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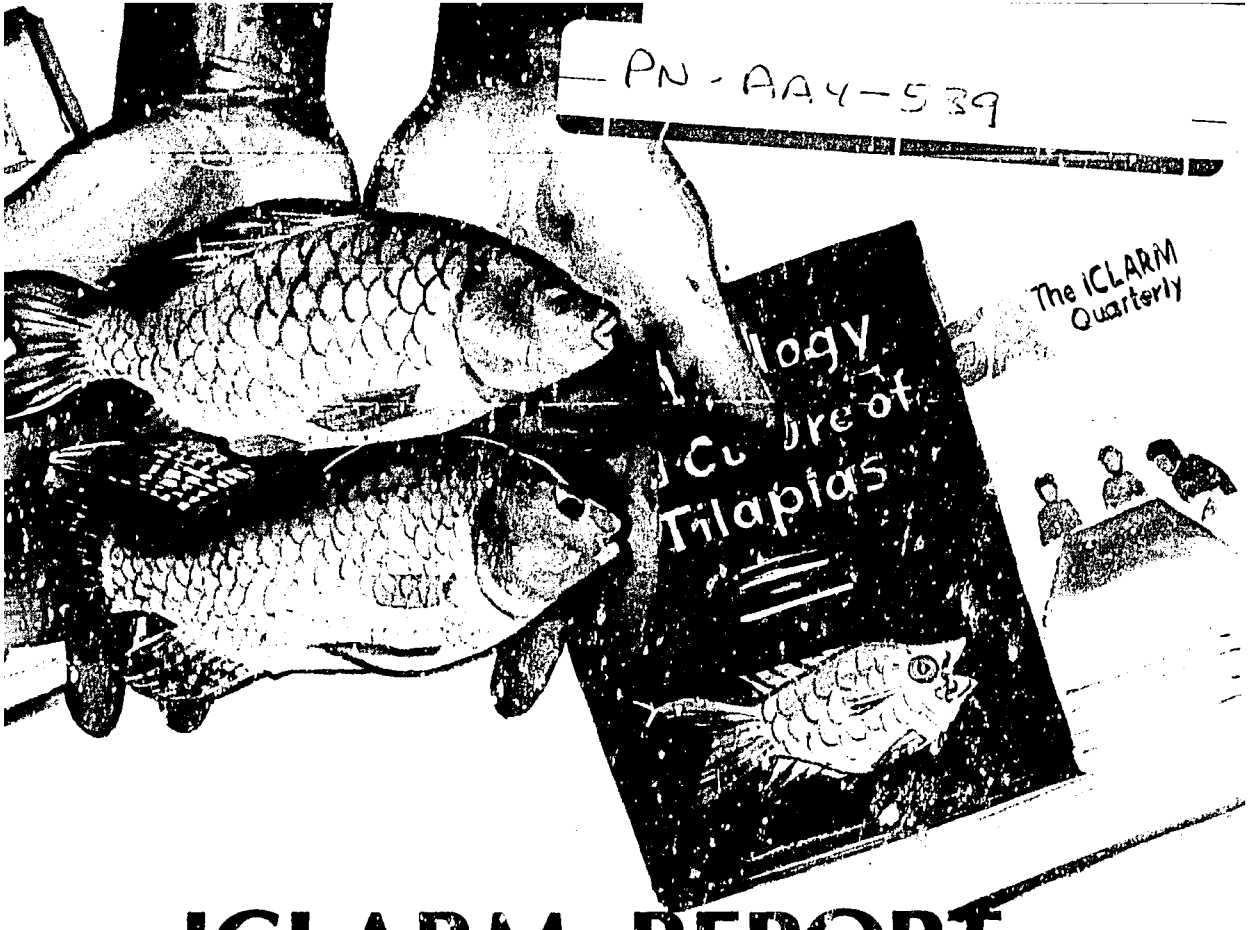


# ICLARM REPORT 1986

## 10th Anniversary

# ICLARM REPORT
# 1986

## STATEMENT OF PURPOSE

". . . the corporation is organized exclusively for charitable, educational, and scientific purposes; and in furtherance of these purposes, the corporation 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."

