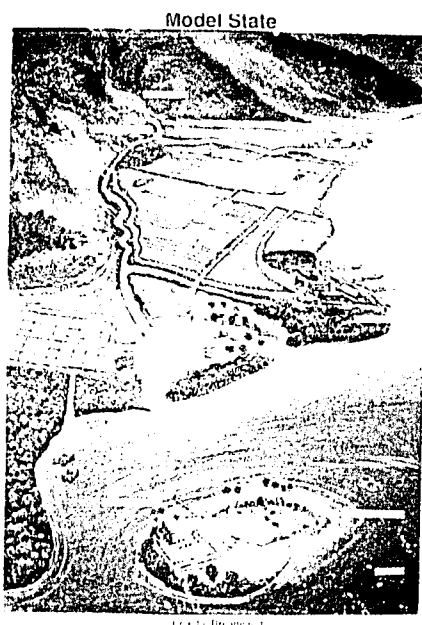


Fig. 3. (left) Schematic representation of the ills affecting Southeast Asian coastal zones, leading to environmental degradations and resources losses.



Fig. 4. (right) Schematic representation of a rehabilitated coastal zone area managed for sustained benefits.

and publishing technical reports, training and educational materials and the project newsletter.

The Project has made significant achievements in terms of completion of most scheduled research, training and information dissemination activities. It has also received recognition and support at the national and regional levels. The impact it has made in the region is evidenced by the following:

- strengthened national capabilities and commitment in integrated coastal resources management;
- identification of economic development opportunities which help in environmental management of the coastal areas; and
- promotion of regional cooperation and collaboration.

#### *Project Midterm Evaluation and Audit*

A highlight of the past year was the mid-term evaluation of the project conducted by a group of technical consultants hired by USAID, 4 January-13 February. The team gave a favorable evaluation of the project and commended the countries for their full participation; their spirit of cooperation; the right direction taken by the task teams; the excellent

performance of ICLARM in its role as executing agency; and the Project Steering Committee's success for keeping the project on the right track.

In June of the same year, USAID conducted an interim audit of the project, the results of which were also satisfactory.

### *In-Country Projects*

*Brunei Darussalam.* Brunei Darussalam has followed its 1988 workplan for projects within the Department of Fisheries. Those projects ongoing during 1988 included development of a water quality management scheme with a focus on baseline studies, sedimentation monitoring, an oil spill contingency plan and a red tide action plan. An artificial-reef development and monitoring project comprised a large segment of the project. The government has requested that waste management of the water village, Kampong Ayer, be included in the project for 1989.

The main constraints in fully completing the 1988 workplan were finding external researchers to work in Brunei Darussalam and the release of counterpart funds needed to complement project funding in the implementation of task activities.

*Indonesia.* All research task activities have been completed in 1988 with each task completing its final report by end of December for the Segara Anakan Lagoon in South Java. The completed research tasks include an assessment of the mangrove resources, an analysis of water quality, the dynamics of water movement and sedimentation, a study on the capture offshore and lagoon fisheries, a baseline on socioeconomic data and a cultural and environmental perceptions survey.

Planning teams are now actively developing management plans and recommendations by synthesizing the research findings and developing a set of management policy and issue-based plans to address the issues of (1) mangrove management; (2) lagoon and offshore fisheries management; (3) sedimentation in the lagoon; (4) land use zonation for agriculture and aquaculture; (5) alternative sources of income; and (6) legal/institutional arrangements for plan implementation.

*Malaysia.* The Malaysian Project in South Johore was able to fully implement its 1988 workplan. Research activities which were carried out in 1988 and which will be completed in early 1989 included development of a coastal forest management scheme; an assessment of coastal erosion; stock assessment of shrimp; analysis of the status and economics of aquaculture; a major socioeconomic survey; making guidelines for tourism development; and formulating a framework for planning with the assistance of a newly developed Geographical Information System (GIS) component of the project.

A major technical reporting workshop was also held in July in Desaru, Johore, to synthesize the data collected to date and to formulate a preliminary management planning framework. This workshop produced a proceedings which is being used by the research teams in formulating their management recommendations.

*Philippines.* The Philippine project in Lingayen Gulf completed all field research activities and most final reports in December. The project also held one major workshop in May 1988 in San Fernando, La Union, to synthesize its research findings and formulate a conceptual framework for the management planning phase.

The completed studies being used in the development of the management plan include:

1. Natural Resource Survey
  - a. Assessment and mapping of coral reefs
  - b. Fish resource assessment
2. Water Quality Baseline
  - a. General water quality
  - b. Pollution/nutrient studies
  - c. Pollutants from fishponds
3. Aquaculture Practices Assessment
4. Aquaculture Potential
5. Aquaculture Farm Testing
6. Economics of Small-Scale Fishing
7. Socioeconomic Baseline
8. Market Information Study
9. Baseline on Sociocultural Practices Affecting CRM
10. Sociocultural context of CRM
11. Assessment of Government and NGO Programs
12. Dynamics of Illegal Fishing

In November, planning activities commenced to formulate a series of issue-based action plans and marine protected area plans to be integrated in a coastal management scheme.

*Singapore.* The Singapore Project has proceeded with cage culture studies, artificial reef development, rehabilitation of the Singapore River by means of openwater fish and shrimp stocking and bottom habitat improvement and the development of a zonation/management plan for the whole of Singapore and its ocean space. The project suffered several delays in obtaining government approval to place artificial reefs in selected sites but has otherwise been able to complete most of the workplan activities for 1988, except the tasks on rotational and submerged cages.

The Singapore Project has also been instrumental in assisting general project activities, such as the Technical Workshop held in October 1988 which provided a venue for most of the six-country project scientists to present their research findings.

*Thailand.* The Thailand Project has completed all its baseline studies for planning in Ban Don and Phangnga Bays. The completed research studies included:

1. Aquaculture Practices Assessment
2. Fisheries Management Assessment
3. Environment of Ban Don Bay
4. Environment of Phangnga Bay
5. Land-Based Pollution Study
6. Evaluation of Mangrove Development Potential
7. Land Wildlife Resources
8. Land-Use Study



9. Socioeconomic Survey
10. Anthropological Evaluation of Sites
11. Institutional Arrangements
12. Recreation and Tourism

The research teams have been cooperating with four planning groups since July 1988 to transfer their findings into a planning context which will include four major action plans on mangrove land-use conflicts with aquaculture, fisheries, coral reef management, water quality control and two marine protected area plans.

The coastal environmental profile of Thailand was also published in 1988.

### *Training Activities*

*Short-term Training.* The project conducted two short-term training courses in 1988. These were: (a) Principles of Coastal Resources Management (3rd course), Jakarta and Cilacap, Indonesia, 3-16 April 1988; and (b) Training Course on Remote Sensing and Geographic Information Systems Applications to Coastal Resources Assessment and Planning, Singapore, 1-12 November 1988. A total of 38 project personnel participated in these courses bringing to 91 the number of project personnel who have benefitted from short-term training courses since 1986.

*Medium-term Academic Training.* Two grantees under this scheme completed their one-year Master in Marine Affairs (MMA) course at the University of Rhode Island, USA in June 1988. Two more are still pursuing their masters degree in US universities.

*Workshops.* The project also conducted two major regional workshops: (1) Policy Workshop on Coastal Area Management on 25-27 October in Johore Bahru, Malaysia, and (2) Technical Workshop on Integrated Coastal Area Management on 28-31 October in Singapore.

The Policy Workshop was co-organized by the State Government of Johore, Ministry of Science, Technology and the Environment, and ICLARM (Fig. 5). It was attended by 54 participants which included ministers, governors, permanent secretaries, directors-general of various line agencies, planners, administrators and resource speakers of varied disciplines from ASEAN and the USA. The workshop was designed for senior government officials who will have a direct involvement in the planning and management of coastal resources in the six project pilot sites. Workshop discussions centered on the integrated approach to CRM and several case studies.

A significant outcome of this workshop was the strong commitment of government officials to include the coastal zone in national economic development planning guided by the principle of sustainable development endorsed at the ASEAN Summit in Manila in 1987. The participants also adopted a series of policy recommendations towards the development of implementable action plans pertaining to the preservation and improvement of environmental quality, rational exploitation of renewable resources and adequate management of the coastal zones.

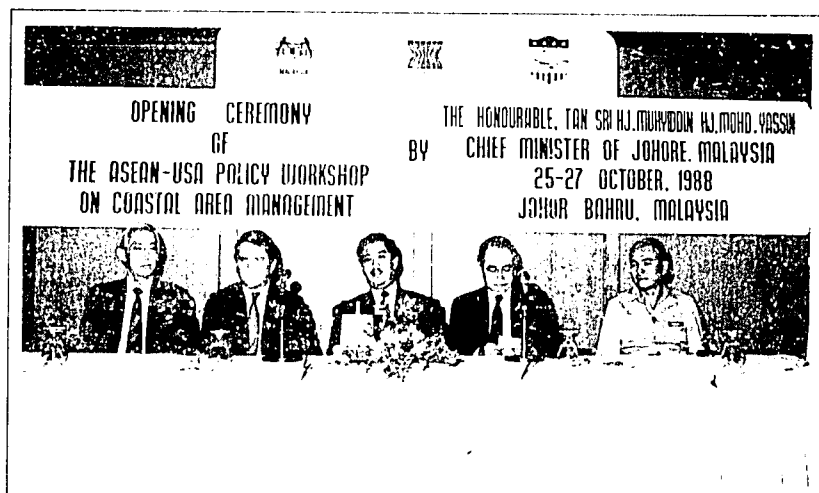


Fig. 5. Opening ceremony of the ASEAN/US Policy Workshop on Coastal Area Management, October 1988, Johore Bahru, Malaysia. *Left to right:* Ir. Goh Kiam Seng, Director General of Environment, Malaysia; Mr. Thomas C. Hubbard, Deputy Chief Mission, The US Embassy in Kuala Lumpur; Y.A.B. Tan Sri Haji Muhyiddin bin Haji Mohd Yassin, Chief Minister of Johore; Y.B. Datuk Amar Stephen K.T. Yong, Minister of Science, Technology and the Environment, Malaysia; and Dato' Haji Abd. Rahim bin Haji Ramli, State Secretary of Johore.

The Technical Workshop brought together for the first time 111 project personnel and other experts from the USA and CRM-related projects in the region to share their experiences on CRM through paper presentations and discussions. A total of 75 papers was presented. The workshop, jointly sponsored and organized by the National University of Singapore, Science Council of Singapore and the CRMP, was able to stimulate greater enthusiasm and appreciation for the project and fostered closer cooperation and goodwill among the countries. As a result, a nucleus of scientists and a network of regional institutions involved in CRM are gradually being formed.

*On-the-Job Training.* Only Singapore availed of this training scheme in 1988. Ms. Grace Lim went to Manila and Batangas Province, Philippines, for a one-month (20 February-20 March) on-the-job-training to identify coral reef fish and conduct a preliminary survey of the fish population at three selected sites as an application of the training.

## Information

Information dissemination remains one of the major activities of CRMP. The project is intensifying its efforts to come out with more materials on CRM and other related subjects in response to the lack of information in the region on the wise utilization of coastal zones and their resources. In 1988, it published two technical reports and three items under its Education Series.

The project has also produced 13 documents under its working paper series. Details are given below.

The project newsletter, *Tropical Coastal Area Management*, is published triannually and is distributed to almost 1,700 institutions and individuals in 94 countries.

### **Linkages**

The Project made efforts to firm up its linkages with various government agencies, research institutions and nongovernmental organizations (NGOs) in ASEAN, the USA and Europe to implement effectively its many activities; seek the much-needed technical expertise/assistance to help in the planning and formulation of the CRM plans for the six pilot sites; and exchange information and knowledge on new concepts, methodologies, approaches and technologies on CRM. In turn, CRMP contributes a modest share of its limited financial resources to enable external experts to travel to the region and assist in project activities; contributes staff time for mutually agreed activities; and provides project materials and other relevant literature and information on CRM.

### **Proposal for Phase II**

The Project's proposal for a Phase II, the primary focus of which is the implementation of CRM plans, has been endorsed by ASEAN/COST and adopted by the ASEAN Standing Committee. It will be presented to USAID for consideration through ASEAN. The Phase II is expected to begin in 1990 for a period of five years.

### **Working Papers**

- |      |   |
|------|---|
| 88/1 | Conceptual Framework for CRM Planning and Management in the ASEAN Countries, 1988-1989, 16 p.   |
| 88/2 | Task 510-S: Role of Artificial Reefs in Living Resource Enrichment - "Site surveys for possible establishment of artificial reefs -- Cyrene Reefs, Terumbu Jarat, Terumbu Pempang Tengah, Terumbu Bemban and Kukor Beacon" by L. M. Chou and Lilian H.L. Hsu, 41 p. |
| 88/3 | Proceedings of the Workshop for the 1988 Annual Work Plan Preparation for Malaysia, Kuala Lumpur, Malaysia, 30 September-2 October 1987, 28 p.  |
| 88/4 | Reconciliation of Coastal Resource Use Conflicts in Southeast Asia by T.E. Chua, 14 p.  |
| 88/5 | Report: On-the-Job Training for Coral Reefs Identification by Grace S.Y. Lim, National University of Singapore, Singapore, 39 p.  |

- 88/6 Background Information and General Considerations for a Proposed Philippine Coastal Resources Management Project, 22 p.
- 88/7 Monitoring of Artificial and Natural Reefs in the Central Philippines, May 1988: A Field Trip Report by David J.W. Lane and Maylene G.K. Loo, National University of Singapore, 23 p.
- 88/8 Management of Coastal Tourism Resources at Ban Don Bay: A Final Draft Report of the Recreation and Tourism Subsector (420-T), 166 p.
- 88/9 Proceedings of the Technical Workshop, ASEAN/US Coastal Resources Management Project, Indonesia In-Country Project, 7-9 March 1988, Semarang, Indonesia, Books 1 and 2, 264 p.
- 88/10 Proceedings of the Philippine National Workshop: Towards Sustainable Development of the Coastal Resources of Lingayen Gulf, Philippines, 25-27 May 1988, La Union, Philippines, 360 p.
- 88/11 Proceedings of the Malaysian CRMP Technical Workshop, 26-28 July 1988, Desaru, Johore, Malaysia, 30 p.
- 88/12 Progress of Activities (1986-1988): A Summary, 9 p.
- 88/13 ASEAN/US Cooperative Program on Marine Sciences: Coastal Resources Management Project, Progress Report of the Project Coordinator 1988, 91 p.

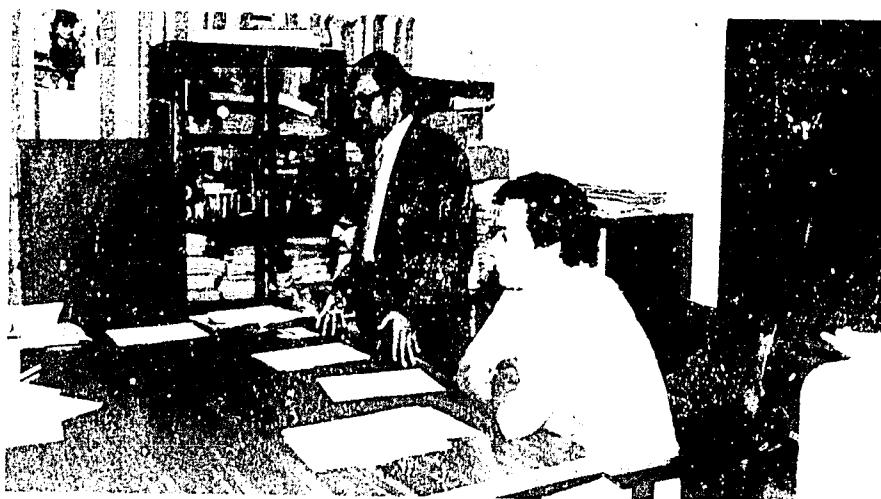
- Project Title** : Management Options for Tropical Small-Scale Fisheries
- Funding Institutions** : The Ford Foundation with additional support from other donors (Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Food and Agriculture Organization (FAO) and World Bank)
- Cooperating Institutions** : Ministry of Fisheries and Livestock (MF&L), People's Republic of Bangladesh; FAO; Bangladesh Centre for Advanced Studies (BCAS), plus informal linkages with other institutions, e.g., Bureau of Fisheries and Aquatic Resources (BFAR) in the Philippines; Corporacion Regional para el Desarrollo de Nariño (CORPONARIÑO) in Colombia; Instituto del Mar del Peru (IMARPE) in Peru; Kasetsart University in Thailand; University of Rhode Island in the USA; Escuela Politecnica Nacional del Ecuador (ESPOL) in Ecuador.
- Duration** : Four years, beginning March 1986
- Key Personnel** ICLARM : Dr. Max Agüero

### **Objectives**

- To develop further suitable interdisciplinary research methodologies for analysis of management options in small-scale fisheries.
- To develop further quantitative as well as qualitative tools for the analysis of important socioeconomic aspects of tropical small-scale fisheries and the identification of the basic underlying cause-effect relationships.
- To identify and document the various institutional types and conditions that have resulted in successful management of small-scale fisheries and related activities in tropical developing countries.
- To develop and widely disseminate a research manual based on the above interdisciplinary methodologies and findings.
- To develop a curriculum and courses in the use of these methodologies and on applications of microcomputers in fisheries management.

### **Results**

Activities in research, training, consultancy and project proposal and planning were undertaken.



Training Program in Bangladesh, 16-26 January 1988. "Application of Microcomputers to Fisheries Management in Bangladesh". From left to right: Mr. Exequiel Gonzalez (ENIMOF Project Specialist), Mr. Liaquat Ali (ENIMOF Ford Foundation Project Director), Dr. Max Agüero (ICLARM's Project Leader).

### *Research*

Modeling efforts to monitor and evaluate the New Management Policy for inland open water fisheries of Bangladesh have been underway with continuous technical support from ICLARM to the local research team in Dhaka. A doctoral thesis was completed using mathematical programming techniques to model the benefits from this fishery under alternative biological and technoeconomic conditions.

A final draft was prepared of a detailed economic profile and gear performance analysis of the small pelagic fisheries of the Philippines with information collected through the ICLARM/World Bank/BFAR project. The final report will be ready in 1989.

An economic evaluation of alternative strategies for investment and marketing in fish culture (grouper) in the Philippines was conducted using decision analysis techniques. The results were presented at the Regional Technical Workshop on Integrated Coastal Area Management, Singapore, 28-31 October.

### *Consultancy*

A 45-day consultancy was held in Colombia, to evaluate the economic feasibility of a US\$30-million Integrated Industrial-Small Scale Fishery Project in the Pacific Coast. A final report was prepared for use by the Government of Colombia to negotiate the project with alternative funding/investment organizations.

A consultancy was held in Lima, Peru, to assist IMARPE in reviewing their research on small-scale fisheries data and information and to initiate collaborative research for the implementation of a bioeconomic model developed at ICLARM to estimate net economic benefits from fishing activities.

### *Planning*

A 4-week trip through various countries of Latin America was conducted to assess the suitability of their research/training institutions as operational bases for ICLARM's activities in Latin America. The countries visited included Peru, Colombia, Ecuador, Chile, Costa Rica and Mexico. A proposal containing a feasibility study, schedule of activities and budget requirements was prepared and presented for discussion and approval. Several European and North American donor agencies were also visited to explore funding sources for future activities of ICLARM in Latin America (countries visited include France, Norway, Sweden, Belgium, Italy and the Federal Republic of Germany).

A proposal for a US\$0.5 million project, "Socioeconomic Impact Evaluation of Integrated Fish Farming in Bangladesh", to be funded by the Danish International Development Agency (DANIDA) and International Fund for Agricultural Development (IFAD) has been prepared, discussed and tentatively approved for funding by the donor agencies. It is now awaiting final government clearance to start by May 1989.

Preparations are underway for two training programs to be held in 1989 in Latin America. The first training program, "Application of Microcomputers to the Economic Evaluation of Investment Projects in Natural Renewable Resources," will be held 16 January-4 February 1989 with financial support from GTZ. The other program, "Aquaculture Economics," is expected to be held on the last semester of 1989 or on the first quarter of 1990 with financial support from the Latin America office of IDRC. This training project will be for the Network of Aquaculture Scientists of Latin America.

### *Training*

A 10-day intensive training program on "Application of Microcomputers to Fisheries Management in Bangladesh" was held in Dhaka during January 1988 with financial support from the Ford Foundation. The course was presented to Government officials of the Directorate of Fisheries and members of the Bangladesh Center for Advanced Studies (BCAS) participating in the monitoring and research activity of the project Experiments in Management Options for Inland Open Water Fisheries of Bangladesh (ENIMOF) with technical support from ICLARM.

### *Workshop*

Dr. Max Agüero was the Coordinator of the Small-Scale Fisheries Symposium of the 46th International Congress of Americanists held in Amsterdam, The Netherlands, 4-8 July 1988. Proceedings of the Symposium are being prepared at ICLARM.

<b>Project Title</b>	:	Assessment and Management of Small Pelagic Stocks of the Philippines
<b>Cooperating Institutions</b>	:	Bureau of Fisheries and Aquatic Resources (BFAR), Philippines, with World Bank funding
<b>Funding Institution</b>	:	World Bank
<b>Duration</b>	:	August 1986 to November 1988
<b>Key Personnel</b>	ICLARM : BFAR :	Mr. Paul Dalzell, Ms. Perlita Corpuz Atty. Reuben Ganaden

## Objectives

- To collate and review available biological and economic data on the small pelagic fisheries of the Philippines.
- To establish a sampling program to obtain improved information on levels of catch, fishing effort and catch composition data on small pelagic fishes.
- To suggest means by which the economic performance of the fishery may be improved.

## Results

The Small Pelagics Management (SPM) project terminated in November having fulfilled the objectives outlined above. The review of secondary data provided an insight into the dynamics of small pelagic fishing in the Philippines. It became clear that these fisheries account for 35-40% of total annual marine landings and are an important source of cheap protein for the majority of the Philippine population. An analysis of a 38-year time series (1948-1985) of catch-and-effort data on Philippine small pelagics shows that these fisheries are grossly overfished (Fig. 6). It was concluded that the fisheries became economically overfished by the mid-1960s whilst biological overfishing began in the mid 1970s. This situation is similar to other pelagic and demersal fisheries in Southeast Asian.

Concurrent with the review was a sampling program extending over 14 months in 6 administrative regions of the Philippines. These 6 regions account on average for 85% of the annual small pelagic production in the country. Sampling results showed that there were gross differences in catch rates among the regions in the Philippines. Basically, low catch rates for standard gears were encountered around Luzon whilst much greater returns for effort were experienced in the central and southern parts of the country. Despite the profusion of gears in the small pelagic fisheries, only five gear types accounted for most of the catch. Similarly, only 10 species comprise three quarters of the small pelagic landings. As



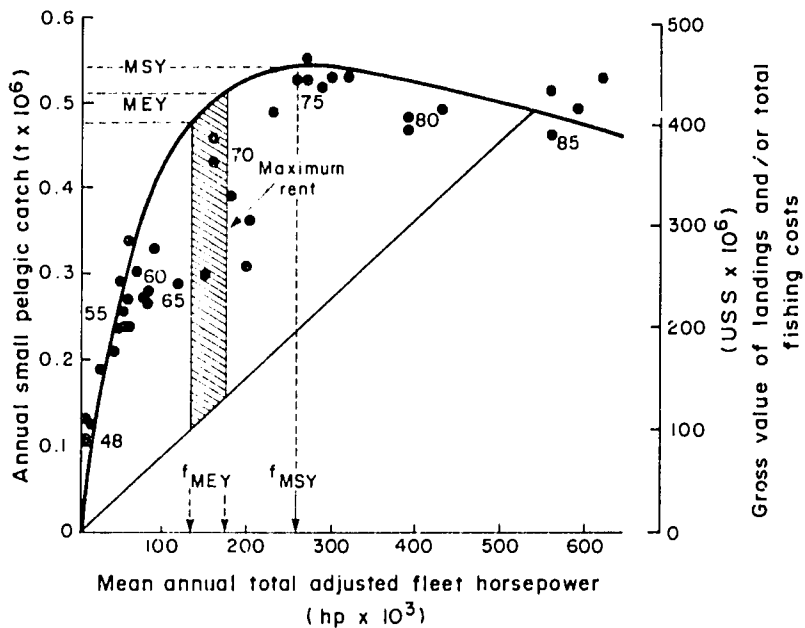


Fig. 6. Surplus production model of the Philippine fishery for small pelagics (anchovies, sardines, mackerels, etc.). Note biological overfishing since the mid-1970s; an indication of the extent of rent dissipation is also obtained via the assumption of equilibrium in the mid-1980s. In such case, about \$300 million potential benefits to society are wasted every year.

such, future sampling and monitoring programs can focus on these, rather than attempting to record all details of landings.

All data for the SPM project were condensed into accessible data volumes lodged at BFAR and ICLARM. An atlas of results of length-frequency analysis was also produced in the same manner as the data volumes. Reports on reviews and analyses were published as BFAR technical papers, in workshop and conference proceedings and as journal submissions. The final report of the project will appear along with other SPM contributions in a special issue of the *Philippine Journal of Fisheries*.

In its final report, the project recommended the following:

- Selective reduction of fishing effort in the commercial fisheries by implementation of existing legislation.
- Increasing employment alternatives for municipal fishermen to reduce effort in small-scale fishing.
- Greater regional control of management for small pelagic (and other) fisheries.
- Strengthening of research and monitoring capabilities for fisheries on a regional basis.

A technoeconometric study of small pelagic fishing gears will appear in 1989 based on the sampling survey. This will report on the profitability and economic performance of different small pelagic gears. This will greatly improve the preliminary economic analysis represented by Fig. 6.

**Project Title** : The ICLARM Software Project

**Cooperating Institution** : Predominantly in-house activity, with informal linkages with various individuals and research institutions.

**Duration** : Continuous from 1986

**Key Personnel** ICLARM : Dr. Daniel Pauly  
Mr. Felimon Gayanilo, Jr.  
Ms. Mina Soriano

## Objectives

- Documentation and dissemination of software for calculators and personal computers in the areas of fish population dynamics, fisheries and aquaculture economics, fish genetics and other fields covering ICLARM's areas of interest.

## Results

The ICLARM Software Project is a continuation and amplification of an earlier two-year project by GTZ, the University of the Philippines in the Visayas and ICLARM to develop a graphics-oriented software package, the Compleat ELEFAN, for the detailed analysis of length-frequency data.

Version 1.0 of this 12-diskette package, which is sold for US\$50 per set, was shipped in 1988 to over 100 users in over 50 countries. Another ELEFAN package, a one-diskette version jointly developed by Dr. T. Brey at Kiel University and by M. Soriano and D. Pauly at ICLARM, was also distributed (in IBM PC or Apple II versions) in large numbers throughout the world; it was made available as well to the computer-user group of the American Fisheries Society.

Other user-friendly programs were developed which implement various sophisticated methods for the study of growth and mortality in tropical fish, and these will either be incorporated in Version 1.1 of the Compleat ELEFAN, to be released in the first half of 1989, or released separately.

Sales of 16K RAM chips for use with HP41CV calculators and incorporating stock assessment program published in 1986 (FAO Fish. Tech. Pap. 101, Suppl. 1) continued throughout 1988, as did sales of preprogrammed cards for HP41C and HP67/97 calculators.

The ICLARM software project has thus been successful in producing software that is widely used, both for research and for training (e.g., in FAO/DANIDA training course in tropical fish stock assessment), and which are also widely used in the context of university curricula. The correspondence received so far suggests that the demand for the software developed so far will increase in the following years and this should provide an appropriate context for the launching of new planned packages dealing, e.g., with aquaculture genetics or fisheries economics.

<b>Project Title</b>	:	Interactive Database on Tropical Fisheries Resources Management
<b>Cooperating Institutions</b>	:	Institut für Meereskunde (IfM), Kiel University and the Food and Agriculture Organization (FAO) of the United Nations
<b>Duration</b>	:	October 1988 to end of 1992
<b>Key Personnel</b>		
IfM	:	Rainer Froese
FAO	:	Dr. Walter Fischer
ICLARM	:	Dr. Daniel Pauly
		Dr. Roger S.V. Pullin
		Mr. Felimon Gayanilo, Jr.
		Ms. Mina Soriano

## Objective

- To develop a database for MSDOS microcomputers which provides key facts and parameter estimates extracted from the literature on tropical fish resources species (for capture fisheries and aquaculture).

## Results

ICLARM consultant, Mr. R. Froese, spent 2 months at ICLARM from October to December, formulating, with the key ICLARM personnel listed above and others, the design for the planned database. This group completed, with F. Gayanilo and M. Soriano, a 160-page report documenting the design, presently implemented through the DATABASE package of Software Solutions, Inc.

The database, as presently conceived, contains 31 relational tables (Fig. 7) and will output nomenclature details on each species included (as based on FAO synopses, catalogues and other documents), allow species identification and provide information on ecology, reproduction, growth, mortality, fishery and aquaculture status, etc. of each species included.

Pictures and graphs will be incorporated in the database. For the development of a 'user-friendly' package, the "view" concept was introduced in the package which allows the user to see related fields of several tables in one "form" or screen. Data will be compiled on special worksheets after extraction from the scientific literature and correspondence. Initially, the database will contain data on about 250 major species and will be distributed on standard media (5-1/4" floppy disks). The goal is to cover 2,500 species using high-density media (CD-ROM laser disks).

The prospective users of the database are staff of research institutes throughout the world, particularly scientists from developing countries, members of the Network of Tropical Fisheries Scientists and Network of Tropical Aquaculture Scientists, as well as FAO staff, consultants and others.

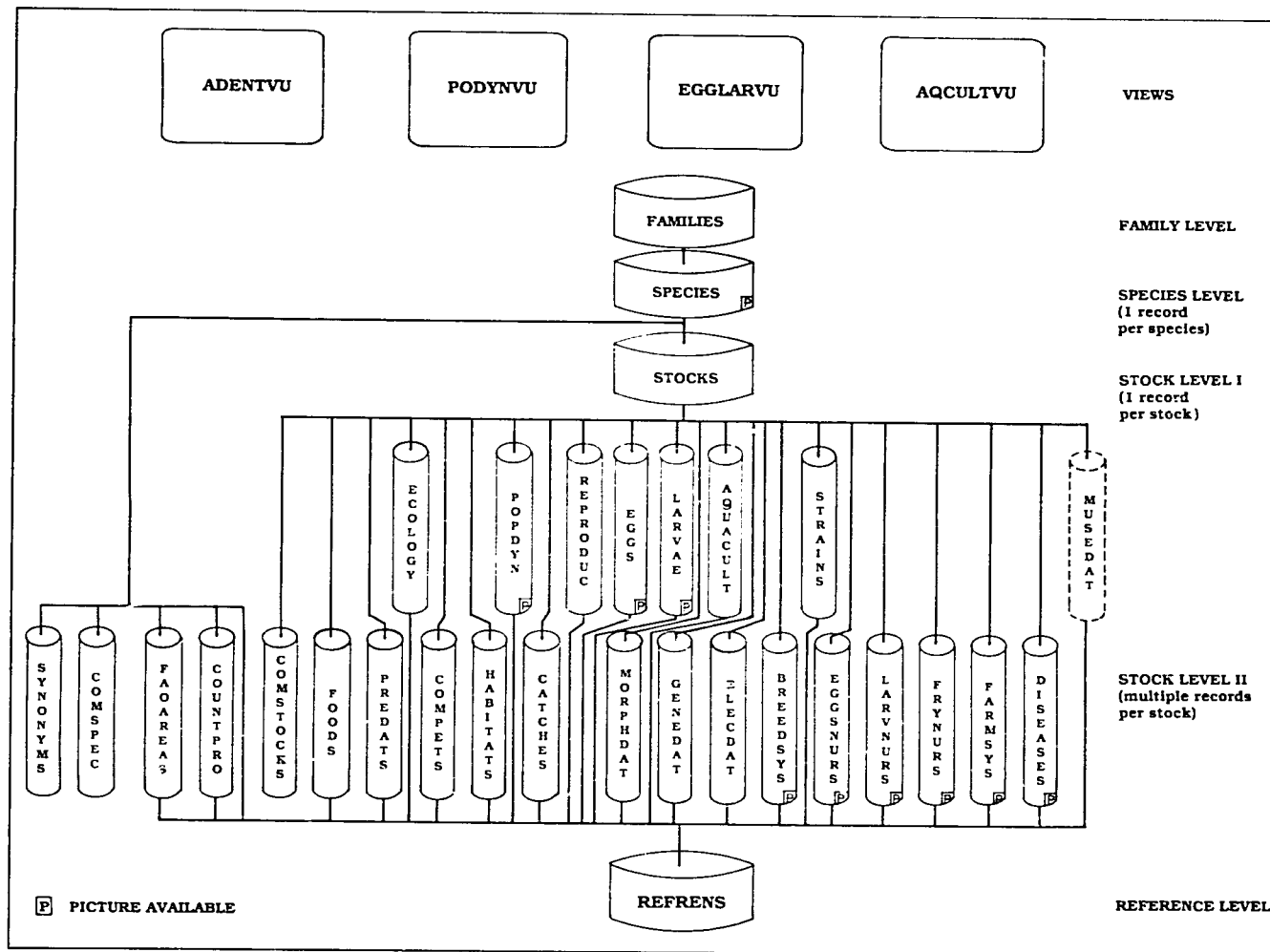


Fig. 7. Schematic representation of the ICLARM database for the documentation of the biology, nomenclature and identification of exploited and/or cultured fishes of the tropics and subtropics.

# AQUACULTURE PROGRAM

## Background

ICLARM's Aquaculture Program concentrates on (1) genetic improvement of cultured aquatic organisms, (2) research for the development of integrated agriculture-aquaculture farming systems and (3) coastal aquaculture. These themes were chosen because of their potential for improving aquaculture technology appropriate for implementation by small-scale farmers and coastal dwellers in developing countries. Genetic improvement of species that feed low in the foodweb, such as tilapias, carps and bivalve molluscs, and their culture in sustainable, resource-efficient systems can improve the incomes of these, the most numerous and needy target groups. The key word is *sustainable*. Integration of aquaculture with crop and livestock raising, and tropical reef culture of giant clams and other marine organisms (the culture systems currently emphasized in the Program) offer excellent prospects for sustainable food production and income improvement.

In pursuing research in these areas, ICLARM is particularly aware of the need to assess the environmental impact of developing-country aquaculture development. All food production invariably has some environmental effects: occupation and fragmentation of former natural habitats; reduction of the abundance and diversity of wildlife and changes in soil, water and landscape quality. Such effects are contributing to and will continue to be major factors in global climatic change. Agriculture will remain the mainstay of most developing-country economies for the foreseeable future and will itself cause much environmental change.

ICLARM's Aquaculture Program is mainly aimed at the development of *semi-intensive* aquaculture systems: pond, cage, pen and nearshore systems that require only modest feed, fertilizer or hatchery-raised seed as inputs. These are the systems that can provide equitable distribution of benefits among small-scale producers. The inputs (fish feeds and fertilizers) available to producers include: vegetation, fresh or composted; human and livestock excreta; chemical fertilizers (N-P-K formulations or urea, which has become increasingly affordable by small-scale farmers); cereal brans and oil cakes. Bivalve mollusc culture usually requires no feed inputs at all beyond the hatchery/nursery stage.

Most developing-country semi-intensive aquaculture does not and will not use typical 'Northern' style intensive feedlot technology. This is important as it is the high throughput of the feedstuffs necessary for intensive feedlot systems that can create environmental pollution. Semi-

intensive systems in synergy with agriculture (crop-livestock-fish integrated farming) capitalize on *in situ* vitamin and protein-rich, natural aquatic feeds, which obviate the need for expensive feed components. Moreover, semi-intensive and extensive marine farming (for example, giant clam culture on coral reefs and in the littoral zone) can coexist well with capture fisheries and fish ranching.

Unfortunately, such aquaculture systems are relatively new and strange for many organizations concerned with development. Their impressions of aquaculture are strongly influenced by the more intensive commercial aquaculture systems typical of the 'North'. Most agriculturists are unaware of the merits of less intensive aquatic food production, particularly its high efficiency of input conversion and its scope for integration with developing-country agriculture. It is ICLARM's view that the promotion of semi-intensive aquaculture in integrated farms in developing-countries will be more beneficial, sustainable, and environmentally benign than other options including short-lived 'goldrushes' to produce high-priced export commodities. The increasingly adverse and largely irreversible environmental effects of some shrimp culture development (large-scale destruction of mangrove ecosystems and salinization of freshwater aquifers) are examples of what can happen when other paths are taken.

With regard to the Program's geographical focus, there is a popular belief that Asian aquaculture is so highly developed and widely practiced that it needs little future support for research and development. This is a serious misconception. Far less than 1% of Asian farmers are involved in aquaculture and very few among the millions of Asian coastal dwellers benefit from aquaculture. This point may be missed by those who see that Asia produces about 75% of the world's cultured aquatic organisms and may thus conclude that future support should be focused mainly on Africa, Latin America and other regions. The state-of-the-art of Asian aquaculture is still undeveloped, particularly in the tropics. It needs to be further advanced through research.

ICLARM's view is that aquaculture can become an immensely successful contributor to food production and livelihood in developing countries throughout the tropics, given suitable climatic and socioeconomic circumstances, extension and institutional support. However, this will require the development of appropriate, sustainable culture systems and breeds of fish that will perform well in those systems. These have the best chances of widespread beneficial impact in Asia. Meanwhile, Asian experience already offers some principles and practices that could be adapted for use in other regions also through research. This requires a very cautious approach. There is no point in trying to grow fish in adverse climates and where there are severe marketing or other socioeconomic constraints. Moreover, many previous attempts to introduce aquaculture to Africa and other regions have used inappropriate technology and/or exotic species. These have not only been costly failures but have also put at risk wild fish genetic resources and habitats of global importance: hence the need for caution and critical research, not wishful thinking.

In addition to its Asian-based activities, ICLARM's Aquaculture Program operates in Africa, largely through a Project Office in Malawi,

and in the South Pacific through its Coastal Aquaculture Centre in the Solomon Islands. Future expansion of activities into Latin America is planned. Throughout these activities, the approach is to see if, where and what kind of aquaculture makes sense and to develop viable technologies through research.

A full account of the planned development of the Aquaculture Program is available in the ICLARM Five-Year Plan (1988-1992), published by the Center.

## **Progress of Work**

### ***Program-wide activities***

The most significant achievement of the year for the Center's Aquaculture Program was the establishment of the Network of Tropical Aquaculture Scientists (NTAS). From modest beginnings, following an announcement in Naga, the ICLARM Quarterly, in mid-1987, NTAS membership grew to over 200 individuals from 50 countries in 1988. Two issues of the NTAS newsletter, *Aquabyte*, were published and drew much favorable comment from members. The NTAS and *Aquabyte* have become the Program's main vehicle answering the need for interregional communication and information exchange. It is hoped to expand NTAS membership and services, given adequate financial support. Appropriate donors will be sought in 1989.

A further major advance in 1988 was the establishment of a French translation capability with the Program. Ms. Catherine Lhomme Binudin was hired to handle communications in French, to liaise with Francophone institutions and to prepare French translations of key ICLARM publications and newsletter items. Her skills will be increasingly needed as ICLARM's collaborative activities expand in Francophone countries. This development was made possible by support from the French Government to facilitate interregional cooperation between Asia and Africa in aquaculture technology development.

This project is financed by a grant to ICLARM from the French Government. The project title is somewhat futuristic as direct and rapid transfer of Asian aquaculture technologies to Africa is inadvisable. A thorough study of African farming systems and their socioeconomic context is first required. It is by no means clear at present to what extent and where aquaculture development in Africa makes sense. There are serious climatic, socioeconomic and institutional constraints to aquaculture development in many African countries and its history so far, despite tremendous efforts by agencies like the Centre Technique Forestier Tropical, has not been very successful.

In 1988, ICLARM and the Ministry of Scientific Research (MSR) of the République de Côte d'Ivoire signed an agreement to be co-organizers of the Third International Symposium on Tilapia in Aquaculture (ISTA III). The MSR assigned host country responsibility for the conference to the Centre de Recherches Océanographiques, Abidjan. ISTA III will be

held in Côte d'Ivoire in 1991. All ISTA III proceedings and literature will be in French and English.

Editing of the proceedings of the previous conference in this series (ISTA II), held in Bangkok in March 1987, was completed in 1988 and the proceedings have gone to press, co-published by the Thai Department of Fisheries and ICLARM.

The year also saw increased interaction between ICLARM and other international agencies and networks engaged in planning and executing regional and international aquaculture research. Aquaculture Program staff participated in meetings of the Technical Advisory Committee of the Consultative Group on International Agricultural Research (CGIAR), the Network of Aquaculture Centres in Asia (NACA), the Special Programme for African Agricultural Research (SPAAR) of the World Bank, the International Development Research Centre (IDRC) of Canada, the Working Party of Experts on Aquaculture of the Indo-Pacific Fisheries Commission of FAO and the Southeast Asian Fisheries Development Center (SEAFDEC).

## Genetics

It has been a momentous year for genetics research activities within ICLARM's Program. Dr. Ambekar Eknath, a former member of the IDRC Asian Fish Genetics Network, joined the ICLARM Headquarters staff in February to provide leadership in expanding the Program's collaboration with Philippine and other institutions in genetics research. In mid-year, substantial training and research planning activities were completed in Norway in collaboration with Norwegian geneticists from the Institute of Aquaculture Research (AKVAFORSK) through NORAGRIC/NORAD, and scientists from the Marine Science Institute of the University of the Philippines (UPMSI), the Freshwater Aquaculture Center of Central Luzon State University (FAC/CLSU) and the National Freshwater Fisheries Technology Research Center of the Philippine Bureau of Fisheries and Aquatic Resources (NFFTRC/BFAR). These activities and the participation of Philippine scientists in the Third International Symposium on Genetics in Aquaculture in Trondheim, Norway, were funded by the United Nations Development Programme (UNDP).

The result was that by July, tilapia genetics research funded by UNDP and the Asian Development Bank (ADB) was well underway as a collaborative effort involving NFFTRC/BFAR, FAC/CLSU, UPMSI and AKVAFORSK. A detailed workplan was devised for screening growth potential, synthetic strain development and selective breeding of new stocks of Nile tilapia (*Oreochromis niloticus*) in the Philippines; the ultimate objective being to develop better breeds for pond, cage and rice-fish culture.

For this, new founder stocks were needed. The collection of pure wild "founder" stocks of Nile tilapia was carried out in several African countries through ICLARM's collaboration with African, Belgian, German and Israeli scientists under a project funded by the Bundesministerium für Wirtschaftliche Zusammenarbeit (BMZ), Federal Republic of Germany. The founder stocks were brought to the University of Hamburg



and from there to the Philippines: the first *direct* transfer of new tilapia genes from Africa to tropical southeast Asia. Quarantine arrangements were made in collaboration with BFAR and the IDRC Asian Fish Disease Network. New facilities for selective breeding work were established at the NFFTRC and FAC/CLSU and the breeding work will now proceed using progeny from the new stocks.



Nile tilapia (*Oreochromis niloticus*) at the Institut des Savanes, Bouaké, Côte d'Ivoire. (Photo by R.S.V. Pullin)

Another important event in 1988 was the publication of ICLARM Conference Proceedings No. 16, "Tilapia Genetic Resources for Aquaculture": the proceedings of a workshop held in Bangkok, 23-24 March 1987. This volume is a unique work for tilapia breeders and researchers on sources of tilapia stocks and genetic conservation issues. It includes a new field guide to identify the cultured tilapias, prepared by Dr. R.H. Lowe-McConnell. A French edition will be published in 1989.

ICLARM's collaboration with the Institute of Aquatic Biology, Achimota, Ghana, was continued through the year. Ghanaian staff

received training in hatchery and growout technology in the Philippines and Israel; and ICLARM and Israeli staff undertook advisory missions to Ghana. Plans were also made to establish a tilapia stock registry in collaboration with the Zoologisches Institut und Zoologisches Museum, University of Hamburg. This will be part of a large relational database, development of the framework of which was begun in November-December 1988 in consultation with Mr. Rainer Froese of the Institut für Meereskunde at Kiel University (see also p. 44).

The year 1988 also saw the commencement of a collaborative tilapia genetics project between the University College of Swansea, UK, and FAC/CLSU, funded by the Overseas Development Administration of the UK. ICLARM participates in this project in a technical advisory capacity. The main objective of the research is the development and application in developing countries of technology for monosex tilapia seed production through genetic manipulation; i.e., gynogenesis and hybridization.

For the future, ICLARM has been invited to establish an Aquaculture Genetics Research Unit on the campus of the University of the Philippines at Los Baños (UPLB), Laguna, Philippines. This is a very favorable location, adjacent to the International Rice Research Institute (IRRI) and the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA). A modest research and training facility is envisaged, from which to lead and coordinate collaborative research with national and regional groups. The focus will be on tilapia genetics. UPLB is expanding its activities in the aquatic sciences and foresees great mutual benefits for itself and ICLARM in hosting this facility. Detailed planning and approaches to donors for funding will proceed in 1989.

## ***Integrated farming***

The main product of the year with respect to overall research planning in integrated farming was the publication of a framework document entitled "Research and Education for the Development of Integrated Crop-Livestock-Fish Farming Systems in the Tropics"



Small-scale integrated crop-livestock-fish farming in a rainfed area of Northeast Thailand. This rice farm has a small fishpond that provides fish, permits dry season cultivation of vegetables on the dikes and supplies drinking water for livestock.

authored by Drs. Peter Edwards, Roger S.V. Pullin and Joseph A. Gartner, and funded by a preparatory assistance grant to ICLARM from the United Nations Development Programme (UNDP) Global and Interregional Programme. This document outlines the research and education needed for substantial expansion of integrated farming systems in the tropics to benefit small-scale farmers. It will be the blueprint for ICLARM's future collaborative research and training activities in this field.

ICLARM's principal collaborator in integrated farming research planning is the Asian Institute of Technology (AIT), Bangkok, Thailand. Under ICLARM's Five-Year Plan, it is envisaged that an Integrated Farming Systems Research Unit will be

established on the AIT campus. Its function will be to lead and coordinate strategic research in this area on campus and through an international network of regional and national groups. An agreement in principle to proceed with this has been reached between AIT and ICLARM. However, planning is still at an early stage and funds have yet to be secured. In the meantime, ICLARM is pursuing its integrated farming activities through projects in Asia and Africa. AIT staff have participated in project research and training activities in both continents.

The main ongoing integrated farming project in Asia is a collaborative Regional Technical Assistance Project on Rice-Fish Farming Systems Research between the Asian Rice Farming Systems Network (ARFSN) of the International Rice Research Institute (IRRI), the Freshwater Aquaculture Center of Central Luzon State University (FAC/CLSU) and ICLARM. The project is funded by the Asian Development Bank. The Ministry of International Cooperation of the Government of the Netherlands has provided an Associate Expert, Mr. Anne van Dam, to join ICLARM's project staff at FAC-CLSU. In early 1990, after two years work with this rice-fish project, Mr. van Dam will transfer to Malawi to use his experience in Asian integrated farming in an African setting. The rice-fish project has ongoing activities in India, Indonesia, the Philippines and Thailand and is investigating a wide range of concurrent and rotational rice-fish systems. The key element is a

whole-farm approach. Among the many new systems being tested, the use of expanded pond refuges for fish, rather than conventional narrow rice-fish trenches, are expected to yield good results. The project's main event of the year was the first Asian Regional Workshop on Rice-Fish Culture, held in Ubon, Thailand, 21-25 March, co-sponsored by IDRC of Canada. There were over 100 participants. The proceedings, to be published in 1989, will be the most comprehensive source of references available on rice-fish culture.

In Africa, ICLARM and the Fisheries Department (FD) of Malaŵi continued to collaborate on research for the development of integrated farming systems appropriate for implementation in rural Africa. The work is wholly funded by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH. A notable event in May 1988 was the signing of a new cooperative linkage agreement with the University of Malaŵi. Through this agreement, the ICLARM-GTZ project began a new series of Master's degree scholarships to expand research on the biotechnical and socioeconomic issues facing farmers in Malaŵi who seek to incorporate fish farming into their mixed farming systems. The project is developing a substantial information base in Malaŵi - the lead nation for fisheries and aquaculture among the nine countries of the South African Development Coordination Conference (SADCC) - and has also constructed 36 experimental ponds and over 100 experimental fish tanks at the Domasi Experimental Fish Farm of the FD. The project has numerous on-station, on-campus and on-farm activities and close linkages with other aquaculture research and development projects in Africa, notably those of FAO/UNDP, IDRC, the Swedish International Development Agency and other GTZ projects. Linkages are also being established with agricultural groups working in the SADCC subregion and elsewhere in Africa, including the international agricultural research centers of the Consultative Group on International Agricultural Research (CGIAR), national institutions and NGOs.