Articles of Incorporation
International Center for Living Aquatic Resources Management

# ICLARM REPORT 1986

Edited by

Jay L. Maclean
and
Leticia B. Dizon

1987

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## PREFACE

ICLARM's tenth anniversary as an international nongovernmental center for fisheries research and development coincides with my own fiftieth year of involvement in international fisheries activities. It is with pride and satisfaction that, as a member and current chairman of its Board of Trustees, I can join in celebrating the first decade of work by this unique organization.

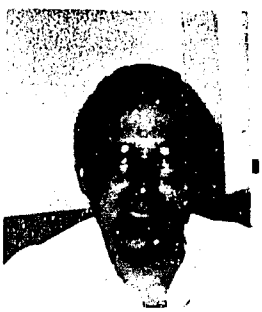
The waters that cover more than 70% of the surface of our planet annually provide increasing amounts of fish and other aquatic products. Yet, the scientific basis for maintaining and hopefully increasing production is sorely inadequate, particularly in tropical and subtropical waters. Newly independent nations, with even more recent extensions of jurisdiction to two hundred nautical miles seaward, are usually ill-prepared to assess, let alone manage, their inland and coastal fisheries. (By and large, most industrialized and developed countries are in the same condition.) Lessons learned in colder zones often have no direct application to the warm waters in or adjoining most developing countries.

The ICLARM approach involves working side by side in the laboratories and universities of countries seeking assistance. It is highly cost-effective. But more to the point, cooperation is on a face-to-face, hand-to-hand basis. There is full awareness of the inhibitions, limitations and opportunities, whether technical, cultural, economic or political, which circumscribe the development process. Ivory tower isolation is negated.

As its first ten years come to an end, ICLARM has a small but skilled and dedicated staff, an effective and well-tested approach, growing visibility, an expanding group of supportive donors and a Board of Trustees international in composition and committed to ICLARM's mission.

The Board is most grateful to those associated with ICLARM in its first ten years and to those who contributed to this special anniversary edition of the Center's Annual Report. We trust that they will concur with our belief that the need for research in fisheries management and aquaculture development is great and that ICLARM deserves continuing and increased support in the years ahead.

Roy I. Jackson
Chairman
Board of Trustees



# INTRODUCTION

Dr. Ian R. Smith
*Director General, ICLARM*

The year 1986 represented ICLARM's tenth year of research, training and information activities based in the Philippines, following the Center's incorporation there in early 1977. Commemorating our tenth anniversary is a cause not only for celebration but also for reflection.

## Celebration and Reflection

Celebration is warranted because for any research organization depending upon financial support from others and program acceptance by colleagues, ten years is ample time in which to demonstrate usefulness or lack thereof. In ICLARM's case, the past year has brought renewed commitment from donors and cooperating institutions alike, providing evidence of the Center's relevance and support for its scientific contributions. This has been most gratifying to ICLARM's Board of Trustees and staff.'

One must, of course, make a distinction between celebrating the survival of the organization and celebrating the impact of the organization. Survival alone is clearly insufficient, although those who have followed closely the fortunes of ICLARM over the past few years, particularly the financial stress of the past three years, will not begrudge us if we pause for a while to celebrate reaching our tenth year. Ultimately, however, celebrating the impact is for others to do; others who have observed or benefitted in one way or another from the work of ICLARM.

Reflection is called for because the world is not a static place and the thinking in the 1960s and 1970s that went into the formation of ICLARM may not be as appropriate now as it was then. On the one hand, financial circumstances of donor organizations around the world are such that obtaining unrestricted support for centers like ICLARM is much more difficult now than it was 10-15 years ago. On the other hand, ICLARM with its many research cooperators has learned a great deal about research approaches and objectives over the past decade and this experience should help guide the Center as it embarks on its second decade. Building on the best of the past experience but being prepared to modify and improve research goals and approaches should be the guiding forces in any institution that wishes to remain dynamic and relevant.

To assist us in this process of reflection, we invited various colleagues to write about their perceptions of problems and research issues in the aquatic resources sector. These persons represent donor organizations and developing-country groups which are very close to the problems of conducting research or development work to benefit fishermen and fish farmers as well as societies of which they are part.

Contributors were asked to develop their ideas and perspectives on a broad theme related to their experience. It was stressed that we were willing to take the risk that those whom we approached might disagree with the perspectives reflected in the Center's program priorities. Also it was felt that a variety of perspectives should be healthy, since ICLARM is certainly not alone in its concern for the wise management of resources and the role of science to bring this about.

John Pino and James Johnston had perhaps the easiest task, of detailing for us the original concepts and planning that went into the formation of ICLARM and the pre-incorporation days when the Center was finding its feet (p. 9-14). Both worked in the 1970s and 1980s with the Rockefeller Foundation, the first (and for the first two years the only) funder of ICLARM.

Kenneth Ruddle is a specialist in aquatic and human ecology and has authored several books dealing with coastal resource management. His essay (p. 15-23) highlights the complexity of the coastal zone and the need for regional perspectives in research and management. ICLARM's work in this field is very young, and we will certainly heed his warning that "some cherished stereotypes must be cast aside" in developing lines of research.

Nyle Brady has provided a donor perspective on small-scale fisheries research (p. 43-49). Insufficient attention has been given to aspects of property rights and distribution of income. It was coincidental that this theme was taken up and voiced even more strongly by John Kurien (p. 33-42) who has first-hand experience of the problems of small-scale fishing communities. John has challenged ICLARM to go beyond empathy and to strengthen the Center's association with these communities. Nyle Brady even pointed out that adverse political repercussions may be generated by such research, which would require innovative and bold initiatives.

Just how difficult casting aside of stereotypes and taking bold initiatives can be for national scientists in developing countries, are amply explained by Dr. Bernabe Santelices who brings many years of personal experience in Chile to bear on this issue (p. 51-58). His essay is a nice reminder to donors of their responsibilities and the basic nature of much research still needed to help develop aquatic resources.

The use of networks in helping such researchers and research in general is well stated by Donald Plunknett and Nigel Smith. ICLARM's experience with two networks—the Network of Tropical Fisheries Scientists and the Asian Fisheries Social Science Research Network—are just as the authors describe. They are cost-effective, and provide new insights and improved communication. However, not stated are those situations where networking may be a less efficient use of resources. ICLARM has been forced to the

conclusion that in some areas of research, such as certain basic research on aquaculture, the necessary facilities do not exist and could not be expected to be shouldered by any national group. Under such circumstances the network approach can make no headway.

Finally, Timothy Rothermel has praised the Center's progress and shared with us UNDP's views of research and development priorities. ICLARM has a clear role to play in implementing them.

These contributions reflect a variety of viewpoints. Most dwell on capture fisheries or coastal environments. We were less successful in finding persons to write on aquaculture. Perhaps this reflects the relative newness of the field though there is no shortage of institutions, national and international, attempting to make their mark. More likely was the unwillingness of many to broaden their viewpoints beyond their own institutional perspectives or vested interests. This in itself says much about the need for a broadly supported international research program with carefully focused priorities. It also indicates the uniqueness of ICLARM's perspective on living aquatic resources which recognizes the interrelationships of fisheries, aquaculture and agriculture as food producing systems.

We would like to thank very much those who contributed to this tenth anniversary report. We hope these essays will stimulate readers of this report as they have ICLARM staff. There were others who wished to contribute but were constrained from doing so by our need to produce the Report early in 1987.

In addition to inviting essays by colleagues, it was essential for ICLARM staff and Board members to contribute in an active way to the Center's future program design. This process began last year with the preparation of a document entitled "Preparing for ICLARM's Second Decade: Program and Finances of the International Center for Living Aquatic Resources Management". Designed primarily for potential contributors to the ICLARM program, this document and subsequent discussion raised numerous key issues related to the programs of the Center and the manner in which they are implemented.

First and foremost, the justification for an international program of research, training and information seems even stronger now than it was ten years ago. This justification derives primarily from conditions and developments in the tropical aquatic resources sector and the economies and societies of which they are a part.

Tropical developing countries are extremely dependent on aquatic resources for food and income. For half the population of the developing world, fish constitutes one-third or more of their animal protein intake; for many developing countries, it makes up more than half. Indeed rice and fish constitute probably the most common dish in the tropics. Just as important is the fact that extremely large numbers of people earn income from living aquatic resources. The result of their dependency has been increasing pressure on these resources and their environments.