A further integrated farming project activity is the work on application of powerful multivariate statistical techniques to analyze large datasets from fertilized ponds. This involves German, Israeli and ICLARM researchers and is funded by the BMZ. Some work on large datasets from Asia and Israel was completed in 1988 by Mr. Mark Prein of the Institut für Meereskunde at Kiel University and researchers of the Israeli Agricultural Research Organisation's Dor Fish Culture Station.

Finally, the project "Development of Aquaculture and Fisheries Activities for Resettlement of Families from the Saguling and Cirata Reservoirs, West Java, Indonesia", a collaboration between the Institute of Ecology (IOE) of Padjajaran University, Bandung, the Indonesian Electric Company (PLN), the West Java Provincial Fisheries Agency and its Technical Management Unit (UPTD) and ICLARM, entered its last full year of operation and achieved notable successes. Fish production from operations in the Saguling Reservoir, developed through this project, now supplies over 20% of the freshwater fish entering markets in the Bandung district (population over 3 million). Over 1,200 families are involved in fish production and related operations in the two reservoirs and the number is growing. The fish production systems have stimulated further hatchery and rice-fish nursery operations in the surrounding

areas. For this success to be sustainable, the integration and co-existence of agriculture, aquaculture and fisheries are essential. The project will enter a final 6-month finalization and reporting phase from January to June 1989.

### ***Coastal aquaculture***

ICLARM's activities in coastal aquaculture are now all led from the Coastal Aquaculture Centre, Solomon Islands: the only exception being occasional publications from ICLARM's Headquarters (such as the Technical Report on Bivalve Mollusc Culture in Thailand, published in 1988) and consideration of aquaculture as a sector within the broad scope of coastal area management (see p. 28).

## **COASTAL AQUACULTURE CENTRE**

### ***Background***

The Coastal Aquaculture Centre (CAC) had its origins in 1983, when ICLARM first launched an international giant clam mariculture project, through which research on giant clams was started at a number of collaborating institutions. A particular objective of ICLARM's work was to establish a giant clam hatchery in a representative equatorial island environment, at which the results on current research could be applied to the development of economically viable farming systems for giant clams, the world's only phototrophic and thus self-feeding potential farm animals.



Spawning induction of giant clams by intragonadal injection of serotonin.



"Canvacon" lined raceways for the first nursery stage of giant clams (5 to 20 mm shell length).

A suitable site for a giant clam hatchery was identified on the northwestern coast of Guadalcanal, in the Solomon Islands and, on 14 June 1986, a formal agreement was signed by ICLARM, the Government of Solomon Islands and the Guadalcanal Provincial Government. Construction of the facilities of the CAC started on 14 October 1986 following the registration of the lease on the 5-ha site. ICLARM's South Pacific regional office transferred to the CAC in January 1988.

The Centre was officially opened by the Prime Minister of Solomon Islands, The Hon. Ezekiel Alebua, on 12 April 1988, at a small ceremony attended by various Members of Parliament, diplomats, senior civil servants, and representatives of various granting agencies and regional organizations.

### *Progress of Work*

#### *Infrastructure development*

At the year's end, completed buildings included the hatchery/laboratory, a house for the Hatchery Manager, cottages for the Foreman and Deputy Foreman and three of a planned set of four small chalets. A house for the Director was near completion and the fourth chalet will be completed early in 1989. A 12.5-kva diesel generator provides general power supplies and two small freshwater pumps supply potable water from a spring which emerges on site.

The basic aquaculture facility consists of one 2.5-cm and one 12.0-cm Yanmar diesel-powered pumps, drawing water from the adjacent reef. The seawater then passes through 8.0-cm PVC pressure pipes mounted 2-3 m above ground to a variety of circular fiberglass (4), vinyl (4) and ferrocement (5) tanks, used for broodstock holding and spawning, larval culture and settlement of spat, respectively. Sixteen raceways have been constructed for use as giant clam nurseries. The raceways are simple troughs constructed of 5.6 m of "Canvacon" fabric fitted between four coconut log sections on a sandy base to give a tank of 5.0 x 1.0 x 0.3 m. They are very inexpensive.

The hatchery/laboratory building was occupied at the start of the year. The upper floor consists of 53 m<sup>2</sup> of general office space and 12 m<sup>2</sup> of veranda/conference area. Airconditioned space includes a small (7.3 m<sup>2</sup>) computer room and scientific laboratory (9.7 m<sup>2</sup>), with a 4.9-m<sup>2</sup> annex intended in the longer-term for larval culture work. The laboratory and computer room have 1.5-kw power conditioners to ensure stable voltages for electronic equipment. The wet laboratory on the ground floor of the laboratory/office building has seawater reticulation, two 1.6-m<sup>3</sup> fiberglass larval culture tanks, aquaria and wet benches.

A modest array of scientific and technical equipment had been assembled from various sources, including a significant component loaned to the giant clam project by our collaborators, the Solomon Islands Fisheries Division, and derived from Japanese bilateral grants.

## Scientific research

The first spawnings of giant clams occurred on 3 November 1987, less than a year after acquisition of the site. A total of 35 broodstock of the largest species of giant clam, *Tridacna gigas*, had been collected and transported to the CAC by the end of July 1987. By the end of 1988, spat originating from clam spawnings in January, March, June, July and October 1988 were being raised in tanks and raceways and cohorts of clams spawned in November 1988, had been transferred to ocean nurseries on the CAC's exclusive reef leaseholding. In October, a batch of 200 giant clam juveniles were transferred to the first village- operated ocean nursery at Ghulavu Village on the west coast of Guadalcanal.

While most efforts were focused on completing the facilities of the CAC, a number of comparative experiments were set up in the raceways. Effects on growth of stocking density, clumping fertilizers and different substrates were examined. The use of grazing fish in raceways and different nursery types and locations have also been studied. Details are given in p. 87.

## Interregional linkages

During 1988, ICLARM's new Coastal Aquaculture Network (CAN) was formally created. The first step was to absorb the existing membership of the International Giant Clam Mariculture Project into the new Network and rename it the "Giant Clam Research Group". The CAN includes funds for visits to participating institutions. So far one Australian researcher has spent two months at CAC under this scheme.

## *Future Plans for the Coastal Aquaculture Centre and Network*

With the major portion of the first phase of building construction completed, the main thrust of the work at the CAC in 1989 will be toward increasing the overall output of giant clams (particularly *Tridacna gigas*) from the hatchery and nursery systems and on expanding the ocean nurseries.

Emphasis will be placed on improving the reliability of spawning induction and on methods for accurately judging the maturity of giant clams. Larval rearing methods successfully produced large numbers of pediveligers and newly settled spat, but improvements in survival are needed during the land-based postsettlement stages. Irregular and largely inexplicable mortalities reduced the output of spat during 1988.

The ocean nurseries have been highly successful. Both survival and growth rates in the ocean nursery cages have been excellent. The current style of cages is relatively robust and inexpensive but improved designs will nevertheless be sought. A large (75-m<sup>2</sup>) intertidal nursery pond will be completed early in 1989 and stocked with juveniles. If successful, the pond will substantially increase the ease with which clams can be raised through the ocean nursery stages. In addition to the ocean nurseries

operated at the CAC, the number of village-operated giant clam nurseries will be substantially increased and will be sited in many of the different habitats available in the Solomon Islands.

A project funded by the Overseas Development Administration, UK, will begin on giant clam product development and marketing. Consultants from the Overseas Development Natural Resources Institute will investigate the drying, storage and marketing aspects. The work will be directed towards the production of acceptable dried adductor muscle for sale as "kaibashira", and the freezing, storage and preparation of clam mantle meat and muscle. Development of various items made from clam shells will also be investigated.

A "Manual of methods for the culture of giant clams" will be prepared and published during the year and economic analyses will be made of the comparative costs of hatchery and nursery operations.

A visitors' information bureau will be constructed near the main entrance to the site. This will have a small aquarium, display tanks, poster presentations of information about ICLARM, coastal aquaculture in general and giant clam cultivation in particular.

Some preliminary work is planned on the potential for coral reef fish ranching. This is expected to concentrate initially on making an inventory of species of potential interest and studies of their relative range of movement.

The Coastal Aquaculture Network (CAN) will be expanded and consideration will be given to the formation of additional research groups and the formation of linkages with other institutions concerned with tropical marine aquaculture.

### ***Education and Training***

As in past years, the training and education activities of the Aquaculture Program were carried out as part of projects and through dissemination of publications, rather than as separate activities. For genetics, the major event was a training course in Norway organized by AKVAFORSK for researchers from Philippine institutions (BFAR/NFFTRC, FAC/CLSU and UPMSI) and ICLARM. Dr. Ambekar Eknath and Ms. Josephine B. Capili participated for ICLARM. Mr. Joseph K. Ofori of the Institute of Aquaculture, Achimota, Ghana, received one month's training in the Philippines on tilapia culture methods and data analysis through the Germany-Israel-ICLARM cooperative project on tilapia genetics research, funded by BMZ.

In integrated farming, the first Asian Regional Workshop on Rice-Fish Culture in Ubon, Thailand, was a major training experience for many of the participants. The IRRI/ICLARM/CLSU rice-fish project also provided instruction to Philippine farmers in Nueva Ecija and Pampanga provinces on rice-fish culture methods.

In Africa, the ICLARM-GTZ project in Malawi instituted a new Master's level scholarship scheme in the University of Malawi (UM) and five students began their studies during the year. The project also conducted a training course on Lake Malawi Fishing Techniques in collaboration with the Fisheries Department and the UM.

In Indonesia, training was a major activity of the collaborative reservoir fisheries and aquaculture project between IOE, PLN, UPTD and ICLARM, funded by the World Bank. Activities in 1988 included training workshops for IOE and Department of Fisheries staff on microcomputer techniques; transfer of Philippine reservoir aquaculture technology to the Saguling region and training of IOE staff in research methods and experimental design. One IOE scientist was sent to ICLARM's Coastal Aquaculture Centre, Solomon Islands, for a month's training in reservoir fisheries data analysis under Dr. John Munro of ICLARM. Another IOE scientist attended a 2-week aquaculture management training workshop at Universiti Diponegoro, Semarang, Indonesia, led by Prof. Harlan C. Lampe of ICLARM, coordinator of the Asian Fisheries Social Science Research Network.

For coastal aquaculture, there is a shortage of scientists in the South Pacific Region and one of the most effective methods for attaining research objectives, while providing research instruction, is to employ young graduates as Research Assistants on the understanding that a part of their research will form the body of a higher degree thesis. This provides an opportunity for gainful employment while at the same time fulfilling higher degree aspirations.

Appropriate arrangements have been made with the University of the South Pacific for the CAC to offer supervision in research methods to candidates for higher degrees of that university.

At the local level, the Centre has already attracted considerable interest from schools and several groups of secondary and high school students have visited the CAC. It is expected that field trips to the Centre will become a regular feature on the curriculum of Honiara schools.

Program publications have had major impacts on training and education. The review entitled "Research and Education for Development of Integrated Crop-Livestock-Fish Farming Systems in the Tropics", published in 1988, is the first ICLARM aquaculture publication to address curricular needs. The "Hatchery Manual for the Common, Chinese and Indian Carps" by V.G. Jhingran and R.S.V. Pullin, co-published by Asian Development Bank and ICLARM, sold out its first 1985 edition and was reprinted in 1988 as a slightly revised edition. It is in demand for courses worldwide. The Bellagio conference proceedings, "Detritus and Microbial Ecology in Aquaculture", edited by D.J.W. Moriarty and R.S.V. Pullin and co-published by ICLARM and GTZ, has been widely distributed and is in use as a graduate teaching text in the USA. On the extension front, a booklet on small-scale hatchery technology for common carp, was produced by the IOE/UNPAD/PLN/ICLARM reservoir aquaculture project. This makes a total of four extension booklets produced by the project, two in Bahasa Indonesia and two in Sundanese. These are proving to be of great benefit to fishermen and culturists in the Saguling/Cirata area. English translations will soon be produced for training and extension elsewhere.

## **Advisory Services**

Aquaculture program staff provided a wide range of advisory services including editorial services to scientific journals and referring research



proposals to national and international agencies such as the International Foundation for Science and the Commission of European Communities. Requests for advice on where to obtain good tilapia broodstocks continued to pour in from all over the world and were answered as helpfully as possible. However, ICLARM will not be able to back up such advice with practical help until the Center's access to good tilapia breeds is expanded. This can be done partly through ongoing collaborative research with national institutions but will ultimately require the development of ICLARM's proposed genetics research unit.

Program Director, Dr. Roger S.V. Pullin assisted the US National Academy of Sciences/National Research Council Committee on Managing Global Genetic Resources, Fish and Shellfish, and participated in a meeting of its Working Group on Aquatic Genetic Resources held in Trondheim, Norway in June. Dr. Pullin also served as a member of the Working Party of Experts on Aquaculture of the Indo-Pacific Fisheries Commission of FAO and assisted at proposal prioritization meetings in the Philippines for the Department of Agriculture and the National Economic and Development Authority.

The concept of Asia-Africa cooperation in aquaculture research and development was advanced by a visit to Malawi in August by Dr. Barry Costa-Pierce, Resident Consultant on the IOE/PLN/ICLARM Indonesian Reservoir Project. Dr. Costa-Pierce advised on aquaculture research, experimental design and water quality analysis and presented a seminar on Asian aquaculture to the Biology Department of Chancellor College, University of Malawi. Dr. Costa-Pierce will join the ICLARM-GTZ project team in Malawi from February 1989.

## Meetings Attended, Papers Presented

Network of Aquaculture Centres in Asia. Second Meeting of the Provisional Governing Council, Bangkok, Thailand, 12-15 January. (R.S.V. Pullin).

Seminar on the Resettlement of the Population of Saguling and Cirata through the Development of Fisheries, Bandung, Indonesia, 12-13 February. (B.A. Costa-Pierce, H.C. Lampe).

Paper presented:

Soemarwoto, O. *et al.* Resettlement of the population of the Saguling and Cirata Reservoir regions through the development of fisheries.

45th Meeting of the Technical Advisory Committee of the Consultative Group on International Agricultural Research, Rome, Italy, 7-12 March. (R. Jackson, R.S.V. Pullin).

Paper presented:

ICLARM. Research for the development of tropical aquaculture: a proposed new venture for the Consultative Group on International Agricultural Research. 40 p.

South Pacific Commission Workshop on Inshore Fishery Resources, Noumea, New Caledonia, 13-25 March. (J.L. Munro, H. Govan).

Paper presented:

Munro, J.L. Status of giant clam stocks in the Central Gilbert Islands Group, Republic of Kiribati.

**First International Workshop on Rice-fish Farming Systems Research and Development, Ubon, Thailand, 21-25 March.** (C.R. dela Cruz, B.A. Costa-Pierce, A.A. van Dam, H.C. Lampe).

Papers presented:

Costa-Pierce, B.A. Rice-fish systems as intensive nurseries.

Costa-Pierce, B.A. Chairman's report. Working group for on-station research.

Cruz, C.R. dela. The ICLARM/IRRI/CLSU Rice-Fish Farming Systems Research Project.

Koesoemadinata, S. and B.A. Costa-Pierce. Development of rice-fish farming in Indonesia. past, present and future.

**Australian Centre for International Agricultural Research (ACIAR)/James Cook University Workshop on the Biology and Culture of Giant Clams, Townsville, Australia, 18-22 April.** (J.L. Munro, G.F. Usher).

Papers presented:

Govan, H. Experiences in sea transport of *Tridacna gigas* broodstock.

Govan, H., P.V. Nichols and H. Tafea. Giant clam resource investigations in Solomon Islands.

Munro, J.L. Growth, mortality and potential aquaculture production in *Tridacna gigas* and *T. derasa*.

Usher, G.F. and J.L. Munro. ICLARM Coastal Aquaculture Centre: current facilities and progress.

**Regional Training Seminar on the Application of Environmental Impact Analysis in the Appraisal of Development Project Planning, Bandung, Indonesia, 30 May-11 June.**

Paper presented:

Costa-Pierce, B.A. Application of environmental impact analysis in fisheries development.

**Third International Symposium on Genetics in Aquaculture, Trondheim, Norway, 20-24 June.** (J.B. Capili, A.E. Eknath, R.S.V. Pullin).

Papers presented:

Eknath, A.E. and R.W. Doyle. Effective population size and rate of inbreeding in Indian major carps aquaculture.

**National Seminar on Fish and Shrimp Hatcheries, Bandung, Indonesia, 5-6 July.** (B.A. Costa-Pierce).

**Asian Fisheries Social Science Research Network First Course in Aquaculture Management, Semarang, Indonesia, 10-23 July.** (M.P. Bimbao).

**Meeting of the Working Group of Experts on Aquaculture of the Indo-Pacific Fisheries Commission of FAO, Bangkok, Thailand, 1-6 August.** (R.S.V. Pullin).

**Sixth International Coral Reef Symposium, Townsville, Australia, 8-13 August.** (J.L. Munro).

**Eleventh Meeting of the Southeast Asian Fisheries Development Center Program Committee, Chiang Mai, Thailand, 20-23 September.** (A.E. Eknath).

**Second Advisory Committee Meeting on Aquaculture for Local Community Development (FAO-SIDA), Harare, Zimbabwe, 5-8 October.** (J.D. Balarin, K. Ruddle).

**National Rice-Fish Workshop in China, Wuxi, China, 10-13 October.** (C.R. dela Cruz).

Paper presented:

Cruz, C.R. dela. Rice-fish farming: A potential contributor to rural socio-economic upliftment in the Philippines.

- International Rice Research Conference, IRRI, Los Baños, Laguna, Philippines, 7-11 November. (C.R. dela Cruz).  
 Paper presented:  
 Cruz, C.R. dela, N. Tongpan and S. Koesoemadinata. Potential of rice-fish farming systems in Asia.
- Nineteenth Asian Rice Farming Systems Network Working Group Meeting, Baguio City, Philippines, 11-15 November. (A.A. van Dam).  
 Paper presented:  
 van Dam, A.A. The first international workshop on rice-fish farming systems: highlights and research thrusts.
- Atelier International sur la Recherche Appliquée en Aquaculture (IDRC), Bouaké, Côte d'Ivoire, 14-17 November. (J.D. Balarin).  
 Paper presented:  
 Balarin, J.D. ICLARM-GTZ Africa Aquaculture Project Plans.
- International Foundation for Science Workshop on Fish Culture Management Techniques and Nutrition, Brawijaya University, Malang, Indonesia, 14-18 November. (B.A. Costa-Pierce, C.R. dela Cruz).  
 Papers presented:  
 Cruz, C.R. dela. Fingerling production trials in rice fields in north Sumatra, Indonesia.  
 Costa-Pierce, B.A., H.Y. Hadikusumah, and Y. Dhahiyat. Tilapia (*Oreochromis* sp.) and carp (*Cyprinus carpio*) cage production system in West Java, Indonesia).
- Meeting on Coordination of Fisheries/Aquaculture Research Support through the Special Programme on African Agricultural Research (SPAAR) of the World Bank, Bouaké, Côte d'Ivoire, 18-19 November. (J.D. Balarin).

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- Costa-Pierce, B.A. 1988. Traditional fisheries and dualism in Indonesia. Naga, The ICLARM Quarterly 11(2):3-4.
- Costa-Pierce, B.A. 1988. Study mission to northeast Thailand for assessment of a pelagic freshwater sardine, *Clupeichthys aesarnensis*. Institute of Ecology, Padjadjaran University, Bandung, Indonesia, and International Center for Living Aquatic Resources Management, Manila, Philippines. 63 p.
- Costa-Pierce, B.A. and P. Effendi. 1988. Sewage fish cages of Kota Cianjur, Indonesia. Naga, The ICLARM Quarterly 11(2):7-9.

- Costa-Pierce, B.A., S. Zainal, and P. Effendi. 1988. ICLARM and south-south technology transfer: Philippine aquaculture technology and Indonesia. *Naga, The ICLARM Quarterly* 11(4):10-11.
- Costa-Pierce, B.A., G. Wiraatmadja, P. Effendi and Sutandar Zainal. 1988. Integrated aquaculture systems in the Saguling Reservoir, West Java, Indonesia, p. 224-233. In S.S. De Silva (ed.) *Reservoir fishery management and development in Asia*. International Development Research Centre, Ottawa, Canada. 246 p.
- Cruz, C.R. dela. 1988. Consultancy Report on Aquaculture Research and Development in Saguling and Cirata Reservoirs. Bandung, West Java, Indonesia.
- Edwards, P., R.S.V. Pullin and J.A. Gartner, Editors. 1988. Research and education for the development of integrated crop-livestock-fish farming systems in the tropics. *ICLARM Studies and Reviews* 16, 53 p. International Center for Living Aquatic Resources Management, Manila, Philippines.
- Govan, H. 1988. Experiences in sea transport of *Tridacna gigas* broodstock, p. 173-175. In J. Copland and J.S. Lucas (eds.) *Proceedings of a Workshop on the Biology and Culture of Giant Clams*. Australian Centre for International Agricultural Research, Canberra.
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- ICLARM. 1988. Research for the development of tropical aquaculture: a proposed new venture for the Consultative Group on International Agricultural Research. International Center for Living Aquatic Resources Management, Manila, Philippines. 40 p.
- IOE/UNPAD-PLN-ICLARM. 1988. Pembenuhan ukuran kecil ikan mas. (Small scale hatchery for common carp). Extension booklet. Institute of Ecology, Padjadjaran University, Bandung, West Java, Indonesia; Perusahaan Umum Listrik Negara; and the International Center for Living Aquatic Resources Management, Manila, Philippines. 43 p. (in Indonesian).
- Jhingran, V.G. and R.S.V. Pullin. 1988. A hatchery manual for the common, Chinese and Indian major carps. Second, revised edition. *ICLARM Studies and Reviews* 11, 191 p. Asian Development Bank, Manila, Philippines and International Center for Living Aquatic Resources Management, Manila, Philippines.
- McCoy, E.W. and T. Chongpeet, Editors. 1988. Bivalve mollusc culture research in Thailand. *ICLARM Technical Reports* 19,

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- Munro, J.L. 1988. Growth, mortality and potential aquaculture production in *Tridacna gigas* and *T. derasa*, p. 218-220. In J. Copland and J.L. Lucas (eds.) Proceedings of a Workshop on the Biology and Culture of Giant Clams. Australian Centre for International Agricultural Research, Canberra.
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## **Aquaculture Program Project Summaries**

<b>Project Title</b>	: Network of Tropical Aquaculture Scientists
<b>Duration</b>	: Continuous from July 1987
<b>Key Personnel</b> ICLARM	: Dr. R.S.V. Pullin (Aquabyte Editor) Ms. Mary Ann P. Bimbao (Network Secretary)

### **Objectives**

- To enhance communication between aquaculture scientists working in the tropics, especially in genetics, integrated agriculture-aquaculture farming systems and coastal aquaculture of tropical molluscs.
- To facilitate increased output by these scientists by assisting in information and database searches, research methods, data analysis and interpretation, and publishing a newsletter at regular intervals.

### **Results**

The Network of Tropical Aquaculture Scientists (NTAS), which follows the same mode as ICLARM's Network of Tropical Fisheries Scientists (NTFS), was created to put isolated scientists in touch with each other and to provide them with information sources. NTAS members write to ICLARM HQ and to each other for publications, unpublished data and information and advice on research methods. Membership of the NTAS is free. Members also exchange informal notes, news and views in a newsletter, 'Aquabyte'. Since the launching of NTAS in Naga, the ICLARM Quarterly, in July 1987, two issues of Aquabyte have been published. Aquabyte 1(1) was published in March 1988 and distributed to 108 NTAS members from 38 countries. Aquabyte 1(2) was published in October 1988. By the end of the year, Aquabyte readership expanded to 221 members in 56 countries, in addition to fisheries and aquaculture institutions from 23 countries.

An "African Section" in French and English was introduced in Aquabyte 1(2) to encourage wider readership and membership in the Francophone and Anglophone countries of Africa. Other regular Aquabyte features, in addition to members' scientific contributions and letters, include a large information section that informs members on where to write for reprints of important articles, short news items and a 'photosection' illustrating key points about tropical aquaculture.

The NTAS and Aquabyte need external donor support to expand the Network's membership and services.

<b>Project Title</b>	:	Transfer of Asian Aquaculture Technologies to Africa
<b>Duration</b>	:	1988-ongoing
<b>Key Personnel</b>	France	: M. Jean-Marie Travers, Multilateral Division, Ministry of Foreign Affairs.
	ICLARM	: Dr. Roger S.V. Pullin, Mr. John D. Balarin; Balarin; Ms. Catherine Lhomme Binudin; Ms. Mary Ann P. Bimbao

## Objectives

- To examine the scope for application of Asian aquaculture principles and practices in Africa.
- To prepare and distribute information relevant to African aquaculture development, especially for Francophone African countries.
- To foster interregional cooperation between Africa and Asia for the benefit of aquaculture research and development.

## Results

ICLARM is taking a cautious approach to the application of Asian aquaculture principles and practices in Africa. The first prerequisite is information. Asian aquaculture has developed in an environment of settled, productive agriculture; well-established traditions of water management; acceptance of fish husbandry as means of food production; and buoyant markets for cultured fish with the rise in human populations and the stasis or decline of capture fisheries. For inland aquaculture, the key factor is that aquaculture must fit into the farming systems that are in use or into new integrated farming systems that farmers will accept. Moreover, modern aquaculture requires the development of better breeds of fish tailored to good performance in such systems.

Through this project, supported by the French Government, a thorough study of African farming systems and their socioeconomic context is to be made, leading to ways in which Asian aquaculture technologies can be modified and applied in appropriate African contexts.

The first activity of this project is to acquire and disseminate relevant information on these topics and in particular to consider the needs of Francophone African countries. A major advance was made in 1988 with the hiring of Ms. Catherine Lhomme Binudin as French translator on ICLARM's Aquaculture Program staff. Three of ICLARM's most important aquaculture publications are being translated into French for distribution to Francophone countries:

1. Tilapia Genetic Resources for Aquaculture, edited by R.S.V. Pullin, ICLARM Conference Proceedings 16, 1988.



2. Research and Education for the Development of Integrated Crop-Livestock-Fish Farming in the Tropics by P. Edwards, R.S.V. Pullin and J.A. Gartner, ICLARM Studies and Reviews 16. 1988.
3. A Hatchery Manual for the Common, Chinese and Indian Major Carps, by V.G. Jhingran and R.S.V. Pullin, ICLARM Studies and Reviews 11. 1988.

The translation of item 1 is almost complete. It is a key work for African aquaculturists to appreciate the need to conserve wild genetic resources and to use them wisely. Final technical editing of the translation will be done by Dr. Jacques Moreau, Ecole Nationale Supérieure Agronomique de Toulouse (ENSAT). ICLARM and ENSAT signed a Memorandum of Agreement on 8 March 1988 to cooperate in aquaculture and fisheries research. Item 2 draws heavily on Asian aquaculture experience and technology and discusses institutional requirements for linkages to Africa and other regions. Item 3 has been one of ICLARM's most successful aquaculture publications and documents Asian carp hatchery methods many of which are probably adaptable for hatchery work with exotic and native carps in Africa.

In addition to these large translation tasks, the Africa page in 'Aquabyte', ICLARM's newsletter of the Network of Tropical Aquaculture Scientists (NTAS), now appears in French and English.

Parallel to ongoing translation and information distribution work, the ICLARM staff involved in this project are now establishing closer ties with aquaculture research and development groups in Francophone African countries. Aquaculture Program Director, Dr. Roger S.V. Pullin, visited Sénégal and Côte d'Ivoire (twice) in 1988 and, in November, ICLARM signed with the Ministry of Scientific Research of Côte d'Ivoire, an agreement to hold the Third International Symposium on Tilapia in Aquaculture (ISTA III) in Côte d'Ivoire in 1991. Therefore, in the lead-up to ISTA III, ICLARM staff will be making more frequent visits to Côte d'Ivoire and neighboring countries. The lead agency in Côte d'Ivoire for the organization of ISTA III is the Centre de Recherches Océanographiques, Abidjan, which is associated with ORSTOM. ISTA III will afford a major opportunity for African aquaculturists to discuss their work with Asian counterparts. Its proceedings will be conducted and published in French and English. A proposal for French support for ISTA III from the Fonds d'Aide et de Coopération was sent in December 1988.

In 1989, ICLARM will be adding a Farming Systems Research Specialist to its Manila headquarters staff. This will increase the Center's capacity to study and understand African farming systems and the scope for integration of aquaculture technology based upon Asian principles and practices.

**Project Title** : Genetic Improvement of Tilapia Species in Asia

**Cooperating Institutions** The National Freshwater Fisheries Technology Research Center of the Philippine Bureau of Fisheries and Aquatic Resources (NFFTRC/BFAR); the Freshwater Aquaculture Center of the Central Luzon State University (FAC/CLSU); the Marine Science Institute of the University of the Philippines (UPMSI); the Institute of Aquaculture Research of Norway (AKVAFORSK) through the Norwegian Centre for International Agricultural Development (NORAGRIC/NORAD); the Asian Development Bank (ADB); and the United Nations Development Programme (UNDP) Global and Interregional Programme.

**Duration** : April 1988 to March 1991<sup>1</sup>

**Key Personnel**

NFFTRC/ BFAR	:	Mr. Melchor Tayamen; Mr. Ruben A. Reyes; Mr. Hermogenes Tambalque; Mr. Marlon A. Reyes; Ms. Jodecel Casayuran; Ms. Edna Dionisio
FAC/ CLSU	:	Mr. Tereso A. Abella; Mr. Antonio V. Circa; Mr. Hernando Bolivar; Ms. Remedios Bolivar
UPMSI	:	Dr. Julie M. Macaranas; Ms. Maria-Josefa R. Pante; Ms. Carmen Ablan; Ms. Liza Agustin
AKVAFORSK	:	Dr. Trygve Gjerdem; Dr. Hans B. Bentsen; Dr. Bjarne Gjerde; Dr. Terje Refstie
ICLARM	:	Dr. Roger S.V. Pullin; Dr. Ambekar E. Eknath; Ms. Josephine B. Capili; Ms. Ravelina Recometa

## Objectives

The primary objectives of the project are to produce better breeds of tilapia by selection for high growth rate and to provide such fish to national broodstock distribution and testing programs in the Philippines

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<sup>1</sup>The activities formerly reported under the project heading "Evaluation of Farmed Tilapia Stocks", a continuous collaboration between UPMSI and ICLARM from 1984, have been absorbed into this large collaborative project.

and from thence to fish farmers. This will be accomplished with the following specific and sequential objectives:

- Documentation of tilapia genetic resources in Asia and Africa and establishment of a collection of strains of important species, principally *Oreochromis niloticus*, from new importations from Africa and from existing Asian stocks.
- Evaluation of the new African germplasm along with existing cultured stocks in the Philippines in different culture systems.
- Selective breeding using promising strains and crossbreeds.
- Distribution of genetically improved fish through national broodstock distribution channels and testing programs initially in the Philippines and thereafter in Thailand and other Asian countries.

## Results

Prior to the official starting date of the project in April 1988, a delegation from ICLARM (Director General, Dr. Ian R. Smith; Director, Aquaculture Program, Dr. Roger S.V. Pullin and geneticist, Dr. Ambekar E. Eknath) with Dr. Rafael D. Guerrero (Executive Director, Philippine Council for Aquatic and Marine Research and Development) and Mr. Melchor M. Tayamen (Manager, NFFTRC/BFAR) visited AKVAFORSK and NORAGRIC/NORAD in February to finalize plans for the involvement of Norwegian geneticists in the project and financial support from UNDP, represented by Mr. Alva App. This visit afforded the first view for ICLARM staff and Philippine collaborators of the tremendous advances achieved in the Norwegian salmon culture industry through applied genetics.

In May-June, a return visit to Norway was made by NFFTRC/BFAR, FAC/CLSU, UPMSI and ICLARM researchers for training in applied genetics and for formulation of a detailed workplan for selective breeding of tilapia. This visit coincided with the Third International Symposium on Genetics in Aquaculture, held at Trondheim, and provided opportunities for interaction and discussion with aquaculture geneticists from all over the world. The project workplan was finalized and widely circulated for comment to centers of excellence in aquaculture genetics research around the world.

With ADB and UNDP funding secured, Dr. Eknath joined the ICLARM HQ staff in Manila in April and project activities commenced in earnest. Based upon previous identification of sources of pure tilapia stocks, the first direct transfers of tilapia from Africa to tropical Southeast Asia were accomplished. Founder stocks of *Oreochromis niloticus* were collected from Egypt, Ghana and Sénégal and *O. aureus* was collected from Sénégal. These collection and shipments were carried out in collaboration with Prof. Wolfgang Villwock (Zoologisches Institut und Zoologisches Museum, University of Hamburg); Dr. D.F.E. Thys van den Audenaerde (Musée Royal de l'Afrique Centrale Tervuren Belgium); Dr. Martin A. Odeh and Mr. Joseph K. Ofori (Institute of Aquatic Biology, Ghana) and Dr. Gideon Hulata (Agricultural Research Organisation, Israel).

The founder stocks were shipped to the Philippines after an intermediate stop at the University of Hamburg (see p. 49). Quarantine procedures and treatment of common diseases were undertaken with the help of a BFAR health team supported through the Fish Disease Network of the International Development Research Centre (IDRC), Canada.

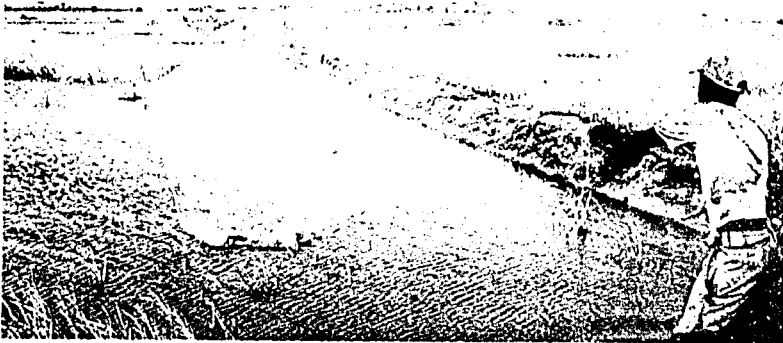
Survival of the Egyptian stock was disappointing. Large adult fish, rather than fingerlings, were shipped. They did not acclimatize well and there was considerable mortality of most fish from the first importation. A second collection from Egypt will be attempted in June 1989. A further collection will also be made in Sénégal. It is hoped to collect *O. niloticus* from Lake Turkana, Kenya stock, in 1989. Four commercial strains of Nile tilapia, popularly known in the Philippines as 'Israel', 'Taiwan', 'Singapore' and 'Taiwan' strains, are maintained in isolation at NFFTRC/BFAR. Evaluation of the culture performance of all these newly imported and Philippine strains will start in March 1989.

Further work was done in 1988 on testing methodologies for comparison of the culture performance of different strains. Several types of tag including Carlin tags, Floy tags and various knot, loop and 'rivet' systems of attachment were tested on fish of various sizes. For tag retention and minimal time involved in tagging, a system called the "knotted rivet tag" (KRT) was found to be the best. Fish as small as 3 g were tagged successfully with little or no effect on growth. This is a significant advance because the period of rearing before fish can be tagged can now be reduced and communal testing can be performed at an early stage. A second series of KRT trials under actual pond conditions with periodic seining is underway.

The efficiency of chlorbutanol as a fish anesthetic during tagging/data recording was evaluated. It was found that at a concentration of 1-2 ml of stock solution (30% chlorbutanol + 70% ethyl alcohol) per liter, Nile tilapia fingerlings become completely inactive in about 60 seconds and revive quickly after the operation, usually in less than two minutes. Chlorbutanol will now be used in place of quinaldine.

At UPMSI, Dr. Julie Macaranas returned from her Ph.D. studies in Japan and Ms. Ma. Josefa R. Pante departed for Master's training under Dr. L. James Lester at the University of Houston at Clear Lake (UHCL). The UHCL linkage has enabled fruitful collaboration on shape analysis as a tool in tilapia population genetics and breeding studies. ICLARM's Research Assistant, Ms. Josephine B. Capili, moved late in the year from the UPMSI genetics laboratory to NFFTRC/BFAR as the tilapia breeding work there required additional staff. ICLARM appointed Ms. Ravelina Recometa to fill Ms. Capili's position at UPMSI. The laboratory work at UPMSI consisted mainly of reassessment of the buffer and staining systems in current use, using tissue isolates from Philippine strains. Although more expensive than other buffer systems, the aminopropyl-morpholine amine buffer (combined with citric acid) still remains the best resolving buffer for the tilapia isozyme markers in use. The UPMSI staff are planning to extend their tilapia population genetics studies using digitized shape analysis and isolation of mitochondrial DNA fractions. A new refrigerated centrifuge will be sought for the latter in 1989.

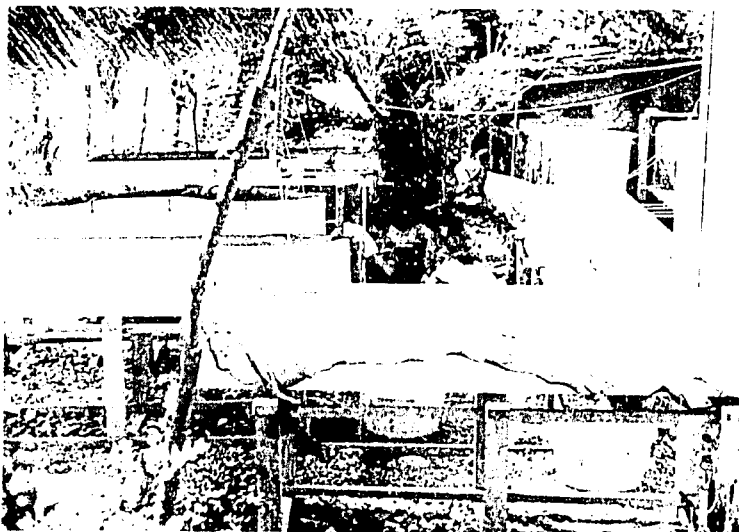
Construction of new concrete tanks for holding the founder stocks is well underway at NFFTRC/BFAR and should be fully operational by the end of April 1989. Excavation of a deep well has also been completed. At FAC/CLSU, an existing hatchery building has been renovated for the sole use of the project.



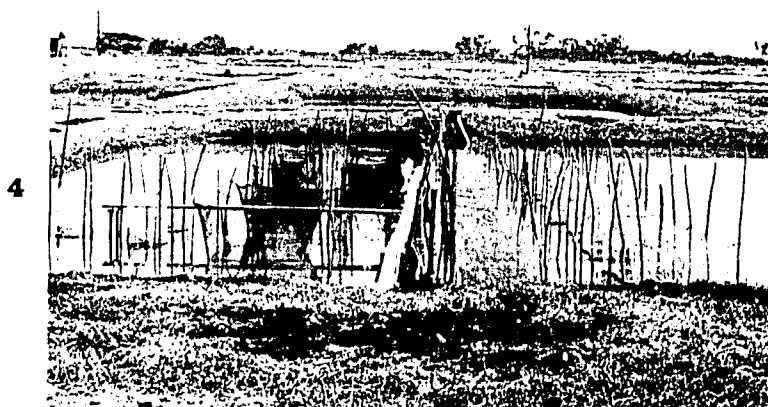
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3



The first ever direct transfer of *Oreochromis niloticus* germplasm from Africa to tropical Asia (Philippines). Pictures show tilapia collection (1) and transportation (2) from Dakar-Bangos near Saint Louis, to Dakar (Sénégal). After preliminary screening and serological studies at the University of Han.nurg, F.R. Germany, the tilapia founder stocks from Egypt, Ghana and Sénégal were held in quarantine tanks (3) for a minimum period of five months, and later transferred to net hapas in separate earthen ponds (4). Individually tagged founder stocks (Fingerling Floy Tag, 5) will be held in Tilapia Reference Collection Tanks (6), expected to be fully operational by April 1989.



<b>Project Title</b>	:	The Federal Republic of Germany-Israel Fund for Agricultural Research in Third-World Countries: Aquaculture Project
<b>Subproject I</b>	:	Optimal Management of Aquaculture Pond Systems in Developing Countries
<b>Cooperating Institutions</b>	:	Agricultural Research Organization (ARO), Israel; Technion, Israel Institute of Technology (T/IIT); Institut für Meereskunde at Kiel University (IfM) African and Asian institutions (to be identified)
<b>Duration</b>	:	1986-ongoing
<b>Key Personnel</b>		
ARO	:	Dr. Gerald L. Schroeder; Dr. Giora W. Wohlfarth; Dr. Ana Milstein; Dr. Gideon Hulata
T/IIT	:	Prof. Yoram Avnimelech; Dr. Shoshana Mokady
IfM	:	Mr. Mark Prein
ICLARM	:	Dr. Daniel Pauly; Dr. Roger S.V. Pullin

## Objectives

- To identify and quantify the effects of major variables affecting production in aquaculture ponds.
- To develop methods applicable to developing countries for monitoring and increasing yields in fishponds, especially in those fed with organic residues and agricultural by-products.
- To understand the flow of nutrients through the autotrophic and heterotrophic food webs to target organisms.
- To optimize the effect of the available inputs (organic and mineral nutrients, fishes stocked) on fish growth and yields.
- To increase yields above the currently attained plateau in ponds without supplemental feed.
- To develop management techniques for aquaculture in developing countries.
- To develop diagnostic techniques, kits and instrumentation.
- To train scientists from developing countries in these techniques.

## Results

ICLARM's main role in this subproject is collaboration with project researchers in the analysis and interpretation of aquaculture datasets by multivariate techniques.

During 1988, further work was undertaken on augmenting a large dataset from experimental and commercial farms, upon which the final analysis will be performed. This required painstaking work on standardizing and digitizing the large datasets assembled in 1987. The bulk of this work was done by Dr. Ana Milstein at the Dor Fish and Aquaculture Research Station, Israel, and Mr. Mark Prein at the University of Kiel working under the supervision of Dr. Daniel Pauly. The final dataset is expected to be completed by mid-1989, after which analysis will proceed, leading to a final and detailed technical report.

The approaches and methods developed through this collaboration are already bearing fruit and being applied elsewhere. Mr. Mark Prein visited Peru in September 1988 to work on data analysis from fish culture in sewage oxidation lagoons, funded by the World Bank. Publications using these multivariate techniques are also increasing; for example, two papers published in 1988 in the proceedings of the Second International Symposium on Tilapia in Aquaculture (ISTA II): "A multivariate model of tilapia growth applied to seawater tilapia culture", by K.D. Hopkins, M.L. Hopkins and D. Pauly; and "A comparison of overall growth performance of tilapia in open waters", by D. Pauly, J. Moreau and M. Prein.

Mark Prein and Ana Milstein published a paper, "Techniques for handling large datasets" in *Aquabyte* and J.M. Vakily, another colleague from IFM published another *Aquabyte* paper on "Microcomputer use in experimental aquaculture" the first of a series of articles. Thus the project is helping to spread awareness of these very powerful techniques.

**Subproject 2** : Utilization of Tilapia Genetic Resources for Expansion of Aquaculture

**Cooperating Institutions** : Agricultural Research Organization (ARO), Israel; Zoologisches Institut und Zoologisches Museum, University of Hamburg (i!U); Institute of Aquatic Biology (IAB), Achimota, Ghana; other African and Asian research institutions (to be identified)

**Duration** : 1986-ongoing

**Key Personnel**

ARO	:	Dr. Gideon Hulata
HU	:	Prof. Wolfgang Villwock
IAB	:	Dr. Martin A. Odei; Mr. Joseph K. Ofori; Mr. J.N. Padi
ICLARM	:	Dr. Roger S.V. Pullin; Dr. Ambekar E. Eknath; Ms. Josephine B. Capili

## Objectives

- To conduct a literature survey on commercially important species, particularly *Oreochromis niloticus*.



- To contact key persons with experience on native populations of tilapia in Africa.
- To establish working relations with African institutes that can participate in the collection and evaluation of resources.
- To select sites for collection of genetic material on the basis of gathered information.
- To assess the needs of selected African countries, with reference to improving their capability for culture of tilapia in general and upgrading their stocks in particular.
- To investigate stock diversity by comparison of morphometric and meristic characters with reference collections and published descriptions.
- To investigate genetic variability using electrophoretic and other analytical techniques.
- To design methods for evaluation of production traits.
- To train African personnel in tilapia genetics research, culture and management.

## Results

The main product of 1988 was the publication by ICLARM of the proceedings of the Workshop on Tilapia Genetic Resources for Aquaculture, 23-24 March, held in Bangkok, Thailand.

This is a unique compilation of information on tilapia genetic resources and the research requirements for their documentation, conservation and utilization in aquaculture. It has been widely distributed and a French edition will be published in 1989. ICLARM's other collaborative tilapia genetic research projects (see p. 67 and 71) have relied heavily on the information provided by this publication on sources of pure wild stocks of *Oreochromis* spp. New founder stocks of *O. niloticus* were collected from Egypt (May), and Ghana and Sénégal (October-November) and a new founder stock of *O. aureus* was collected from Sénégal only. For the Sénégal collections, Drs. Pullin, Eknath and Villwock were guided by Dr. D.F.E. Thys van den Audenaerde, Musée Royal de l'Afrique Centrale, Tervuren, Belgium.

All shipments were made in the first instance from African sources to the University of Hamburg, where Dr. Villwock and his colleagues are engaged in research to develop serological identification kits for tilapias, through immunological research. The new stocks are already being used in research programs at the University of Hamburg and in the Philippines (see p. 67). A new shipment of *O. niloticus* from the IAB to Israel was also made successfully in 1988.

Further training was provided in 1988 for IAB staff in Israel (Mr. J.N. Padi) and in the Philippines (Mr. J.K. Ofori). For the latter, ICLARM organized a comprehensive tour of tilapia hatcheries and farms in Luzon and a visit to tilapia cage culture sites in Lake Sebu, Mindanao. Mr. Ofori also received instruction in microcomputer techniques for fish growth and mortality data analysis.

In 1988, Dr. Gideon Hulata (ARO) and Dr. R.S.V. Pullin (ICLARM) visited the IAB to advise on development of the Fish Culture Station at Akosombo. It is clear that this station requires substantial assistance in order to realize its full potential. ICLARM will assist IAB whenever possible in making new proposals for its development.

Towards the end of the year, ICLARM was fortunate to receive a visiting scientist, Mr. Rainer Froese of the Institut für Meereskunde at Kiel University. Mr. Froese is a fisheries scientist well versed in the establishment of relational databases (see also p. 44). This afforded an opportunity to plan the establishment of a tilapia strain registry for wild and cultured populations and a database on relevant museum collections. These will contain pictures as well as data and text. Further discussions between Mr. Froese, ICLARM and Hamburg University staff and tilapia experts such as Dr. Thys van den Audenaerde will be held early in 1989 so that rapid progress can be made on this - one of the main recommendations of the 1987 Workshop on Tilapia Genetic Resources for Aquaculture. Documentation of genetic resources is the essential prerequisite before conservation and utilization can proceed in harmony.

<b>Project Title</b>	:	Rice-Fish Farming Systems Research
<b>Cooperating Institutions</b>	:	The International Rice Research Institute (IRRI) and its Asian Rice Farming Systems Network (ARFSN); the Freshwater Aquaculture Center of Central Luzon State University (FAC/CLSU); funding is from the Asian Development Bank, supplemented by additional funds for workshop organization from the International Development Research Centre (IDRC) of Canada and provision of an Associate Expert by the Ministry of Development Cooperation of the Government of the Netherlands.
<b>Duration</b>	:	August 1987 to February 1990
<b>Key Personnel</b>	FAC/ CLSU IRRI/ ARFSN ICLARM	: Prof. Ruben C. Sevilleja; Dr. Rodolfo G. Arce : Dr. Virgilio R. Carangal; Dr. N.F.C. Ranaweera : Dr. Catalino R. dela Cruz; Mr. Anne A. van Dam; Dr. Roger S.V. Pullin

## Objectives

- To establish collaborative research on rice-fish farming between national, regional and international programs as a means of overcoming the narrowness of previous research on this subject.
- To formulate and refine rice-fish research methodologies to be applied in the development of technology within the Asian Rice Farming Systems Network (ARFSN)
- To evaluate options for integrating rice and fish production, including concurrent and rotational rice-fish farming, deepwater rice-fish systems and smallholder rice-/backyard fish farms.
- To facilitate training and the exchange of research information and ideas on rice-fish farming among rice and aquaculture scientists in Asia by holding meetings and workshops and distributing publications.
- To develop improved rice-fish farming systems which will increase the productivity and income of Asian rice farmers.

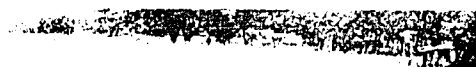
## Results

The planned on-station and on-farm research in the participating countries (India, Indonesia, the Philippines and Thailand) was continued

with new ideas and activities including an orientation on rice-fish culture for Filipino farmers in Nueva Ecija and Pampanga, Philippines, and experiments on a modified rice-fish system with pond refuge at FAC/CLSU.