It is not an exaggeration to say that a crisis of major proportions exists for the living aquatic resources sector in the tropics because these

economically and environmentally important yet fragile systems are widely mismanaged or, more commonly, unmanaged. Increasingly around the world, marine, coastal and inland ecosystems are overexploited, even irreparably damaged, by diverse and competitive users. If managed to yield food and other products on a long-term sustainable basis, however, these systems could be of immense value to humankind into perpetuity.

Coastal environments in the tropics, including the coral reefs offshore and the river basins that form integral parts of these environments, are steadily deteriorating. Siltation from overexploited uplands accumulates on coral reefs, permanently damaging many of them. Coastal mangrove forests are rapidly disappearing and pollution is increasing. Coastal fisheries have become scenes of intense competition between trawlers on the one hand, which have rapidly increased in numbers with the availability of low-cost credit, and small-scale fishermen, on the other hand, who eke out an increasingly marginal existence. The growing number of landless laborers, many of them recent migrants from the agricultural sector to coastal communities, is alarming. Ironically, incidence of malnutrition is especially high in tropical coastal fishing communities which have become increasingly market-oriented to meet just their basic needs. The problems facing the aquatic resources sector thus have environmental, nutritional, income and employment dimensions and are not simply a production constraint solvable through standard development approaches.

Since the 1970s, annual yields have begun to decline from many major fisheries. So far, the exploitation of new resources has offset this decline, but rates of increase in aquatic food production are falling behind rates of increase in population. It is clear that new unexploited resources are limited in number and that better control over use of aquatic resources and enhancement of habitats are the keys to sustaining, if not increasing, present levels of productivity.

## The Context of Aquaculture

Aquaculture, as part of these aquatic systems, offers considerable hope of increased growth in production, but the transition from hunting to scientific farming of aquatic resources is only just now beginning. Of the approximately 80 million tonnes of fisheries production in 1985, less than 10% was generated by aquaculture. In the absence of reliable aquaculture statistics, even these estimates of the sector's contribution are subjects of considerable debate. There is more general agreement that the rate of growth of aquaculture (approximately 7.5% annually) is amongst the highest of all food sectors. For the near-term future, however, the world's growing population will remain primarily dependent upon the renewable capture fisheries for the bulk of its aquatic food supply.

Perspectives on these interrelated issues have changed quite dramatically over the past decade. It is now the exception rather than the rule to hear discussion of new investment potential in capture fisheries. We can hardly ignore the vessels lying idle in many Asian locations or the social conflicts

that have arisen. Results of stock assessment studies are showing the extent of overfishing with increasing authority. Studies documenting the economic losses to societies when fisheries are left unmanaged are beginning to emerge. Countries that take into account broader social issues are even banning certain highly efficient gear types when their activities are not in the interests and welfare of the majority of coastal residents, especially small-scale fishermen. Artificial reefs are increasingly being seen as means of indirectly dealing with the trawling problem, while potentially enhancing production. The challenges in the decades ahead will be to foster the development of appropriate institutional mechanisms that reduce economic losses, environmental damage and coastal antagonisms. There is clearly a role for research institutions here but the focus of their work must shift from one of "documenting problems" to one of "exploring solutions".

Aquaculture has been widely recognized as a food-producing system with tremendous scope for growth, especially in the tropics and subtropics. Increases in production over the last 5 to 10 years, for example, the growth of the Philippine tilapia culture industry from insignificance to around 50,000 tonnes annually, are already occurring. Meaningful research to facilitate and accelerate this growth requires first a broad interdisciplinary perspective, recognizing socioeconomic as well as biotechnical constraints, and second a focus on improvement of a few commodities and farming systems of global potential. Too much of past aquaculture research has been from a narrow perspective, for example inducing a species to spawn and formulating a better feed, without recognizing the factors affecting the whole farm, the farmer and the consumer. Moreoever, research efforts have been spread thinly amongst a staggering diversity of species and systems.