In the on-station research, eight experiments were conducted, dealing with the improvement of rice and fish culture compatibility. The border method of rice planting, the use of livestock manure with inorganic fertilizers, and fish as biological control of rice pests in rice-fish culture were tested. The growth performance of Indonesian Majalaya strain of common carp (*Cyprinus carpio*) and of selected lines of Nile tilapia (*Oreochromis niloticus*) were evaluated. In two related studies, water management aspects were investigated and FAC/CLSU data on rice-fish culture accumulated since 1976 were analyzed and modelled.

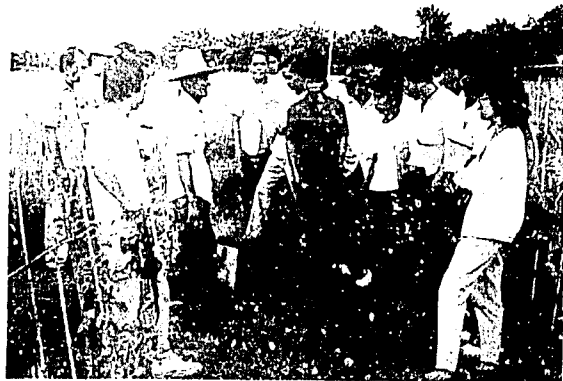
Extrapolated fish harvests from the experiments ranged from 38 to 195 kg/ha per culture period for Nile tilapia and from 85 to 149 kg/ha per culture period of Majalaya carp (with an average culture period of 70 days). It was shown that some inputs, such as livestock manure can increase fish production, but fish recovery remained highly variable and the short duration of the culture period still requires large (20-25 g) fingerlings to be stocked to produce harvest attractive to farmers.



An on-farm research site in Guinba, Nueva Ecija, Philippines.



Farmer-to-farmer discussions on rice-fish farming in Maragol, Muñoz, Nueva Ecija, Philippines.



Vegetables (beans, taro) as additional crop in rice-fish system.



These constraints seem to be brought about by the conventional design of rice-fish systems with shallow trench refuges. A modified refuge systems, consisting of a small pond (about 10-15% of the rice-fish plot, 1 m deep) connected to the rice field, would facilitate fish stocking before transplanting and the fish could be retained in the pond after the rice harvest. This improved refuge system is now being tested both on-station and on-farm. It is expected to allow better fish recovery and a longer culture period leading to higher production. Economic analysis (including the effects on rice production) will show whether the system can lead to higher income for the farmer.

In the Philippines, the experimental site at FAC/CLSU was further improved. An additional water pump was installed, and a shed for the project workforce was constructed. Pond refuge systems were built adjacent to the rice-fish plots for experimental work.

In all the participating countries, the project coordinated the on-farm research with national programs and the international donors and research agencies involved in rice-fish farming (IDRC and the Overseas Development Administration of the UK). On-farm rice-fish research is now in progress in India (deepwater rice-fish), Indonesia and the Philippines (irrigated systems) and Thailand (lowland rainfed systems). In India, culture trials with important food fish species (*Catla catla*, *Cirrhinus mrigala*, *Labeo rohita*, *Labeo calbasu*, *Cyprinus carpio* and *Puntius gonionotus*) were conducted in the deepwater environment, as well as performance tests on grass carp (*Ctenopharyngodon idella*) and air-breathing fish (*Clarias batrachus* and *Heteropneustes fossilis*). In addition, the ecology of the deepwater rice environment is being studied. First results indicate that *Cyprinus carpio* and *Puntius gonionotus* grow much better than the Indian species.

On-farm research in Indonesia consisted of a study on rice-fish practices in Binong, West Java, and a baseline survey of the on-farm research site. Different rice-fish farming systems will be evaluated after agro-economic monitoring. Small backyard ponds were studied as integral parts of rice-fish farms. In the Philippines, various rotational rice-fish cropping patterns and the use of organic and inorganic fertilizers were evaluated. In northeast Thailand, multilocation testing of rice-fish culture was continued.

The first International Workshop on Rice-Fish Farming Research and Development was successfully held in Ubon, northeast Thailand, on 21-25 March 1988 with the Department of Agriculture of the Government of Thailand. Participating researchers from Bangladesh, Bhutan, China, India, Indonesia, Laos, Malaysia, the Philippines and Thailand reviewed the state-of-the-art in rice-fish farming and discussed plans and methodologies for on-station and on-farm research. In addition, several research institutions and nongovernmental organizations were represented. The proceedings of the workshop will be available in 1989. The workshop was cosponsored by IDRC.

<b>Project Title</b>	:	Research for the Development of Tropical Aquaculture Technology Appropriate for Implementation in Rural Africa
<b>Cooperating Institutions</b>	:	The Malaŵi Fisheries Department (FD); the Bunda Agricultural College and Chancellor College, University of Malaŵi (UM); Ministry of Agriculture, Malaŵi (MOA); other African institutions to be identified; Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ)
<b>Duration</b>	:	Planning phase, November 1985-April 1986; Startup phase, May 1986-October 1986; Main project, November 1986-October 1989 (with provision for extension)
<b>Key Personnel</b>	FD	: Mr. Orton V. Msiska; Mr. Brian B.A. Rashidi
	UM	: Mr. Godfrey Banda; Mr. Fredson J.K.T. Chikafumbwa; Mr. Daniel M. Jamu; Mr. Winston Kadongela; Dr. Owen J.M. Kalinga; Dr. Benson F. Kandoole; Dr. Paul Kishindo; Mr. Jeremy S. Likongwe; Mr. Alfred O. Maluwa; Dr. Davis H. Ng'ong'ola; Dr. Reg Noble
	MOA	: Ms. Ruth Ayoade
	GTZ	: Mr. Ousmène Mandeng
	ICLARM	: Mr. John D. Balarin; Dr. Roger S.V. Pullin; Dr. Kenneth Ruddle

## Objectives

- To develop aquaculture technology appropriate for implementation in rural Africa through a program of cooperative research with African and Asian institutions.
- To train research and teaching personnel from African institutions to strengthen their capabilities for supporting aquaculture research and development.
- To strengthen aquaculture research, training and information exchange activities between African and Asian institutions.
- To provide African cooperating institutions with relevant information for the furtherance of rural aquaculture research and development.
- To publish and disseminate widely the results of all cooperative research and training activities.

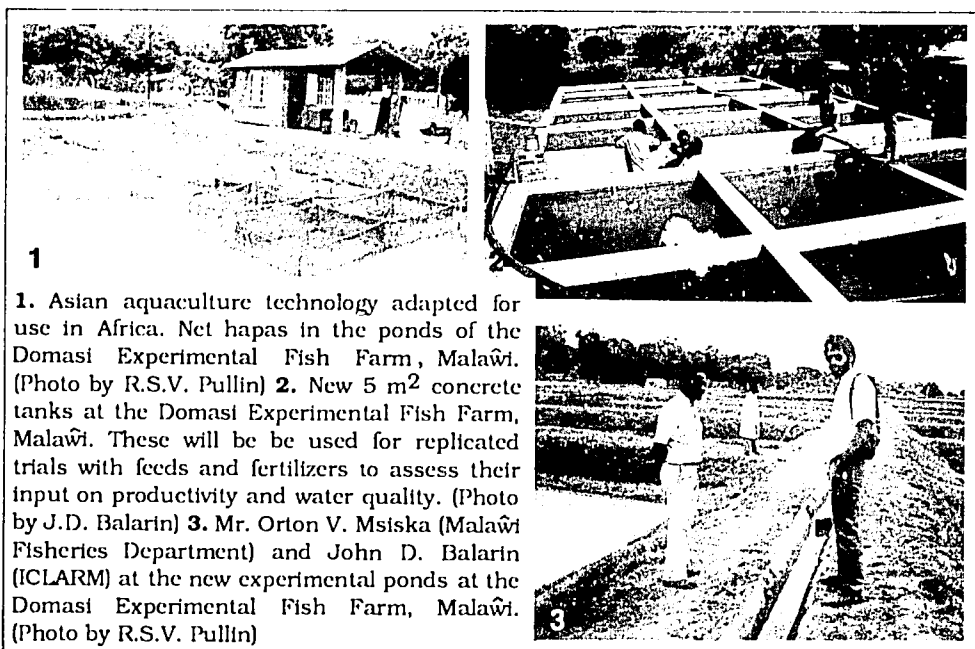
## Results

The construction of office and research facilities was completed at Domasi Experimental Fish Farm (DEFF), 15 km from the town of Zomba, Malaŵi. These facilities include staff offices, a student laboratory, a food store, a storeroom, a garage, and lockable storage compound. The new research facilities consist of 36 x 200-m<sup>2</sup> ponds in a securely fenced area, 36 x 5-m<sup>3</sup> bioassay tanks and 78 x 500-l experimental tanks. Pond construction was done manually. The task force of 100 laborers was drawn from the local community. The workers gained experience in pond building during the 6-month construction period, a skill which may benefit them as aquaculture expands in Malaŵi.

The other new building constructed at the DEFF was the library. This houses the Africa Aquaculture Information Component of ICLARM's Selective Fisheries Information Service, which is coordinated from Manila. Telefax communication, Aquatic Science and Fisheries Abstracts (ASFA) on CD-ROM and a computer linkage to ICLARM's Library in Manila have been installed to facilitate speedier communication and responses to enquiries from African scientists. ICLARM Librarian, Ms. Norma Jhocson, will spend 6 months in Malaŵi in 1989 organizing fisheries information systems and training fisheries librarians. A considerable quantity of scientific literature has been distributed through the project to African researchers and libraries.

These developments have turned the DEFF into one of Africa's leading aquaculture research centers, with 5 ha of ponds designed for well-replicated experiments. The new facilities have made it possible to increase the training of support staff in pond maintenance, seining techniques, fish handling and weighing, net mending and record keeping.

In May, ICLARM signed a cooperative linkage agreement with the University of Malaŵi (UM). The first joint endeavor was the establishment



of a Master's level scholarship scheme. Four students were registered with the Biology Department and one with the Sociology Department at Chancellor College. Their thesis research projects complement the main program underway at the DEFF and they gain valuable hands-on experience. This cooperative linkage agreement has also facilitated a number of collaborative studies with UM staff. ICLARM Visiting Scientist, Dr. Kenneth Ruddle, visited Malaŵi in February and October 1988 to help plan some of these collaborative studies. By the end of the year, 20 joint projects had been initiated and two more are due to start early in 1989. A list of activities is given in Table 2. Data gathered as background information to help in the formulation of these various studies will be used in the context of a monograph to be published by ICLARM. The results of the studies listed in Table 2 will be presented during a project workshop planned for September 1989. This will be open to participants and observers from other groups. The UM link also facilitated a lively series of seminars during 1988 each with over 30 participants. The topics presented are listed in Table 3.

The project attracted many visitors to the DEFF and UM during 1988 including staff and representatives of FAO; the International Development Research Centre (IDRC), Canada; GTZ, Eschborn; the Overseas Development Administration (ODA), UK; the United States Peace Corps Volunteers and the United States Agency for International Development (USAID).

In February 1989, ICLARM's staff member Dr. Barry A. Costa-Pierce will transfer from Indonesia to Malaŵi to join the project team. He will undertake part of the project's research activities in collaboration with the FD and UM; supervise some of the Master's research projects; and contribute to aquaculture biology teaching at the UM.

Table 2. List of collaborative aquaculture research activities being undertaken in Malaŵi between the Fisheries Department, the University of Malaŵi and ICLARM.

A. Socioeconomic Studies

	Researchers	Study Title	Starting Date
1.	Godfrey A. Banda	Socioeconomic Survey of Fish Farmers in Malaŵi	May 1987
2.	Kenneth Ruddle and John D. Balarin	The Development of Small-Scale Aquaculture and Integrated Farming Systems in Africa: A Case Study of Malaŵi	May 1987
3.	Godfrey A. Banda, Reg Noble, Jeremy S. Likongwe and Owen J.M. Kalinga	An Inventory of Fish Farmers in Malaŵi	May 1987
4.	Godfrey A. Banda and Ousmène Mandeng	Implications of Social and Economic Factors for Fish Farming in Zomba District, Malaŵi	Feb 1988

Continued



Table 2. (Cont.)

	Researchers	Study Title	Starting Date
5.	Godfrey A. Banda	Farm Household Decision-Making with Respect to Fish Farming in Zomba District, Malaŵi	Apr 1988
6.	T. Martin Williams, Kenneth Ruddle, Orton V. Msiska and John D. Balarin	Land Capability Study for Aquaculture	Feb 1988
7.	Reg Noble and M. Manda	Analysis of On-Farm Residues Available for Aquaculture	Sep 1988
8.	Benson F. Kandoole, Paul Kishindo and Maxwell M. Mkwezalamba	An Economic Analysis of Fish Farming Households in Zomba District, Malaŵi	Nov 1988
9.	Ruth B. Ayode	The Nutritional Status and Role of Fish in Nutrition in Farm Households in Zomba District	Feb 1989
10.	Owen J.M. Kalinga	A Socioeconomic History of Fish Farming in Malaŵi	Aug 1988
11.	Graham Mills	The Entrepreneurial Role of Women in Integrated Fish Farming	Feb 1989
12.	Kenneth Ruddle, Orton V. Msiska and John D. Balarin	Modelling of Integrated Farming Systems	Feb 1987
13.	Jeremy S. Likongwe	Analysis of the Mechanisms of Informal Extension and the Rate of Innovation Diffusion among Small-Scale Farmers and Fish Farmers in Lilongwe, Dedza and Ntcheu Districts, Malaŵi	Aug 1988
14.	Davis H. N'gon'gola	Analysis of the Socioeconomic Factors Impeding Acceptability of Fish Cultured in Waste-Fed Systems	Aug 1988
B.	<i>Biological Studies</i>		
1.	John D. Balarin, Orton V. Msiska and Peter Edwards	Grass and Madeya (Maize Bran) as Pond Inputs in Malaŵi	Apr 1988
2.	Daniel M. Jamu	Farm By-Products, Ash and Compost as Pond Fertilizers	Jul 1988
3.	Fredson J.K.T. Chikafumbwa	Herbivory in Selected Malaŵian Tilapias and the Use of Grass as Feed in Ponds	Jul 1988
			Continued

Table 2. (Cont.)

	Researchers	Study Title	Starting Date
4.	Alfred O. Maluwa	Reproductive Biology of <i>Oreochromis shiranus shiranus</i> Under Farm Conditions	Jul 1988
5.	Winston K. Kadongola	Cereal By-Products, Madeya (Maize Bran) as Supplemental Fish Feeds in Ponds in Malaŵi	Jul 1988
6.	T. Martin Williams	Turbation of Pond Soils as a Method of Increasing Productivity	Dec 1988
7.	Orton V. Msiska	A Synoptic Review of the Biology and Culture of <i>O.shiranus shiranus</i> and <i>O.s. chilwae</i>	Jun 1988
8.	Brian A.A. Rashidi	A Synoptic Review of the Biology and Culture of <i>Tilapia rendalli</i>	Jun 1988

Table 3. Seminars held at the Biology Department, Chancellor College, University of Malaŵi 1988, through the ICLARM-GTZ African Aquaculture Project in collaboration with the Fisheries Department and the University of Malaŵi.

Date	Topics	Presented by
15 Aug	Aquaculture Production Networks for Common Carp and Tilapia in Indonesia	Dr. Barry Costa-Pierce
10 Oct	Large-Scale Integrated Farming Systems in S.E. Asia, with Particular Reference to South China	Dr. Kenneth Ruddle
27 Oct	Herbivory in Selected Malawian Tilapias	Mr. Fredson J.K.T. Chikafumbwa
	Farm By-Products as Pond Fertilizers in Malaŵi	Mr. Daniel M. Jamu
	Cereal By-Products as Supplemented Fish Feeds in Ponds in Malaŵi	Mr. Winston K. Kadongola
	Reproductive Biology of <i>Oreochromis shiranus shiranus</i>	Mr. Alfred O. Maluwa

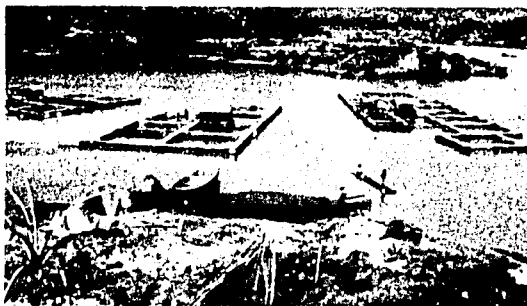
<b>Project Title</b>	:	Development of Aquaculture and Fisheries Activities for Resettlement of Families from the Saguling and Cirata Reservoirs, West Java, Indonesia
<b>Cooperating Institutions</b>	:	Institute of Ecology (IOE), Padjadjaran University; Indonesian State Electric Company (PLN); West Java Provincial Fisheries Agency and its Technical Management Unit (UPTD) for Saguling and Cirata; with funding from the World Bank
<b>Duration</b>	:	July 1986 to January 1989; extended to June 1989
<b>Key Personnel</b>	IOE	: Prof. Dr. Otto Soemarwoto; Ir. Gelar Wiraatmadja; Drs. Rusydi Kotanegara
	UPTD	: Mr. Pepen Effendi
	PLN	: Mr. Sutandar Zainal
	ICLARM	: Dr. Barry A. Costa-Pierce, Dr. John L. Munro, Dr. Catalino dela Cruz and Prof. Harlan C. Lampe

## Objectives

- To identify the appropriate aquaculture and fisheries methods for the resettlement of 3,000 families; 1,500 each from the Saguling and Cirata Reservoirs.
- To establish and conduct research on various aquaculture systems with potential for large-scale job creation among displaced persons.
- To provide technology transfer, extension and training advice, and scientific training of selected staff at Asian centers of excellence.
- To complete a comprehensive aquaculture and fisheries development plan for these reservoirs.

## Results

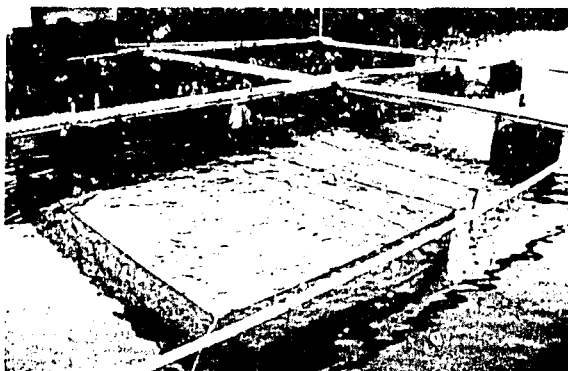
Reservoir floating net cage aquaculture has been a notable success in the Saguling Reservoir, and continued to expand rapidly in 1988 despite a prolonged 15 m drawdown that was needed to fill the new, downstream Cirata Reservoir. By the end of October, 1,235 floating 7 x 7 m net cage units were operating and total aquaculture fish production reached 2,044 t. Fish production from Saguling now supplies more than 20% of the total inland fish entering the Bandung district, an area with a population of over 3 million. The goal of the project to resettle 1,500



Floating net aquaculture in the Saguling Reservoir, West Java, Indonesia. This photograph was taken during a period of draw down when Saguling water was used to fill the adjacent Cirata Reservoir.



Feeding common carp (*Cyprinus carpio*) fingerlings in a floating net unit.



Red tilapias in net cages: the reservoirs can be used for lake-based tilapia hatchery/nursery systems and for tilapia growout, making good use of the plankton as natural feed.

All photos by B.A. Costa-Pierce.

families in aquaculture, fisheries and related occupations in Saguling has nearly been reached, with 1,222 families reportedly involved in these activities by October. Aquaculture development in the new Cirata Reservoir was developing as rapidly with 58 net cages, and over 400 families involved in capture fisheries and aquaculture.

In 1988 the project accomplished major research projects in reservoir capture fisheries and aquaculture. The Saguling Reservoir was characterized as having unusually poor capture fisheries. Saguling is dominated by small populations of native, carnivorous cyprinids (*Hampala macrolepidota*) whose food items mainly comprise benthic insects, fish, gastropods and detritus. An innovative program of seeding Indonesian reservoirs with a freshwater clupeid imported from Thailand to occupy the empty pelagic niche was proposed. Two study missions to Thailand were undertaken by project scientists. Findings were compiled in a comprehensive report on the Thai freshwater sardine (*Clupeichthys pesamensis*), which was circulated to international fisheries experts and organizations for evaluation. Importation was approved by national authorities and a large majority of experts consulted. The fish will be seeded into Saguling in 1989.

Aquaculture research produced improvements in hatchery, nursery and grow-out technologies for common carp. Research results will be used to develop a management plan for a new and more efficient production network for common carp aquaculture in the project area, incorporating and coordinating aquaculture production systems.

Improved methods for increasing common carp fry (1-3 cm) production in traditional, land-based Indonesian hatcheries from the present 50-100/m<sup>2</sup> to 200-350/m<sup>2</sup> were demonstrated and transferred to farmers. Duoculture of common carp (*Cyprinus carpio*) in fine-mesh nursery hapas and Nile tilapia (*Oreochromis niloticus*), stocked on the outside of the hapas in floating net cages to clean the nursery nets and provide an additional fish crop, was successfully demonstrated. Culture in floating net cages using 40% common carp and 60% tilapia at 1.0 kg/m<sup>3</sup> yielded 4.8 kg/m<sup>3</sup> at food conversion ratios (FCR) of 1.2 over 90 days compared with monoculture of carp at 3.7 kg/m<sup>3</sup> and FCR 1.7. Optimal fish density and feeding rates for high production in grow-out cages were determined. A stocking density of 1.0 kg/m<sup>3</sup> and feeding a 26% protein feed to satiation three times a day was found to be the most cost-effective system.

Modern aquaculture technology for rearing Nile tilapia currently used in the Philippines was documented by project scientists and successfully transferred to culturists in the Saguling Reservoir in 1988. Hapa hatcheries using 'insert' broodstock nets were stocked at a female to male ratio of 3:1 with a biomass of 0.5 kg/m<sup>3</sup> with males 100-300 g and females 300-500 g and produced 7-15 fry/m<sup>2</sup>/day during a 5-month period. Grow-out hapas of 11.5 m<sup>3</sup> were tested in both good and poor water quality, with 5.5-8.2 g/fish stocked at 0.5 kg/m<sup>3</sup>. Nile tilapia reached 150-200 g/fish with a final biomass of 10.2-12.3 kg/m<sup>3</sup> in 89 days at an FCR of 3.1-3.4. Tilapia production and growth rates were not significantly affected by water quality conditions. On-going experiments with tilapia will give further information on optimal stocking rates for grow-out using rice bran or no feed. Initial results have shown that the Saguling Reservoir has rich blue-green algal populations that will support Nile tilapia with no supplementary feed at a stocking density of 40-50 fingerlings/m<sup>2</sup>.

Results of this and further research will allow the formulation of guidelines for a low-cost reservoir culture system for tilapia. After pilot commercial trials, this technology will be transferred to the Fisheries Agency and to poor farmers in the area in 1989.

<b>Project Title</b>	:	Giant Clam Mariculture Project
<b>Cooperating Institution</b>	:	Fisheries Division, Government of Solomon Islands (GSI)
<b>Duration</b>	:	Indefinite
<b>Key Personnel</b>	ICLARM	: Dr. John L. Munro, Mr. Graham F. Usher (seconded to ICLARM by UK Overseas Development Administration), Mr. Mark H. Gervis (seconded to ICLARM by UK Overseas Development Administration), Mr. H. Govan (UK Voluntary Service Overseas (VSO))
	GSI	: Mr. Hugo Tafea, Mr. Paul Nichols, Mr. Sylvester Diake

## Objectives

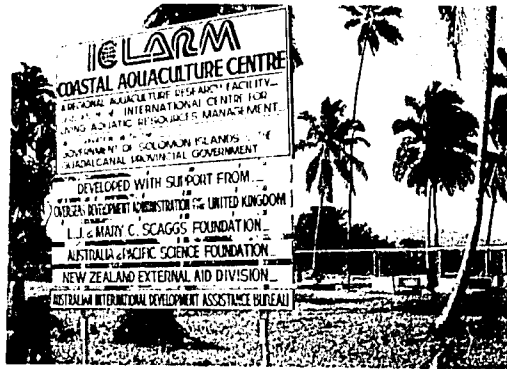
- To test, develop and demonstrate economically viable systems for the cultivation of various species of giant clams.
- To enhance the productivity of giant clams by selective breeding for improved growth or survival or other desirable characteristics.
- To investigate economic, legal and social factors which affect giant clam culture in the South Pacific Region.