ICLARM's Aquaculture Program has evolved over the last decade to assume a position of research leadership to support future aquaculture development. The Program recognizes the value of the examples set in research for agricultural development in which genetic improvement of farmed species and technological improvement of farming systems have been highly interactive and successful. ICLARM visualizes a similar approach for the tilapias and carps in inland aquaculture and for the bivalve molluscs in coastal aquaculture.

The greatest scope for near-term growth is in inland aquaculture. The challenge here is to bring aquaculture into the mainstream of agriculture by integrating it as a subsystem into existing crop and livestock farming systems. Prospects for the coastal sector are more difficult to summarize but here ICLARM's clearly defined focus on bivalves and broad perspectives on the continuum between fisheries and aquaculture which compete for markets, are appropriate. These aquaculture activities need to be integrated into existing community work patterns and economic activities. An interdisciplinary perspective is necessary.

Above all, what seems to be necessary for ICLARM's immediate future is to concentrate on the species and approaches mentioned above, thus avoiding the temptation to work on everything under the aquaculture label. This focus, consistent with the Center's Bylaws, is also on species

suitable for low-cost production and destined for domestic, not export, markets.

A key issue currently being addressed by ICLARM is the question of potential ownership or management by the Center of aquaculture research facilities. Genetics research programs on tilapias, for example, because they are facility-dependent, will require a level of financial support beyond that currently available to ICLARM. Also required, from our point of view, are assurances of long-term access to research equipment and facilities. One might argue that national groups should take the initiative on such long-term research. However, this puts an unfair burden on national research systems because the benefits from such work will be clearly international in nature. During its reflection process, ICLARM is debating internally this issue of research facility management and support. We will be benefitting considerably from our experience to date in the Solomon Islands where a Coastal Aquaculture Center is managed by ICLARM in cooperation with the Fisheries Department there. We are also seeking the advice of other researchers in the tropics and potential funders of such research, regarding the appropriate mix of centralized activities and decentralized networks that would be necessary to pursue this theme effectively and have an impact on production.

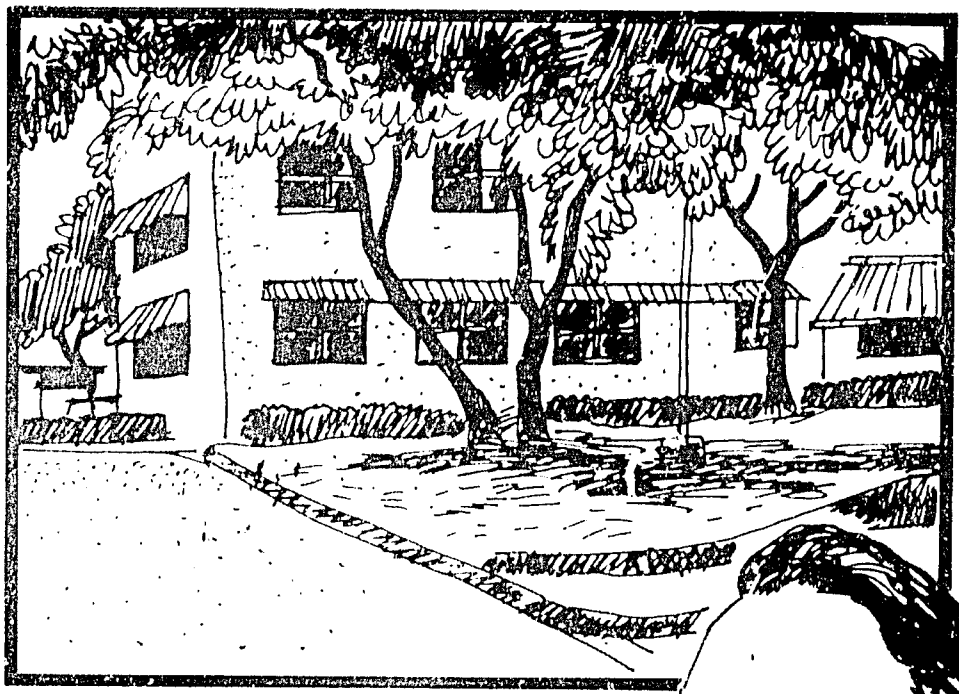
Part of this broader process—broader than ICLARM alone, that is—has included a review of aquaculture research priorities and mechanisms by the Technical Advisory Committee (TAC) of the Consultative Group on International Agricultural Research (CGIAR). This review was conducted by Dr. Claire Idyll for the TAC and is the most recent of a series of such reviews and consultations on this topic which first began almost 20 years ago. It is encouraging that aquaculture (but not yet the rest of the aquatic resources sector) appears closer now to TAC endorsement than in years past.