## Results

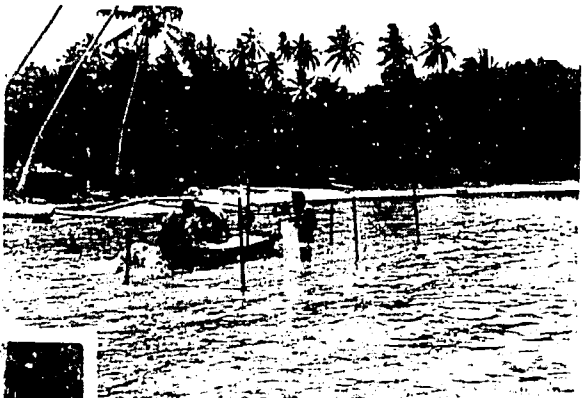
All work has focused on the largest species of giant clam, *Tridacna gigas*. The first major clam spawnings were initiated at the Coastal Aquaculture Centre (CAC) near Honiara, Solomon Islands, in November 1987, just over one year from the acquisition of the site and the start of construction. A further five cohorts of clam spat were obtained during 1988. Settlement rates declined in the latter half of the year and no spawnings were obtained after heavily overcast conditions and monsoonal rains started in November. Part of the first cohort of giant clams, spawned on 6-7 November 1987, and averaging about 2 cm in length were stocked into the ocean nurseries at the end of June. The nurseries are small wire mesh cages with cement bases intended for emplacement at a depth of 2-3 m on the CAC's fringing reef. Additionally, construction was started on a large intertidal pond which will be used as a nursery area.

By the end of the year approximately 12,500 3-13 month old *Tridacna gigas* spat were in the ocean nurseries and a further 30,000-40,000 spat (<15 mm shell length) in the land-based nurseries and raceways.

Entrance to the Centre, listing the sponsors of its activities.



Subtidal ocean nursery cages for spat > 20 mm.



First village operated ocean nursery at Ghulavu, Guadalcanal - October 1988.



Collecting the products of induced spawning from giant clam (*Tridacna gigas*) broodstock.

Several experiments were carried out in the raceways. Horticultural fertilizers had a marked positive effect on the growth of spat while high stocking densities inhibited growth suggesting that the availability of nutrients could be a limiting factor. The correct combination of stocking densities and fertilizer dosage will clearly optimize output from the system.

The Mozambique tilapia, *Oreochromis mossambicus*, has proven particularly useful for controlling algal overgrowths in tanks, the ready availability of fry being a major factor. They adapt readily to seawater.

Serotonin was used as a spawning stimulant for some of the clams on several occasions but these clams produced sperm only. All egg production to date has been spontaneous and appeared to be synchronized between tanks and between broodstock in the sea. Whether the stimulus is a water-borne chemical or is controlled by ambient conditions such as light is not yet clear.

Results from the first year of operations suggest that the main spawning period might be located in the first half of the year but this observation might have been influenced by heavy rains in the latter half of the year, as there appears to be a definite correlation between sunny days and spawning activity; probably related to the activity of the symbiotic algae within the tissues of the clams. Improved methods for judging the degree of maturity of the gonads and for induction of spawning are still required.

The first five cohorts of larvae were reared under extensive conditions using open outdoor tanks supplied with filtered seawater. Larvae were fed with mixed cultures of microalgae obtained by fertilizing raw seawater and filtering off the smallest components of the resulting blooms. The cohort obtained in October 1988 was reared under more intensive culture conditions in two 1.6-t culture tanks in the newly-completed wet laboratory and the larvae fed with axenic cultures of microalgae and routinely rinsed in antibiotic solutions. This appeared to give better settlement rates from a relatively limited number of eggs.

For most of the cohorts, survival averaged 40-55% per month in the 3-6-month-old clams in the raceway system, improving to over 70% per month in the later stages. Growth rates were also less than desired and dramatic improvements in growth and survival appeared to take place when the spat were transferred to ocean nursery cages on the CAC's reef, at around 3 m depth. The relatively poor performance in the raceways might be the result of their shallowness and consequently high light intensities or might be attributable to the problem of heavy metal contamination of the seawater by one of the pumps in the early stages. Improvements in the environmental conditions in the raceways and in the management of the system will be implemented in 1989 with the objective of proving or disproving the efficacy of the canvacon raceways for giant clam cultivation.

A basic design for the ocean nursery cages has been developed using a light ferrocement pad measuring 1.8 m x 0.9 m, with a semicylindrical framework covered by 1.25 cm galvanized wire mesh. These appear to be durable and inexpensive and can be made relatively easily. The cages are maintained in raceways for a few days until the juvenile clams have attached themselves directly to the cement base and then transferred to the ocean. Growth of around 1 cm shell length per month is being attained, coupled with very high survival rates.

The first village-operated giant clam nursery was established in October on a trial basis. Juveniles were initially maintained in a shallow water exclusion cage. However, small predatory muricid snails caused heavy mortality until the clams were transferred to a standard ocean nursery cage. Numerous other villagers have expressed interest in participating in these trials and a further 6-10 village nurseries will be activated during 1989. This aspect of the work is funded by a £5,300 grant from the VSO organization.

Construction of a large (75 m<sup>2</sup>) intertidal pond at the CAC is nearing completion. This will permit juvenile giant clams to be reared in the intertidal zone on the CAC's moderately exposed littoral beachrock platform or, alternatively, by closing the sluices the clams might be maintained at a constant 1m depth in a pool flushed by the waves and tides. Tests of this system will be initiated early in 1989.



<b>Project Title</b>	:	Coastal Aquaculture Network
<b>Cooperating Institutions</b>	:	James Cook University of North Queensland, Townsville, Australia (JCUNQ); Fisheries Research Branch, Department of Primary Industry, Brisbane, Queensland (DPIQ); University of Papua New Guinea, Port Moresby (UPNG); Silliman University, Dumaguete City, Philippines (SU); Marine Sciences Institute, University of the Philippines, Quezon City (UP); Fisheries Division, Ministry of Agriculture and Fisheries, Suva, Fiji (FDF); Fisheries Division, Ministry of Natural Resources, Honiara, Solomon Islands (FDSI); Overseas Development Natural Resources Institute, London, England (ODNRI); University of Newcastle-upon-Tyne (UNT); Center for Oceanological Research and Development, Jakarta, Indonesia (CORD); Fisheries Division, Tarawa, Kiribati (FDK); Fisheries Division, Apia, Western Samoa (FDWS) and the Micronesian Mariculture Demonstration Centre, Koror, Republic of Palau (MMDC)
<b>Duration</b>	:	Indefinite
<b>Key personnel</b>	ICLARM :	Dr. John L. Munro Ms. Cathreena M.T. Gervis

## Objectives

- To enhance and promote international collaboration in coastal aquaculture by creating networks of interested institutions and individuals.
- To develop participating research groups concerned with specific organisms or aquaculture techniques and facilitate the rapid exchange of information and results by newsletter and meetings.
- To promote exchange visits between participating institutions.

## **Results**

The first step in the creation of the Coastal Aquaculture Network (CAN) was to absorb the existing membership of the International Giant Clam Mariculture Project into the new Network and rename it the "Giant Clam Research Group". This group has thirteen institutional members and the mailing list for "Clamlines", the Group's newsletter, now includes over 100 individuals. Two issues of the newsletter were published during the year.

The CAN has a small pool of funds to finance visits to participating institutions to do collaborative research on topics of prime interest. The first recipient of support within the Giant Clam Research Group was Mr. Paul Southgate of James Cook University who spent two months at the CAC to test the utility of micro-encapsulated foods for the rearing of giant clam larvae.

# INFORMATION PROGRAM

## Background

ICLARM's information activities have two thrusts - services and research. As detailed at length in ICLARM's 1988-1992 five-year plan, the objectives of these two thrusts are to improve information availability and access on the one hand and to improve the quality and quantity of information on the other.

In past years, ICLARM has campaigned on both fronts, not only pointing out the need to improve access to information but also doing just that through increasing the scope and size of the Information Department of Naga, the free ICLARM Quarterly; distributing some 300 copies of ICLARM's technical publications free; and promoting the use of secondary literature (abstract journals, etc.) and information services. On the quantity and quality front we have been assisting in the production of *Asian Fisheries Science*, the journal of the Asian Fisheries Society; and undertaking research miniprojects to investigate the nature of tropical fisheries research publications and their use. Such data are required if we are to help improve timeliness, access and quality of information available to researchers - by drawing attention to the deficiencies in the system and suggesting ways to remedy them.

## Progress of Work

### *Information services*

With regard to services, 1988 saw the revitalization of ICLARM's Selective Fisheries Information Service, funded by the International Development Research Centre (IDRC) of Canada. The Service ran from April 1984 to March 1987 under IDRC sponsorship. When the project lapsed, we continued aspects of the Service until April 1988, when full operations began again. The new Service is an interesting one, incorporating two novel aspects - preparation of minireviews that describe the development and directions of the literature on a given subject and refer the reader to important papers and contacts; and a user-pays system. Some of the minireviews are published in Naga and the limited feedback we have received suggests that they are appreciated. The user-pays system is operating, but it is too early to foresee the future role of such a service in a developing-country setting. Details of the project are on p. 99.

The other major service is ICLARM's publishing activity. From sales, library exchange and free issue, the total number of books in the technical series (now numbering seven) distributed since the first publication in 1980 is over 80,000.

Significant publications in the technical series produced in 1988 include: the proceedings of *The Second International Symposium on Tilapia in Aquaculture*, *Tilapia Genetic Resources in Aquaculture* (Studies and Reviews series), *Research and Education for the Development of Integrated Crop-Livestock-Fish Farming Systems in the Tropics* (Conference Proceedings series) and *Bivalve Mollusc Culture Research in Thailand* (Technical Reports series).

During the year, the popular *Hatchery Manual for the Common, Chinese and Indian Major Carps* was reprinted.

Distribution of *Naga*, *The ICLARM Quarterly* (formerly the *ICLARM Newsletter*) from the first issue in July 1978 is more than 132,000 copies. Circulation at the end of 1988 was 2,600 of each issue.

ICLARM also edited and produced *Fisheries Education and Training in Asia: Workshop Proceedings* and two issues of the Asian Fisheries Society's journal, *Asian Fisheries Science*. The Center, which hosts the Society's Secretariat, handles its editorial and publishing functions.

*Book exhibits.* In 1988, the Center's publications were exhibited at the Philippine Center for International Trade and Exhibitions Book Fair (courtesy of the Philippine Information Agency), Manila, Philippines, 20-28 February; Il Mare Libreria Internazionale First International Exhibition of Books, Videos and Maritime Publishing, Naples, Italy, 5-12 June; Friends of the Philippine Council for Aquatic and Marine Research and Development Collection, Los Baños, Philippines, 30 June; and the Frankfurt Book Fair, Federal Republic of Germany in October.

*Contributions.* The number of items published or in press by ICLARM staff and in the Center's technical series during 1988 was 94. The total number of contributed items since ICLARM's first output in 1975 is now 502.

Finally, in information services, ICLARM's library provides the bibliographic base for SFIS, for ICLARM staff activities and for many external visitors, who conduct their own searches on the CD-ROM (compact disc) version of FAO's Aquatic Sciences and Fisheries Abstracts.

## **Library**

Growth of the ICLARM library collection has continued steadily. By December 1988 there were 8,890 books and monographs; 660 serial titles; 3,770 reprints; 127 microfiche titles; and 2 microfilms.

External researchers and students numbered 2,014 in 1988, a slight increase over the 1987 number, 1,929. External users are finding the CD-ROM version of Aquatic Sciences and Fisheries Abstracts a useful tool. During 1988, some 419 external users undertook literature searches using this tool.

The library's collections are still in the process of computerization, using CDS-ISIS software on microcomputers. Nearly 3,000 records were added during 1988 bringing the total to 9,235 references. These records

consist of books and monographs acquired from 1987, relevant journal articles published in Naga/ICLARM Newsletter from 1978, and various bibliographies. Conversion of the computer files of staff reprint collections from Scimate and Paperbase software into CDS-ISIS added a further 7,431 records although some are duplicates of library records.

Chief Librarian Rosalinda Temprosa and Associate Librarian Norma Jhocson attained their master's degree in library science during the year, with a special problem based on literature needs of ICLARM library users and a thesis on a citation analysis of the theses of master's graduates in economics at the University of the East, respectively.

It should be remembered that information activities are not confined to the Information Program. Like education and training, information is a responsibility of each research program. Four networks are in operation - the Network of Tropical Fisheries Scientists, the Network of Tropical Aquaculture Scientists, the Coastal Aquaculture Network and the Asian Fisheries Social Science Research Network - all supported by newsletters and offering access to relevant literature (see the respective program sections).

### **Research activities**

With regard to research, the main miniproject of the Information Program was a citation analysis of all ICLARM's publications and other contributions to the literature. There were nearly 380 contributions by the end of 1987, cut-off point for the exercise. The idea was to see to what extent the Center's output was used by others.

One sure way to tell if the various publications are read is by citation analysis - counting the number of references to them in other persons' publications. This does not include all those who have read ICLARM articles, but at least those who have subsequently used the information in their own research and recorded the fact in the reference list of their research report. Finding out who cites ICLARM and where, however, was not an easy proposition.

By digging into library and staff collections to search for citations - excluding those in our own articles, of course - of ICLARM publications, we found a total of 2,130 citations and, since we do not have even the majority of the world's recent literature on fisheries (the library specializes only in tropical fisheries), it is assumed that there were even more citations.

The major kinds of publication in which ICLARM citations were found were technical reports (28%) of which FAO was the main publisher, followed by conference proceedings/papers (23%). ICLARM citations in the primary literature comprised 22% of the total.

Some individual ICLARM articles have been cited many times, the highest being 152! Our major conference proceedings volume, on biology and culture of the freshwater fish tilapia, has been cited at least 285 times.

These citations are astounding when compared to those of the average scientific article which is only cited once, while about half of all the primary scientific literature never gets cited at all!

The geographic spread of citations of ICLARM's contributions shows that over half (58%) were in developing-country publications.

ICLARM's major audience is intended to be the researchers who work in the applied fisheries and aquaculture fields in tropical, developing countries. Through them the Center seeks to further the science of fisheries and hence to improve management of fisheries resources and aquaculture. It would appear that ICLARM has been successful in impacting upon research and researchers, both in western and developing countries.

Future documents that add to our knowledge of fisheries in a particular situation and which lead to better management practices, may perhaps not bear any further reference to ICLARM, but the Center is proud that its publications and other contributions have been useful, in some cases we believe critical, in the process of gaining this knowledge.

ICLARM is also assisting the Asian Fisheries Society in a study of the characteristics of the Asian aquatic science research community and literature. Based on the biodata and publication records of about 500 members of the Society, this analysis will provide a description of the academic training and performance of Asian fisheries scientists. The results of the study are intended to become a basic tool for researchers, educators, administrators and publishers.

## ***Training***

The library staff have carried out a number of training activities during the year. These are listed below:

- Lecture-Demonstration of Computerized Library Operation and Database Management System for the Asian Institute of Management (AIM) Library Staff (3), Manila, 21 January
- Extended Technical Assistance on the Use and Application of UNESCO's micro-CDS/ISIS System Software Package for Seaweed Information Center Project Staff (2) at the Marine Science Institute, University of the Philippines, Diliman, Quezon City, 5 and 9 February
- Lecture-Demonstration of Computerized Library Operation and Database Management System for De La Salle University (DLSU) Library Staff (4), 23 March
- Lecture on ICLARM's Information Sources and Services for Three Indonesian Fishery Officers as part of their Training Course on Fish Catching Technology at the Department of Marine Fisheries, University of the Philippines in the Visayas College of Fisheries, Diliman, Quezon City, 22 March
- Lecture-Demonstration on Fisheries Information System and Management for the Participants (6) of the AIBA/SEARCA Training Course on Agricultural Information Management, 22 April
- Lecture-Demonstration of Computerized Library Operation and Database Management Information System for the Participants (15) of the 7th Summer Institute on Information Science, Institute of Library

- Science, University of the Philippines, Diliman, Quezon City, 6 May
- Lecture-Demonstration of ICLARM's Information System and Management for the Participants (33) of the Summer Institute on Managing and Servicing Information, Institute of Library Science, University of the Philippines, Diliman, Quezon City, 20 May
- Technical Assistance to UN-ESCAP Regional Network for Agricultural Machinery (University of the Philippines at Los Baños) in the initial development of their database on agricultural machinery, 29 May
- Lecture on ICLARM's Information Sources and Services for Prawn Farming Development Group (7 Chinese; 1 British) as part of their Technical Study Tour to the Philippines, sponsored by EEC Assistance Programme for Dalian, China, 6 June
- Introduction to Online Searching via DIALOG for a Professor of Library Science, Manila, 6 June
- Fisheries Information System and Management for a Senior Indonesian Fishery Officer, 5 July to 31 August
- Introduction to Electronic Mail System for the Foreign and Local Participants (15) of the Small Industry Information Management (SINFOMAN) Course, University of the Philippines, Institute for Small-Scale Industries, Diliman, Quezon City, 19 October
- Training on the Design of Computerized Bibliographic Database for a Filipino Fisheries Librarian, ICLARM, Manila, 7-18 November
- Online Searching via DIALOG for the Computer Staff (2) of the Technology and Livelihood Information Dissemination Department, Technology and Livelihood Resource Center, Manila, 21-25 November
- On-the-Job Training Apprenticeship for Three Graduating Students (Associate in Computer Science) from Pamantasan ng Lungsod ng Maynila for a total of 120 hours each starting 12 December

## Program Plans

In information services, SFIS will continue in its present form until March 1990, when, subject to funding, the Service may be reduced but will not cease; the Service has become an institution for tropical researchers. There are plans to publish ICLARM's serial holdings list and a 10-year retrospective, indexed listing of bibliographic entries in Naga's Information Department.

Information activities in Africa will begin early in 1989, with the posting of associate librarian Norma Jhocsen to ICLARM's aquaculture project office in Malaŵi. An information service will be set up, initially for aquaculture in southern Africa. First the office library will be established and the holdings computerized using UNESCO's CDS-ISIS software.

In research, in-house miniprojects will continue, including the ICLARM citation analysis and studies on the use of fisheries literature. One study just beginning compares the citation behavior of scientists in two Philippine journals and an overseas journal. It follows the project on reprint use from the same Philippine journals, reported in the 1986

ICLARM Report. Managing editor Letty Dizon will undertake an analysis of citations to these two journals amongst the Philippine literature for her masteral special problem. Together the three studies will provide a new understanding of the status of Philippine scientific publishing.

No staff are yet available to carry out the broader tropical fisheries citation analysis, as called for in 1989 in the five-year plan.

## Meetings Attended

- Developments in Publishing: Market Situation, Marketing and International Situation, Goethe-Institut, German Cultural Center, Manila, Philippines, 14-16 March. (L.B. Dizon)
- Seminar-Workshop on Classification and Cataloguing of Books, Serials, and Non-Book Materials, Manila, 25-27 May. (G.C. Luis)
- Asian Fisheries Society Workshop on Exotic Aquatic Organisms in Asia, Darwin, Australia, 19-21 June. (J.L. Maclean)
- The Philippine Book Industry: Focus on Problems, University of the Philippines College of Mass Communication, 3 September. (L.B. Dizon, member, organizing committee)
- 14th Annual Conference of the International Association of Marine Sciences Libraries and Information Centers (IAMSLIC), Miami, Florida, USA, 2-7 October. (J.L. Maclean and R.M. Temprosa, resource persons)
- First Philippine Micro-CDS/ISIS User's Group Meeting, University of the Philippines, National Engineering Center, Quezon City, Philippines, 3-5 October. (N.I. Jhocson)

## Publications

- Eng, C.T. and J.L. Maclean. 1988. Has scientific research in Asia contributed to Asian fisheries development, p. 5-8. *In* M.M. Joseph (ed.) The First Indian Fisheries Forum, Proceedings. Asian Fisheries Society, Indian Branch, Mangalore, India.
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- Maclean, J.L. and L.B. Dizon, editors. 1988. ICLARM Report 1987. ICLARM, Manila, Philippines.
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- Vega, M.J.M. 1988. Who's working on tilapia and carp diseases? Naga, The ICLARM Quarterly 11(3): 18-19.
- Vega, M.J.M. 1988. Who's working on fish aggregating devices? Naga, The ICLARM Quarterly 11(4): 16.
- Vega, M.J.M. 1988. Who's working on reservoir fisheries - developing countries? Naga, The ICLARM Quarterly 11(4): 17.

<b>Project Title</b>	:	Selective Fisheries Information Service (SFIS) Phase II: Project ADD (Analysis and Document Delivery)
<b>Cooperating Institution</b>	:	International Development Research Centre (IDRC), Canada
<b>Duration</b>	:	2 years beginning March 1988
<b>Key Personnel</b>	ICLARM :	Mrs. Rosalinda M. Temprosa Ms. Georgina C. Luis Mr. Marcos Jose M. Vega

### **Major Objective**

To extend the capabilities of the existing ICLARM Information Program to users in tropical developing countries.

### **Specific Objectives**

- To assist in an advisory capacity in strengthening the information capability of fisheries institutions in developing countries.
- To provide answers to specific questions to researchers working in subject areas in which ICLARM has special expertise -- finfish and mollusc aquaculture, integrated farming, small-scale fisheries and resource management.
- To analyze 50 selected specific topics of the literature built up over the first three years of the SFIS.
- To provide key literature to enquirers.
- To produce bibliographies and minireviews on important topics as identified by trends in enquiries.

### **Results**

The recommencement of ICLARM's Selective Fisheries Information Service (SFIS II) funded by IDRC was first announced in the April 1988 *Naga, The ICLARM Quarterly*. Since then, SFIS II has been republicized through publications in national, regional and international newsletters and through personal contacts. In addition, a new and revised brochure was produced to facilitate publicity.

Project ADD - Analysis and Document Delivery - is a feature added to SFIS II; it refers to the analysis of 50 selected specific topics of the

literature built up over the first 3 years of the service and to the provision of key literature to SFIS enquirers, respectively.

A new policy was also established in SFIS II. IDRC indicated that while it desires to support fisheries research and development work with timely and appropriate information, it is concerned that scientists and researchers in developing countries should be made more conscious about the need to budget for access to information to support their work. Thus, a fee for services was required. We decided to charge the cost of materials and postage plus \$5 in the case of developing-country enquirers, and \$20 for developed-country enquirers. For persons without access to foreign exchange or information-related funds, enquirers are advised they can *exchange* information, which may be reprints or even an essay or photographs of research sites. But no enquiry is left unanswered.

We are carefully monitoring the users' responses so that by the end of the project we can make statements on the usefulness of the user-pays policy.

Under the question-and-answer service component of the project, a total of 146 enquiries from 43 countries/territories were received during the period May to December 1988. Queries from Nigeria were the most numerous followed by the Philippines, then India. An average of 18 enquiries is received each month. Fig. 8 shows the geographical pattern of enquiries received.

From the 146 enquiries, 10% were "user pays"; 70% were still answered free and 15% availed of the exchange procedure from which we received 30 reprints and 5 monographic/technical reports. Requests outside ICLARM's areas of expertise were referred to other appropriate information centers. The remaining 5% were referred to other services.

Table 4 shows that requests for culture systems, and fish biology were the most requested. The next largest groups were general fisheries, then crustaceans. This pattern differs from the initial 3-year phase of the project when tilapia, integrated farming and socioeconomic aspects, respectively, were the most requested subjects.

Table 4. SFIS enquiries by major subject (May 1988 to December 1988).

Topic	No.
General fisheries	23
Culture systems	22
Crustaceans	20
Fish biology	15
Tilapia	12
Molluscs	10
Ecology	8
Socioeconomics	7
Carps	6
Seaweeds	6
Integrated farming	5
Others	32

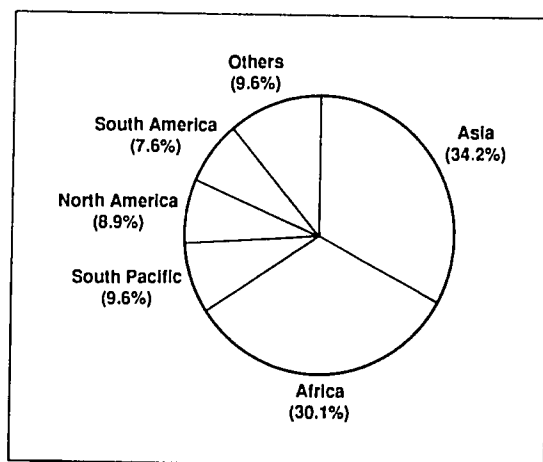


Fig. 8. Geographical spread of SFIS enquiries (May 1988 to December 1988).

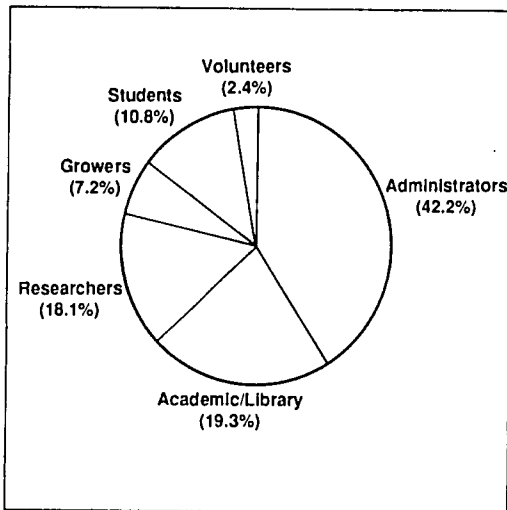


Fig. 9. Position or occupation of enquirers where known (n = 81) (May 1988 to December 1988).

An analysis of occupation or position held by the enquirer was also made. Fig. 9 shows (n = 81) that most of the requests were from administrators, followed by academic/library personnel, researchers, growers, students and volunteers (US Peace Corps and VSO).

Assistance in information use and handling has been provided through participation in local and international conferences, workshops and meetings. Short-term training in fisheries librarianship, online searching and nontechnical library activities was also conducted for various groups and individuals, both local and foreign.

Cooperative information activities have also been strengthened with other specialized information centers like the Brackishwater Aquaculture Information System of the SEAFDEC Aquaculture Department, Seaweed Information Center of the Marine Science Institute of the University of the Philippines and the Indonesian Fisheries Information System.

Fifteen minireviews on various topics have been prepared, six of which have been published in the *Naga*. Prior to publication, each article is sent to two experts identified during the literature surveys.

### *Publicity and Information*

SFIS brochure, No.5 May 1988. Total 2,000 copies

Questionnaire card. Total 2,000 copies

ICLARM's Selective Fisheries Information Service 1988-1990. *Naga*, The ICLARM Quarterly 11(2): 16. 1988.

ICLARM's Selective Fisheries Information Service 1988-1990. IAMSILC Newsletter 29: 12. 1988.

ICLARM's Information Service Revitalized. *Aginfo Link* 2(3):2-3. 1988.

ICLARM's Selective Information Service. *ASTINFO Newsletter* 3(4): 9. 1988.

ICLARM's Selective Fisheries Information Service 1988-1990. *BRAIS Newsletter* 3(2):3. 1988.

ICLARM's Selective Fisheries Information Service Renewed for 1988-1990. *IAALD Quarterly Bulletin* 33(3):135. 1988.

ICLARM's Selective Fisheries Information Service. *AFSIB Newsletter* Oct. 1988-Mar. 1989:23-24.

ICLARM's Selective Fisheries Information Service Phase 2. *Ang Mamamalakaya UP KATIG '88*. College of Fisheries, University of the Philippines, Diliman, Quezon City.

# ASIAN FISHERIES SOCIAL SCIENCE RESEARCH NETWORK

## Background

The role of the social sciences in ICLARM's activities builds upon a tradition of concern for the economic and social welfare of the small fish farmers and small-scale fishermen that permeates its programs. Activities in the Resource Assessment and Management Program and the Aquaculture Program have increased in this area and the Asian Fisheries Social Science Research Network (AFSSRN) has continued its leadership of social science research and educational development in Southeast Asia.

The AFSSRN consists of a Network of ten research teams at universities and government agencies. Each of the institutions has made a commitment to the development of social science research and education relating to fisheries. The Network, administered by ICLARM through its Coordinator, Prof. Harlan Lampe, is financially supported by IDRC of Canada and Ford Foundation. It assists the member institutions in developing effective research programs and in professional development.

Among these member institutions are more than eighty active research workers drawn from economics and the other social sciences as well as fisheries and aquaculture science.

The current AFSSRN membership is as follows:

### *Indonesia*

UNDIP                      The Faculty of Economics of the Universitas Diponegoro (UNDIP)

RCCF                      The Research Coordinating Center for Fisheries (RCCF) of the Agency for Agricultural Research and Development (AARD) with three research centers:

- The Marine Fisheries Research Center
- The Fresh Water Fisheries Research Center
- The Coastal Aquaculture Research Center

KEPAS                      The Agro-Ecosystems Research Group of AARD

### *Malaysia*

UPM                      The Department of Resource Economics of the Faculty of Economics and Management of the Universiti Pertanian Malaysia (UPM)

*Thailand*

KU	The Department of Agricultural Economics of the Faculty of Economics and Business Administration of Kasetsart University (KU)
DOF	The Fisheries Economics Section of the Fisheries Policy and Planning Division of the Department of Fisheries (DOF)
PSU	The Faculty of Natural Resources of Prince of Songkla University (PSU)

*Philippines*

UPV	The Social Science Division of the College of Arts and Sciences and the College of Fisheries of the University of Philippines in the Visayas (UPV)
AQD	The Economics section of the Research Division of The Aquaculture Department (AQD) of the Southeast Asian Fisheries Development Center (SEAFDEC)
UPLB	The College of Economics and Management with the Center for Policy Development Studies (CPDS) of the University of the Philippines at Los Baños (UPLB)

**Organization**

The Network established three new teams during 1988. In Indonesia, the team of the Research Coordinating Center for Fisheries (RCCF) draws upon its three research centers with the team leader and five other members coming from the Marine Fisheries Research Center. The Coastal Aquaculture Center has five members and the Fresh Water Center two. The new team is beginning Network research and is receiving strong support from Center Directors as well as from the RCCF director.

Another team has been formed within the Agency for Agricultural Research and Development (AARD) within KEPAS (Kelompok Penelitian Agro-Ekosistem) or the Agro-Ecosystem Research Group. This team has excellent experience in community-linked research programs in agriculture and some work in the coastal zone. The team has provided excellent support in the design and planning of both the small pelagics and "tambak" projects in Indonesia. It is expected that the KEPAS group will continue as an important collaborator in most Indonesian research projects.

The last team to enter the Network is the Prince of Songkla University (PSU) in Haad Yai, Thailand. The early work of the PSU team will be in collaboration with the Kasetsart University (KU) team which is more experienced. PSU provides an important geographic advantage to the Network in addressing both the coastal zone and marine fisheries issues of Thailand.

A new team has also been established in the University of the Philippines at Los Baños.

The Philippine Bureau of Fisheries and Aquatic Resources (BFAR) has been collaborating in research with the SEAFDEC/AQD team. National networking has been initiated by AFSSRN during the year in order to establish more effective links between Network teams and other national fisheries policy, research and extension organizations. The national networking program provides for the participation of non-network members in research development and planning, for the participation of non-members as associates of member institutions in research and for the broad review and dissemination of research results. National seminars and workshops sponsored by Network teams provide the instruments for research planning and review.

## **Progress of Work**

The beginning of Phase III of the Network development has seen a major shift in research emphasis to the management of fisheries and aquaculture systems, which has largely determined the nature of the work during the past year. It has been a period of initiating and designing new and more complex research projects using new methods of analysis. Significant educational and training activities have also been undertaken.

In addition, the Network has been consolidating the reorganization inaugurated in late 1987 as a result of the program review undertaken earlier in the year.

## **Research in process**

AFSSRN research falls into three main categories: 1) marine fisheries management; 2) farming systems and 3) coastal (brackishwater) aquaculture management. Under the new Network program, research has begun in only the first two areas while projects will soon be started in coastal aquaculture management and additional projects will soon be underway in marine fisheries management and farming systems (see Program Plans, p. 107).

### **Marine fisheries management**

The management of small pelagic fisheries is the focus of a project on the Guimaras Strait between Negros and Panay Islands in the Philippines. The research is on a multispecies multigear fishery of considerable complexity although it is concentrated in a fairly small area.

### **Farming systems**

In Thailand, fieldwork has been completed in the research on aquaculture in northeastern Thailand. This study is the precursor to a more extensive study to be conducted in the central plains on integrated farming.

In Indonesia the initial farming systems study on the integration of fishponds into farm operations and family life has been completed and reported upon in Indonesian. The English language report is forthcoming. This work will be expanded to address questions of the management of integrated farming systems such as rice-fish culture in the new study involving the collaboration of Universitas Diponegoro and The Fresh Water Fisheries Research Center (Balai Penelitian Perikanan Air Tawar).

## Operations

The National Networking activity by AFSSRN was effectively used in May by the Universitas Diponegoro at Semarang, Java. This was the first independently sponsored effort by any team and it brought together a selected group of local officials, fisheries and others, as well as academicians and representatives of the central government. The objective was to present the preliminary analyses of ongoing projects and the results of those just completed for information, review and evaluation. This activity has contributed substantially to expanding the links of researchers among important client groups as well as potential collaborators.

The process of research project appraisal and approval has been made substantially more demanding. While this has increased the work required to prepare an acceptable proposal it has also required much more careful project identification, fieldwork design and selection of analytical methods.

## Projects - Active or soon to be initiated

- The Management of the Small Pelagic Fisheries of Guimaras Strait and Vicinity, University of the Philippines in the Visayas, August 1988
- The Management of Aquaculture Enterprises and Systems in South Sulawesi and the North Coast of Java, Universitas Diponegoro & Research Coordinating Center for Fisheries, March 1989
- The Management of the Large and Small Purse Seine Fisheries of the North Java Coast in the Java Sea, Research Coordinating Center for Fisheries, March 1989
- The Simulation of Operations of Small Prawn Farms, Universiti Pertanian Malaysia, April 1989
- Evaluation of the Impact of Prawn Farming on Coastal Resource Systems, Southeast Asian Fisheries Development Center & Bureau of Fisheries and Aquatic Resources, April 1989



- The Management of the Small Pelagic Fisheries of the East Coast of Peninsular Thailand, June 1989
- Evaluation of the Impact of Prawn Farming on Coastal Resource Systems, Kasetsart University & Prince of Songkla University, April 1989
- The Management of Integrated Fish Farming Operations in Central Thailand, Kasetsart University, April 1989
- The Management of Integrated Fish Farming Operations in West and Central Java, Research Coordinating Center for Fisheries, April 1989

## **Education and Training**

### ***Training***

Three short courses, of eight planned, on management research methods have been offered.

The first course, at the Universiti Pertanian Malaysia, was given in May and dealt with the dynamics of marine capture fisheries and the implications for research. The course introduced participants to computer simulation methods as one way to analyze system dynamics. The computer program "Dynamo" formed the foundation for the analysis of system dynamics.

The course was conducted during eleven working days with three and one-half hours of lectures in the morning, four hours practicum in the afternoon with exercises and assignments being completed at night.

There were twenty-four participants, eighteen from outside Malaysia. The teacher was Dr. Jon Sutinen of University of Rhode Island (URI), Rhode Island, assisted by the Coordinator.

The second course, in Semarang, the site of Universitas Diponegoro, addressed the problems of conducting research on the management of fish farming systems. This course introduced researchers to a range of analytical tools ranging from simple farm budgeting to applications of non-linear programming. The software "Enfin" which is linked to Lotus-123 provided the core tool and an effective framework for introducing new concepts. It provided simple tools of business analysis as well and multiobjective and linear programming. More advanced programming software was also introduced and used by the participants.

There were twenty-one full-time participants of whom nine were from Indonesia. The teacher was Dr. John Gates of URI assisted by the Coordinator.

The third short course, in Haad Yai, Thailand, was the second on fisheries management. The course combined training for economists and biologists alike in stock assessment using the ELEFAN programs developed by ICLARM. In addition, the course presented a concentrated introduction to practical methods of economics research for fisheries management.

There were twenty-one full time participants of whom six were from Thailand. The teachers were Dr. Parzival Copes of Simon Fraser University (SFU), Burnaby, British Columbia, and Mr. Geronimo Silvestre of ICLARM (on leave from the University of the Philippines).

## **Education**

One Network member from Malaysia has just begun doctoral studies at SFU and a second, from the Philippines, has departed but not yet begun his course of studies. Two Network members attending SFU are developing doctoral theses and one is currently involved in the pelagic fisheries project in the Philippines.

Four other Network members are studying for doctorates at universities in the United States and Australia. One member has just returned from the UK with a doctorate.

## **Program Plans**

During 1989 two more short courses on management research methods will be offered; one will relate to aquaculture, in May; and the other to capture fisheries, in October. Two additional courses will be offered in 1990.

Demersal fisheries management will be the subject of research in Thailand. The research is to be directed at the resources in the Andaman Sea although the results on current research may result in a shift to other fishing areas.

A comprehensive analysis of the "tambak" systems of Java and South Sulawesi will be initiated soon. The complexity of the systems involved with small- and large-scale culture operations, with low and high level technologies employed along with the large area to be studied required careful planning and organization. The collaboration of the Coastal Aquaculture Research Center (Balai Penelitian Budidaya Pantai) of the Research Coordinating Center for Fisheries (RCCF), the Universitas Diponegoro and the Directorate General of Fisheries will provide the professional resources for this work. Substantial preliminary work has been done by the research team to develop an information base sufficient to design effective sampling schemes and to manage the field work.

A joint project between Kasetsart University and Prince of Songkla University will also address some questions relating to coastal aquaculture in the south of Thailand.

While research activities will command most Network energies during the ensuing years, a major effort will also be made to advance the National Networking activity, particularly in those countries where it has not yet been initiated.

The Network will continue to promote professional development through graduate education and to assist members in their continued study. The Master of Science program in Fisheries Economics at the Universiti Pertanian Malaysia will continue to be central to this activity.

New members in current member countries will be sought during the coming years. They will be included as research programs and resources permit.

## Reports

Reports of seven studies were completed in 1988. Since the Network began, the following reports, copies of which are available from the Coordinator, have been prepared:

- ECONOMICS OF GIANT AFRICAN SNAIL PROCESSING IN THAILAND. Sarun Wattanutchariya, Banlu Puthigorn & Wunwiboon Garnjanagoonchorn: Department of Agricultural Economics, Faculty of Economics and Business Administration, Kasetsart University, Bangkok, Thailand, 1985
- ECONOMICS OF SHORT-NECKED CLAM PROCESSING IN THAILAND. Sarun Wattanutchariya, Banlu Puthigorn & Wunwiboon Garnjanagoonchorn: Department of Agricultural Economics, Faculty of Economics and Business Administration, Kasetsart University, Bangkok, Thailand, 1985
- ECONOMICS OF GREEN MUSSEL PROCESSING IN THAILAND. Sarun Wattanutchariya, Banlu Puthigorn & Wunwiboon Garnjanagoonchorn: Department of Agricultural Economics, Faculty of Economics and Business Administration, Kasetsart University, Bangkok, Thailand, 1985
- ECONOMICS OF COCKLE PROCESSING IN THAILAND. Sarun Wattanutchariya, Banlu Puthigorn & Wunwiboon Garnjanagoonchorn: Department of Agricultural Economics, Faculty of Economics and Business Administration, Kasetsart University, Bangkok, Thailand, 1985
- MARKETING SYSTEM OF SHELLFISH PRODUCTS. Ruangrai Tokrisna, Somkit Tugsinavisuitti, Sanit Kao-ian & Piti Kantangkul: Department of Agricultural Economics, Faculty of Economics & Business Administration, Kasetsart University (KU), Bangkok, Thailand, 1985
- MARKETING SYSTEM OF FRESH CEPHALOPOD IN THAILAND. Ruangrai Tokrisna, Somkit Tugsinavisuitti, Marut Muangkoe & Sanit Kao-ian: Department of Agricultural Economics, Faculty of Economics & Business Administration, Kasetsart University (KU), Bangkok, Thailand, 1985
- FISH MARKETING IN PENINSULAR MALAYSIA. Mohd. Ariff Hussein, Fatimah Mohd. Arshad, Nik Mustapha Raja Abdullah, Tai Shzee Yew, K. Kuperan, Abu Hassan Md. Isa, & E.T. Gibbons:

Faculty of Economics & Administration, Universiti Pertanian Malaysia, Serdang, Selangor, Malaysia, 1985

- FISH CONSUMPTION PATTERNS IN ILOILO: A CONSUMER PROFILE AND BEHAVIOR STUDY. Benedict C. Posadas, Nida R. Ty & Ebonia B. Seraspe: Social Science Division, College of Arts and Sciences, University of the Philippines in the Visayas, Iloilo City, Philippines, 1985
- SOCIOECONOMICS OF MARKETING PRACTICES OF SMALL-SCALE FISHERIES IN ILOILO. Ma. Luisa E. Mabunay & Antonina Baldevia: Social Science Division, College of Arts and Sciences, University of the Philippines in the Visayas, Iloilo City, Philippines, 1985
- PSYCHOLOGICAL CHARACTERISTICS OF FISHING HOUSEHOLDS IN ILOILO. Nuria B. Catells & Cynthia Ticao: Social Science Division, College of Arts and Sciences, University of the Philippines in the Visayas, Iloilo City, Philippines, 1985
- COMPARATIVE ECONOMIC ANALYSIS OF DIFFERENT SCALES OF PRAWN (*Penaeus monodon*) HATCHERY PRODUCTION SYSTEMS. Danilo C. Israel, Renato F. Agbayani & Dioscoro T. dela Peña, Jr.: Aquaculture Department, Southeast Asian Fisheries Development Center, Tigbauan, Iloilo, Philippines, 1986
- COSTS AND RETURNS OF INDIVIDUAL AND INTEGRATED PRAWN HATCHERY-NURSERY-GROW OUT SYSTEMS: A COMPARATIVE ANALYSIS. Danilo C. Israel & Renato F. Agbayani: Aquaculture Department, Southeast Asian Fisheries Development Center, Tigbauan, Iloilo, Philippines, 1986
- AN ASSESSMENT OF THE CREDIT AND FINANCIAL PROGRAMS FOR THE FISHERY SECTOR, PHILIPPINES, 1985-86. Generoso G. Octavio, Ma. Eden S. Pladozo & Iluminada S. Pamplona: Department of Agricultural Economics, College of Development Economics & Management, University of the Philippines at Los Baños, College, Laguna, Philippines, 1986
- THE ECONOMICS OF AQUACULTURE: THE CASE OF SHRIMP CULTIVATION IN CENTRAL JAVA, INDONESIA. Mudiantono, Johannes Hutabarat & Subjanto: Faculty of Economics, Diponegoro University, Semarang, Indonesia, 1986
- SOCIAL AND ECONOMIC ANALYSIS OF HULBOT-HULBOT FISHING IN ILOILO, PHILIPPINES. Benedict C. Posadas, Ma. Cecilia L. Tarrosa & Tara Ma. Estela C. Alminaza: Social Science Division, College of Arts and Sciences, University of the Philippines in the Visayas, Iloilo City, Philippines, 1987

- MARKET STRUCTURE ANALYSIS OF FISH DISTRIBUTION CHANNELS SUPPLYING METRO MANILA. Enriqueta B. Torres, Isabelita M. Pabuayon & Nerissa D. Salayo: Department of Agricultural Economics, College of Economics and Management, University of the Philippines at Los Baños, College, Laguna, 1987
- AN ECONOMIC ANALYSIS OF OYSTER (*Crassostrea* sp.) FARMING IN THAILAND. Somkit Tugsinavisutti: Department of Agricultural Economics, Faculty of Economics and Business Administration, Kasetsart University, Bangkok, Thailand, 1987
- AN ECONOMIC AND SOCIAL ANALYSIS OF THE SEaweEDS INDUSTRY IN SELECTED AREAS IN THE PHILIPPINE. Benedict C. Posadas, University of the Philippines in the Visayas, Iloilo, Philippines, 1988
- THE ECONOMICS OF AQUACULTURE: THE CASE OF CATFISH CULTURE IN CENTRAL JAVA, INDONESIA. B. Suwardo, Mudiantono, J. Hutabarat, Universitas Diponegoro, Semarang, Indonesia, 1988
- COSTS AND RETURNS ANALYSIS OF DEMERSAL AND PELAGIC FISHING GEARS OF THAILAND. P. Boonchu Wong & A. Lawapong: Department of Fisheries, Bangkok, Thailand, 1988
- STUDI PENDAHULUAN TENTANG MANAJEMEN BUDIDAYA PERIKANAN DI JAWA. Drs. Mudiantono, Ir. Johannes Hutabarat & Drs. Edy Yusuf Agunggunanto: Faculty of Economics, Universitas Diponegoro, Semarang, Indonesia, 1988
- ANALISIS EKONOMI USAHA KOLAM KELUARGA DI JAWA TENGAH. Drs. Mudiantono, Ir. Johannes Hutabarat & Drs. Amie Kusumawardhani: Faculty of Economics, Universitas Diponegoro, Semarang, Indonesia, 1988
- AN ECONOMIC ANALYSIS OF THE GREEN MUSSEL (*Perna viridis*) CULTURE SYSTEM IN THAILAND. Sanit Kao-lan: Department of Agricultural Economics, Faculty of Economics and Business Administration, Kasetsart University, Bangkok, Thailand, 1988
- A REPORT OF A WORKSHOP ON AQUACULTURAL ECONOMICS RESEARCH METHODS (Workshop Report No. 1). Organized by Kasetsart University, Bangkok, Thailand & Asian Fisheries Social Science Research Network/International Center for Living Aquatic Resources Management, Manila, Philippines, 1988

## **ADMINISTRATION AND FINANCE**

### **Board of Trustees**

The Center is administered by a Board of Trustees composed of fifteen members. Two of these members serve on an ex-officio basis, while the others, though affiliated or formerly affiliated with various international and national institutions, serve in their personal capacities. The ex-officio members of the ICLARM Board are the Center's Director General and the highest ranking Philippine government official with direct responsibility for fisheries (presently the Secretary of the Department of Agriculture).

The Board's primary responsibilities are:

- a) to act as the policymaking body of the Center;
- b) to lay down or approve the Center's programs;
- c) to review the finances of the Center and approve an annual budget; and
- d) to review the progress and management of the Center.

The ICLARM Board of Trustees also has several standing committees to assist the Board in carrying out its responsibilities. The Board members elect, from among themselves, members to these standing committees. In 1988, the Board had four standing committees - the Executive Committee, Finance Committee, the Program Committee and the Nominating Committee.

A list of members of the 1988 ICLARM Board of Trustees and the activities and terms of reference of and membership on the 1988 Board Committees follow.

### **Board Membership**

1. Senator Edgardo J. Angara: University of the Philippines - President (1981-1987). Elected to the Philippine Senate in 1987; ICLARM Board member since 1984.
2. Dr. Keishi Amano: Tokai Regional Fisheries Research Laboratory (1950-1975); Tokyo University of Fisheries - Professor (1975-1979), President (1979-1985). ICLARM Board member since 1985.
3. Dr. Martin Bilio: Deutsche Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation) - Head, Fisheries and Aquaculture (1982-Present). ICLARM Board member since 1986.

4. Mr. Carlos G. Dominguez: Secretary, Philippine Department of Agriculture, Secretary (1987 to the present). ICLARM Board member since 1987.
5. Mr. Alban F. Gurnett-Smith: Commonwealth Scientific and Industrial Research Organisation (CSIRO) of Australia - Former Secretary (Research); International Rice Research Institute (IRRI) Board of Trustees - Former Member. ICLARM Board member since 1982.
6. Mr. Roy I. Jackson: International Pacific Salmon Fisheries Commission (1938-1955); International North Pacific Fisheries Commission (1955-1964); Food and Agriculture Organization (FAO) - Director, Fisheries Division (1964-1965), Assistant Director General (1966-1971), Deputy Director General (1972-1977). ICLARM Board member since 1982.
7. Ms. Hannah R. King: Commonwealth Secretariat (London) - Fisheries Officer, Food Production and Rural Development Division. ICLARM Board member since 1986.
8. Ratu Sir Kamisese T. Mara: Prime Minister of Fiji, ICLARM Board Member since 1980.
9. Dr. Gunawan Satari: Padjadjaran University (Indonesia) - Secretary, Board of Professors (June-October 1988); Minister of State for Research and Technology (Indonesia) - Secretary (1988). ICLARM Board member since 1986.
10. Dr. Gunnar Saetersdal: Institute of Marine Research (Norway). Directorate of Fisheries - Professor. ICLARM Board member since 1986.
11. Dr. Ziad H. Shehadeh: Food and Agriculture Organization (FAO) - Fishery Resources Officer (Aquaculture) (1972-1976); ICLARM - Associate Director General and Director, Aquaculture Program (1976-1979), Director General (1979-1982); Kuwait Institute for Scientific Research (KISR) - Program Leader, Mariculture and Fisheries Department (Present). ICLARM Board member since 1979.
12. Dr. Ian R. Smith: ICLARM Director General and Board member since 1985.
13. Dr. James A. Storer: Food and Agriculture Organization (FAO) - Director, Fishery Economics and Institutions Division of the Department of Fisheries (1969-1973); NOAA, US Department of Commerce (1973-1978); US Department of State - Director, Office of Fisheries Affairs, Bureau of Oceans and International Environmental and Scientific Affairs (1978-1986). ICLARM Board member since 1983.
14. Dr. Monkombu S. Swaminathan: India Ministry of Agriculture - Secretary (1979-1980); India Planning Commission - Member (1980-1982); International Rice Research Institute (IRRI) - Director General (1982-1988); International Union for the Conservation of Nature and Natural Resources (IUCN) - President (1984 - Present). Elected ICLARM Board member in 1988.