Nevertheless, before any developments will occur in the international perspective of aquaculture, major financial hurdles remain to be overcome as do donor perceptions of institutional confusion and overlap amongst aquaculture institutions. Is it institutional bickering that has denied aquaculture research the support and endorsement to date of international groups such as the CGIAR? I believe there is certainly an element of truth in that question. It is my personal hope that these donor concerns can be overcome so that aquaculture research will soon receive its share of international support commensurate with its potential to contribute to incomes, employment and nutrition in developing countries.

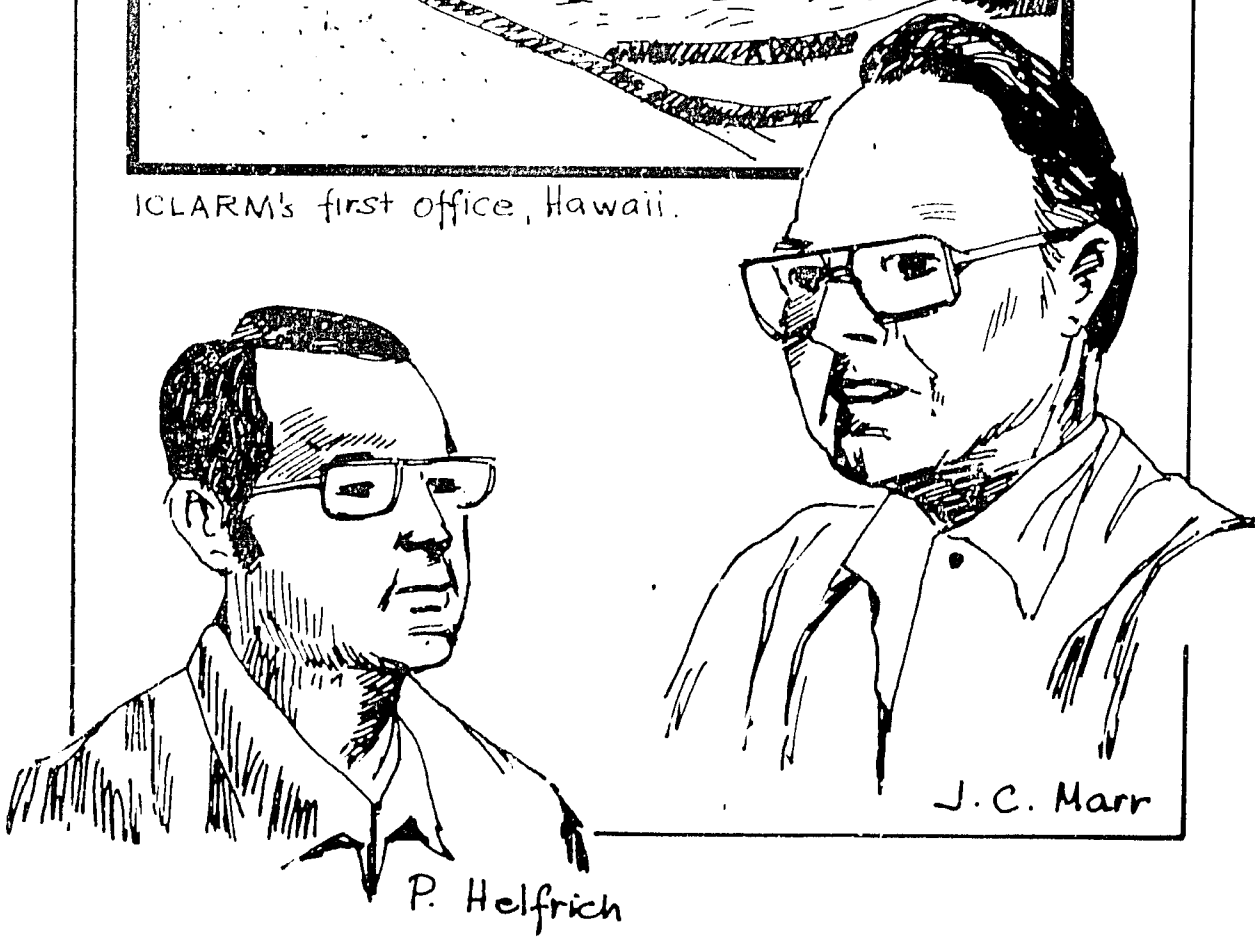
I would like to close this introduction with sincere thanks to all those whose support, both financial and intellectual, has helped sustain ICLARM over its first decade. The Center is the product of considerable thought and energy of a large number of people. This large group includes not only those who developed the original ICLARM concept and set it on its way, but also those many individuals in national institutions who suggested "let's do this together" or responded enthusiastically "yes, we'd like to work with you on that." It includes also the staff and Trustees of the Center and the many individuals around the world who ponder our proposals and agree

to provide the necessary funds for us and our many cooperators to pursue them.

ICLARM's first ten years have been very much a group effort. We trust that the Center's work to date has warranted the support and cooperation that so many have provided. The formation, during 1986, of the ICLARM Support Group, with Mr. Timothy Rothermel, Director of Global and Interregional Projects for UNDP as Chairman, has been a most encouraging development for us because it provides some promise of a more coordinated approach by donors to sustain the ICLARM program. As we begin our second decade, we look forward very much to the future and contributing our share to living aquatic resources management around the globe.



ICLARM's first office, Hawaii.



# ORIGIN AND ESTABLISHMENT OF ICLARM[1]

John A. Pino[2]
*Senior Research Fellow*
*National Research Council, National Academy of Sciences*
*Washington, DC, USA*

and

James E. Johnston[3]
*Assistant to the Director*
*International Programs, Lousiana State University*
*Baton Rouge, Lousiana, USA*

As with many new initiatives, the real origins of ICLARM are buried in the evolution of ideas and events which preceded by many years its eventual creation. By the turn of this century, a number of individuals and institutions began focusing their attention on fisheries, marine biology and aquaculture, and indeed, new research centers came into existence in the early twentieth century. Following World War II, there was a growing recognition of the importance of marine fisheries and aquaculture as sources of food for exploding human populations. In keeping with its belief in the key role of science in the resolution of world problems particularly related broadly to human health, much of the early support of the Rockefeller Foundation, in the area of marine biology, was directed toward support mainly for equipment and facilities of existing research laboratories. In 1924, the first grant awarded by the Natural Sciences Division of the Foundation was made to the Marine Biological Laboratory at Woods Hole. Over the years, many other laboratories in various parts of the world engaged in marine biological research, fishery biology and oceanography were awarded financial support for their programs by the Foundation.

Up until the middle 1960s, the Foundation's interest in the general subject of marine biology and fisheries was largely the responsibility of Dr. Gerald R. Pomerat of the Natural Sciences Division. Not only did Dr.

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[1]The views expressed are those of the authors and do not necessarily reflect those of the Rockefeller Foundation, The National Academy of Sciences, Louislana State University or ICLARM.

[2]From 1970 to 1983, served as the Director of Agricultural Sciences of the Rockefeller Foundation, New York.

[3]From 1975 to 1985, served as the Deputy Director of Agricultural Sciences of the Rockefeller Foundation, New York.

Pomerat identify and encourage many of the key research institutions but he ushered in a period of systematic, scientific inquiry in this important area of biology which continues to this day.