15. Dr. Klaus Tiews: Institute for Coastal and Inland Fisheries of the Federal Research Center for Fisheries (Federal Republic of Germany) - Director (1968-Present); European Inland Fisheries Advisory Commission (EIFAC) of the FAO - Chairman (1976-1982). ICLARM BOARD member since 1982.

### **1988 Meetings**

In 1988, the Center's trustees held the following meetings:

- Executive Committee Meeting - 15-17 May 1988.
- Program Committee Meeting - 5 December 1988.
- 13th Annual Meeting of the ICLARM Board of Trustees - 6-9 December 1988.
- Nominating Committee Meeting - 7 December 1988.
- Finance Committee Meeting - 7-8 December 1988.

The various actions taken by the Board of Trustees during the above meetings are summarized below:

### **Programs**

- Reviewed the progress and activities of the Center's research programs and declared these consistent with the Center's mandate and Five-Year Plan (1988-1992).
- Established Coastal Area Management as a new major program of ICLARM.
- Renamed the Resource Assessment and Management Program as the Capture Fisheries Management Program.
- Abolished Education and Training as a program in itself to formalize the Center's current practice of incorporating education and training activities under each of the major programs.
- Designated the Asian Fisheries Social Science Research Network (AFSSRN) as a special project under the supervision of the Director General.
- Approved the Center's plan to outpost one of its staff members in Latin America for an initial period of two years to evaluate the feasibility of eventually establishing an ICLARM Latin America office.
- Approved budget allocations for the convening of *ad hoc* meetings of specialists and experts to provide program advice and assistance in the planning for the aquaculture research units and the Coastal Area Management Program.

### **Finances**

- Reviewed 1988 financial performance and declared as satisfactory the Center's financial and budget management.



- Reviewed and accepted the 1987 external auditor's reports.
- Approved a 1989 core expense budget of US\$4,509,663.
- Reviewed the 1990 projected core expenses budget.
- Reviewed the progress of the Center's fundraising activities and prepared strategies for future fundraising efforts.

#### Administration

- Reviewed and took action on the personnel recommendations of the Director General.
- Reviewed ICLARM's relationships with the CGIAR, resource-oriented centers, the ICLARM Support Group and other groups.
- Reviewed the Center's projected need for office space as well as the progress of the Center's plan to construct its own headquarters building.
- Reviewed the issue of ICLARM's legal status within the Philippines.
- Reviewed the recommendations of the AIDAB/USAID Review team and approved the Director General's proposed responses to these recommendations.

#### Board Matters

- Approved, by poll, the election of Dr. M.S. Swaminathan as new ICLARM Trustee in 1988.
- Accepted the retirement from the Board, effective end-1988, of Dr. Klaus Tiews, Dr. Ziad Shehadeh, Ratu Sir Kamisese T. Mara and Senator Edgardo Angara.
- Evaluated the list of potential trustees and approved the invitation of four new trustees to join the ICLARM Board in 1989.
- Approved the renaming of the Finance Committee to Finance and Management Committee.
- Approved that the By-Laws be reviewed.
- Elected the officers of the Board for 1989 as well as the 1989 membership to the Board's various committees.

## 1988 BOARD OFFICERS AND COMMITTEES

### BOARD OFFICERS

Mr. Roy I. Jackson	-	Chairperson
Mr. Carlos G. Dominguez	-	First Vice-Chairperson
Mr. Alban F. Gurnett-Smith	-	Second Vice-Chairperson
Dr. Roger S.V. Pullin	-	Treasurer
Mr. Basilio M. Rodriguez, Jr.	-	Secretary

### BOARD COMMITTEES

#### 1. *Executive Committee*

- Functions:
- To implement and execute the policies and decisions laid down by the Board.
  - To exercise the powers and perform the duties delegated by the Board.
  - To act for the Board between Board of Trustees meetings on matters requiring immediate attention.

Members:

Mr. Roy I. Jackson - Chairperson  
 Mr. Carlos G. Dominguez  
 Mr. Alban F. Gurnett-Smith  
 Dr. Klaus Tiews  
 Ms. Hannah R. King  
 Dr. James A. Storer  
 Dr. Ian R. Smith

#### 2. *Finance Committee*

- Functions:
- To review the external auditor's report and the Center's financial statements and recommend their acceptance by the Board of Trustees.
  - To review budget recommendations made by the Director General.
  - To make budget and financial policy recommendations for adoption by the Board of Trustees.
  - To evaluate the management performance of the Center in relation to policies and budgets established by the Board of Trustees.
  - To evaluate the performance of the external auditors.
  - To review management issues, including personnel matters, appropriate to the Board of Trustees' responsibilities and make recommendations thereon to the Board of Trustees.
  - Other duties and functions delegated to it by the Board of Trustees.

Members:

Dr. James A. Storer - Chairperson  
 Dr. Klaus Tiews  
 Ms. Hannah R. King  
 Dr. Ian R. Smith

### 3. **Program Committee**

#### Functions:

- To receive and review, on behalf of the Board of Trustees, the Director General's annual report on the Center's research, training and information programs.
- To review and evaluate proposed changes in and/or additions to the Center's program structure.
- To review and evaluate the Center's annual and long-term program plans.
- To conduct all of the above functions and duties with due consideration to the Center's mandate and previously established program plans, directions and priorities.
- To review the results of any external reviews conducted of the Center's programs, as well as the Center's responses as proposed by the Director General, to recommendations made by the external reviewers.

#### Members:

Dr. Klaus Tiews - Chairperson  
 Dr. Keishi Amano  
 Dr. Ziad H. Shehadeh  
 Dr. Gunnar Saetersdal  
 Ms. Hannah R. King  
 Dr. Ian R. Smith

### 4. **Nominating Committee**

#### Functions:

- To assist the Board in establishing criteria and procedures for the election of members to fill vacancies on the Board.
- To review and identify potential candidates who meet established criteria.
- To recommend and present to the Board of Trustees a short list of possible members for election to the Board and its subsidiary committees.
- To nominate persons who would be required to serve in the positions of Chairperson, Vice-Chairpersons and Secretary and any other officers as may be deemed necessary by the Board of Trustees.

#### Members:

Mr. Alban F. Gurnett-Smith - Chairperson  
 Dr. Martin Bilio  
 Dr. Gunawan Satari  
 Dr. James A. Storer  
 Dr. Ian R. Smith

## Finances

In 1988, the Center's total revenue rose 19% from US\$3.1 million to US\$3.7 million (Fig. 10). Although amounts in all revenue categories posted growth, the most significant was the 36% or US\$231,000 increase of unrestricted grant revenue the total of which, in 1988, accounted for close to 24% of total revenue (Fig. 11).

This increase in unrestricted grants was primarily caused by two new unrestricted grant donors - the World Bank and Der Bundesministerium für Wirtschaftliche Zusammenarbeit (BMZ), Federal Republic of Germany. The World Bank grant of US\$300,000 was

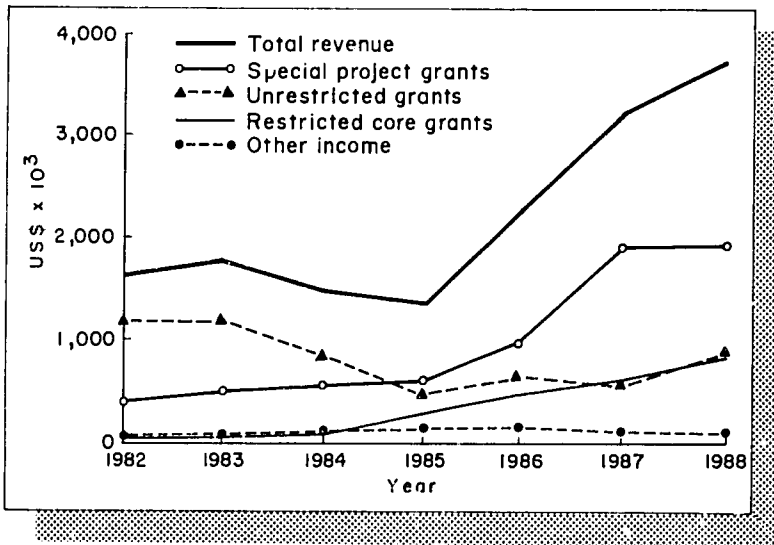


Fig. 10. Revenue profile in actual amounts, in million US\$.

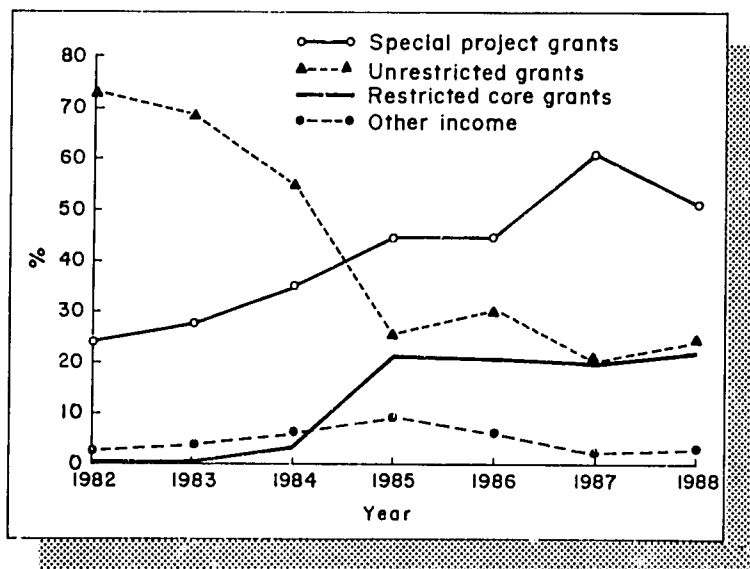


Fig. 11. Revenue profile as a percentage of total revenue.

provided from a special linkage fund which was established to provide financial assistance to international Centers being considered for CGIAR affiliation. The BMZ grant (DM250,000), meanwhile, was the Federal Republic of Germany's first unrestricted grant contribution to a nonCGIAR center and was the first of what ICLARM hopes will become an indefinite annual commitment.

Previous unrestricted donors Australia (AIDAB) and Denmark (DANIDA) also increased, in both home currency and US dollar terms, their annual contributions to ICLARM. AIDAB's grant increased by 39% while DANIDA gave a 26% larger grant (in \$US). These developments served to more than offset the 62% decline in USAID's unrestricted contributions to the Center.

Given the above growth, the total level of unrestricted grants was slightly higher than total restricted core grants (27% of total revenue) after having dipped slightly below the level of restricted core grants in 1987. Special project grants, however, accounted for close to 51% of total revenue and continued to dominate the funding profile of the Center. Other income increased its contribution to total revenue in 1988 to 3% from 2.5% in 1987.

Despite the growth in revenue, the Center was unable to fund all of its planned activities for the first year of its Five-Year Plan. Total unrestricted revenues were only sufficient to cover very basic, high priority expenses which allowed the Center to maintain operations at the 1987 level. ICLARM was unable to hire the new staff it required due to a US\$300,000 shortfall in unrestricted revenue. Another US\$800,000 in activities (network start-ups, additional staff, workshops, conferences, etc.) had to be deferred until restricted funding for them is found.

Although 1989 promises to be financially better for the Center due to increased unrestricted grant commitments, projected levels of unrestricted support will only allow the Center to fill two key professional staff positions. While several planned activities (including the start-up of the aquaculture research facilities) will, in 1989, again have to be postponed due to lack of restricted grants, it is hoped that efforts started in 1988 to define high priority research and service areas will begin to attract donors in 1989.

## **ICLARM SUPPORT GROUP**

In early 1986, ICLARM and some of its donors saw the need to provide current and potential donors as well as other parties interested in the Center's research programs with a forum to discuss regularly ICLARM's research programs and financial requirements as well as areas of mutual concern.

In order to address this need, the United Nations Development Programme (UNDP), during the 1986 International Centers Week of the Consultative Group on International Agricultural Research (CGIAR), convened a meeting of ICLARM donor representatives to assess their interest in holding regular meetings. It was during this meeting that donor representatives and other interested observers agreed to the formation of the ICLARM Support Group which was "to provide the mechanism and venue for communication and consultation concerning ICLARM's research program and financial requirements amongst those organizations that provide financial and in-kind support to ICLARM." The Group also agreed to meet regularly and the members viewed the Support Group's role as being advisory to the ICLARM Board of Trustees. They also agreed that all meetings were to be held at the time and place of meetings of the CGIAR since all ICLARM donors as well as ICLARM representatives expected to be usually present at such meetings.

Four other meetings thus followed this first meeting as follows:

- 23 May 1987 - Montpellier, France
- 29 October 1987 - Washington DC, USA
- 15 May 1988 - Berlin, West Germany
- 31 October 1988 - Washington DC, USA

The 1988 meetings were attended by representatives from the following organizations:

- Ministère de la Recherche, France
- Australian International Development Assistance Bureau (AIDAB)
- United States Agency for International Development (USAID)
- International Fund for Agricultural Development (IFAD)
- International Fund for Agricultural Research (IFAR)
- United Nations Development Programme (UNDP)
- Federal Ministry for Economic Development (BMZ), Federal Republic of Germany
- Overseas Development Authority (ODA), United Kingdom
- International Development Research Centre (IDRC), Canada
- Ministry of Foreign Affairs, Netherlands
- German Council for Tropical and Subtropical Agriculture Research (ATSAF), Federal Republic of Germany
- Danish International Development Cooperation (DANIDA), Denmark

- World Bank
- The Ford Foundation

ICLARM was represented by its Director General, Chairperson of the Board, and the Chairpersons of the Finance and Program Committees of the Board.

At both 1988 meetings, the Director General reviewed ICLARM's research programs, stressing the new developments, including the broader range of geographical activities of ICLARM. He presented and reported on the ICLARM Five-Year Plan which was developed at the request of the Support Group in 1987. The Director General also brought the group up to date on the financial status of ICLARM and its future needs. He reported that the Center's financial position was slowly improving as a result of increased donor numbers and contributions. Despite this support, he reported that ICLARM was still one million dollars short of the desired level of core funding for the 1988 budget and had to postpone many activities.

At both meetings much attention was given to expressions of views and advice on ICLARM's efforts to be included in the CGIAR system. Views were informal and individual; no attempt was made to achieve a consensus. It was recognized that association with CGIAR would give enhanced visibility and credibility to ICLARM's objectives and programs, although several donors noted that this was not an issue in their own cases. Caution was expressed concerning the hope for any increase in funding simply by joining the CGIAR. Members of the Support Group advised the Director General that the Center should not totally depend on CGIAR affiliation for additional funding. Many of them felt that, even when affiliated with the CG, ICLARM will still have to seek funds actively.

Representatives of a number of donor countries expressed appreciation of ICLARM's work and reported continued or increased funding for ICLARM in 1989. During the extended discussion during these meetings, it was apparent that there was an increased awareness of the importance of the role that the Support Group exercises on behalf of ICLARM and the donors.

At a time when financial resources for international development are limited, and those for research especially limited, it is critical for research institutions like ICLARM, which is making outstanding progress under very difficult financial constraints, to ensure that their achievements - and difficulties - are exposed to the international donor community. A full understanding of the work of ICLARM by donors is critical for its future viability.

As Chairman of ICLARM's Support Group, I am grateful to the Center's staff and Board Members who have participated in Support Group meetings as well as to the increasing number of representatives of donor agencies who have generously devoted their time, at an invariably busy period, to ICLARM.

Mr. Timothy Rothermel  
Chairman, ICLARM Support Group  
and  
Director of Global and Inter-  
regional Projects, UNDP

# 1988 SOURCES OF SUPPORT

## 1. Unrestricted Support

World Bank - (CGIAR)  
 United States Agency for International Development (USAID)  
 Australian International Development Assistance Bureau (AIDAB)  
 Danish International Development Agency (DANIDA)  
 Bundesministerium für Wirtschaftliche Zusammenarbeit (BMZ)

## 2. Restricted Support

Activity	Sources of 1988 Support
a. Giant Clam Project/Coastal Aquaculture Centre	Commission of European Communities (CEC) New Zealand Government Overseas Development Administration (ODA) Skaggs Foundation Australia and Pacific Science Foundation
b. Asian Fisheries Social Science Research Network	Ford Foundation, New York International Development Research Centre (IDRC) of Canada
c. Management Options for Small-Scale Fisheries	Ford Foundation, New York
d. Selective Fisheries Information Service	International Development Research Centre (IDRC) of Canada
e. Network of Tropical Fisheries Scientists	Food and Agriculture Organization (FAO)/Danish International Development Agency (DANIDA) Norwegian Ministry of Development Cooperation (NORAD)
f. Integrated Farming Systems	United Nations Development Programme (UNDP)



- |    |   |  |
|----|---|--|
| g. | ASEAN Coastal Resources Management  | United States Agency for International Development (USAID)   |
| h. | Reservoir Management (Cirata and Saguling Dams, Indonesia)                                | International Bank for Reconstruction and Development (IBRD)   |
| i. | Philippine Small Pelagics Management  | International Bank for Reconstruction and Development (IBRD)   |
| j. | Appropriate Technology for Aquaculture in Africa  | Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ)  |
| k. | Germany-Israel Third-World Aquaculture Research Cooperation                               | Der Bundesminister für Wirtschaftliche Zusammenarbeit (BMZ)  |
| l. | Rice-Fish Farming Systems   | Asian Development Bank (ADB)   |
| m. | Publication - The Peruvian Anchoveta and Its Upwelling Ecosystem: Three Decades of Change | Programa Cooperativo Peruano<br>Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) through Programa Cooperativo Peruano |
| n. | Management of Tropical Small-Scale and Open Water Fisheries in Bangladesh                 | Ford Foundation, Bangladesh  |
| o. | Interregional (Asia-Africa) Cooperation in Aquaculture                                    | French Government  |
| p. | Tilapia Genetic Improvement   | Asian Development Bank (ADB)<br>United Nations Development Programme (UNDP)  |
| q. | Tropical Fisheries Data Analysis  | University of Rhode Island (URI-USAID)   |
| r. | Lake Victoria Project   | Commission of European Communities (CEC)   |

# STATEMENT OF REVENUES AND EXPENSES<sup>1</sup>

## (US\$)

	1988	1987
REVENUES		
Grants	\$ 3,375,027	\$ 2,878,675
Consultancy and service fees	106,458	198,291
Publications	22,492	19,440
Miscellaneous	<u>110,241</u>	<u>36,949</u>
	<u>\$ 3,614,218</u>	<u>\$ 3,133,355</u>
EXPENSES		
Resource Assessment & Management	\$ 1,475,599	\$ 1,651,372
Aquaculture	1,250,503	820,274
Social Sciences	244,048	183,651
Library & Information Services	171,810	161,614
Information Research	27,675	18,308
Board of Trustees	95,128	67,925
Administration & Finance	257,466	232,574
General Operating Expenses	95,976	109,611
Capital Expenditures	<u>110,674</u>	<u>0</u>
	<u>\$ 3,728,879</u>	<u>\$ 3,245,329</u>
EXCESS (DEFICIENCY) OF REVENUE OVER EXPENSES	(\$ 114,661)	<u>(\$ 111,974)</u>
FUND BALANCE AT BEGINNING OF YEAR	159,921	
As previously stated		405,317
Adjustment <sup>2</sup>		<u>(133,422)</u>
As restated		<u>\$ 271,895</u>
FUND BALANCE AT END OF YEAR	<u>\$ 45,260</u>	<u>\$ 159,921</u>

<sup>1</sup>As audited by Sycip, Gorres & Velayo & Co.

<sup>2</sup>Adjustment was caused by changes in 1987, in the policies for accounting for property and equipment. The new accounting policies are now closer to those used by members of the CCIAR.

## **ICLARM STAFF**

**Director General**  
Ian R. Smith, Ph.D.

### **Resource Assessment and Management Program**

Daniel Pauly, Ph.D.	Director
Annabelle V. Cruz, M.A.	Program Assistant
Ma. Lourdes D. Palomares, M.S.	Research Associate
Mina L. Soriano, M.O.S.	Research Associate
Felimon C. Gayanilo, Jr., B.S.	Research Associate
Astrid C. Jarre, M.S.	Integrated Expert

### **ASEAN/US COASTAL RESOURCES MANAGEMENT PROJECT**

Chua Thia-Eng, Ph.D.	Project Coordinator
Alan T. White, Ph.D.	Technical Advisor
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Flordeliz Y. Guarin, M.S.	Project Specialist
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Marie Sol M. Sadorra, A.B.	Project Editor
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Rachel C. Josue, B.S.	Accounts Clerk
Rachel C. Atanacio	Project Artist

### **PHILIPPINE SMALL PELAGICS MANAGEMENT PROJECT**

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Ruben Ganaden, Ll.B.	Project Officer
Perlita V. Corpuz, M.A.	Project Economist
Josefina G. Cañeño, B.S.	Secretary

### **MANAGEMENT OPTIONS FOR TROPICAL SMALL-SCALE FISHERIES**

Max N. Agüero, Ph.D.	Associate Scientist
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### **Aquaculture Program**

Roger S.V. Pullin, Ph.D.	Director
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Josephine B. Capili, B.S.	Research Assistant
Ravelina M. Recometa, M.S.	Research Assistant
Catherine Lhomme-Binudin, A.B.	French Translator/Interpreter
Emma M. del Rosario, B.S.	Secretary

#### **GENETIC IMPROVEMENT OF TILAPIA**

Ambekar E. Eknath, Ph.D.	Project Leader
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#### **INDONESIAN RESERVOIR PROJECT**

Barry A. Costa-Pierce, Ph.D.	Associate Scientist
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#### **AFRICA AQUACULTURE PROJECT**

John D. Balarin, M.Sc.	Project Director
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#### **RICE-FISH FARMING SYSTEMS RESEARCH**

Catalino R. dela Cruz, Ph.D.	Project Leader
Anne A. van Dam, M.Sc.	Associate Expert

#### **COASTAL AQUACULTURE CENTRE (SOUTH PACIFIC)**

John L. Munro, Ph.D.	Director
Graham F. Usher, M.Sc.	Research Associate/Hatchery Manager
Mark H. Gervis, M.Sc.	Research Associate
Hugh Govan, B.Sc.	Scientific Assistant
Cathreena M.T. Gervis, B.Sc.	Scientific Assistant
Hugo Tafea	Fisheries Officer
Julia Topping, B.S.	Administrative Assistant/Secretary
John Suli	Foreman/Caretaker
Benson Kalea	Deputy Foreman/Caretaker
Jack Kola	General Laborer
Alfred Lau	General Laborer
Timothy Line	General Laborer
George Lionel	General Laborer
Texlee Meve	General Laborer
Ngara Pila	General Laborer
Maxwell Sau	General Laborer
Julia Kakau	Cleaner

### Information Program

Jay L. Maclean, M.Sc.	Director
Leni-Lou F. Estudillo, B.S.	Secretary

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Regina G. Morales, B.S.	Editorial Assistant
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Eloisa A. Espiritu, B.S.	Typesetter
Ovidio F. Espiritu, Jr., B.S.	Senior Artist
Christopher M. Bunao, B.S.	Junior Artist
Ramon B. Estarez	Information Aide

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Erlinda B. Gonzalez, B.S.	Assistant Librarian
Nelia R. Balagapo, B.L.S.	Assistant Librarian
Georgina C. Luis, M.A.	Project Librarian, SFIS
Marcos Jose M. Vega, B.S.	Project Information Officer, SFIS
Reynaldo A. Damalerio	Library Aide

### Asian Fisheries Social Science Research Network

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Marissa W. Manela	Project Assistant

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Arlene G. Balane, B.S.	Accountant
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Irma C. Reyes, C.P.A.	Accountant
Ma. Concepcion Q. Bernardo, B.S.	Senior Secretary to the Director General
Nenita J. Sunglao, B.S.	Secretary
Ma. Concesa A. Calderon, B.S.	Clerk-Typist
Belen R. Dagmil	Receptionist/Clerk-Typist
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Dominador V. Gomez	Driver/Mechanic
Florentino D. Paulino	Driver