The post World War II period also witnessed a rising concern with agricultural development as the growing populations of developing countries strained the existing capacities of their food systems and general economies. The agricultural program launched by the Rockefeller Foundation[4] in Mexico in 1943 provided much of the impetus which spawned the "Green Revolution" and the subsequent formation of the CGIAR[5], which came into being in 1971. By that time, the impact of the international agricultural programs were no longer in doubt—the Green Revolution had made its mark. The success of the International Rice Research Institute in the Philippines initially jointly sponsored by the Ford and Rockefeller Foundations and the Maize and Wheat Center (CYMMIT) had caught the attention of the technical assistance community, the donor countries, and multilateral funding agencies. The international center concept rested on the premise that broadly important problems of food crop production (in this case, those affecting the countries situated in the tropics and subtropics), could effectively be addressed through the application of modern science. The strategy was simple enough—focus the efforts of an interdisciplinary group of scientists on rather specific problems. The sharp focus on rice, corn, wheat, beans and potatoes began with varietal development and a knowledge of soil, climate, disease, pests, and environmental, social and economic factors affecting production.

Would such a concept work on the problem of fisheries? Could the sciences of the marine biologists and others be brought to bear on problems of aquatic resources management and development? The officers of the Foundation thought that it was time to find out.

With encouragement from Dr. J. George Harrar who was then President of the Rockefeller Foundation, Dr. John A. Pino, as Director of the Agricultural Sciences Program initiated in 1971 a series of consultations with leading fisheries scientists. During these early discussions, the contributions of persons such as Drs. Burr Steinbach, John Bardach, David Wallace, Colin Nash, Garth Murphy and Harold Goodwin were crucial to the formulation of the ICLARM concept. William W. Sellew, then Vice President of the Oceanic Institute, worked closely with Dr. Pino in generating a wide circle of interest in the activity.

As a result of these encouraging discussions, a conference was held at the Rockefeller Foundation on 2 October 1973 which brought together a group of distinguished scientists, representatives of donor agencies and Rockefeller officers. The first draft of a proposal to establish an International Center for Living Aquatic Resources Management (ICLARM) was presented to the group.

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[4]Stakman, E.C., R. Bradfield and P.C. Mangeshdoef. Campaigns against hunger. Cambridge, Mass. Belknap Press. 1967.

[5]Baum, W.C. Partners against hunger. The World Bank, 1986.

It was determined that ICLARM should not be an operating institute in the sense that it would maintain research facilities and manage training and development programs. Instead, the Center would seek to achieve the cooperation of existing institutes and agencies throughout the world in focusing on the problem areas and weaknesses impeding the more extensive practice of subsistence aquaculture and artisanal fishing in underdeveloped regions. It was proposed that ICLARM be organized as a tax exempt corporation governed by a Board of Directors international in character and balanced between experts familiar with technical problems in the field, people outstanding in public life and nonscientists with special interest in the success of the project.

Concluding such a step to be both timely and practical, in January 1974 a discussion paper was circulated among fisheries experts, assistance agencies' officials and government leaders of countries likely to benefit from the work of the proposed Center. Reactions were favorable, and with minor modifications suggested by those to whom the discussion paper was given, a revised proposal was prepared in May 1974.

After nearly three years of study of the need for and potential contribution of an international agency dedicated to the promotion of research and development in aquatic sciences, the Rockefeller Foundation announced in January of 1975 that it had taken action to establish a Pacific Fisheries Center. Firm decisions had been made that the initial emphasis of the Center would be on the Pacific basin and that the headquarters should be in a developing country but site selection would require a survey and discussions with governments of countries within the region. Arrangements were made by Dr. John Craven, Marine Affairs Coordinator for the Governor of Hawaii, to have the Research Corporation of the University of Hawaii serve as a transitional structure to administer the program during the organizational phase. Hawaii was selected for this purpose because of its location in the Pacific region and the fact that it was the base for several institutions with expertise and active programs in fisheries research, training and development. Dr. Philip Helfrich, then Deputy Director of the Hawaii Institute of Marine Biology, was employed as a Foundation field staff member to serve as Director of the ICLARM Program effective 1 January 1975. Thus ICLARM became an operational program as of that date.

Mr. Stephen Ritterbush, an engineer with experience in South Pacific fisheries operations, was also employed through the Research Corporation to serve as a program coordinator for ICLARM in December 1974. An office with a small support staff was established in space provided by the National Marine Fisheries Service facility adjacent to the University of Hawaii campus in Honolulu. The operations of the program were supported jointly by funds provided by the Marine Affairs Coordinator of the State of Hawaii and the Rockefeller Foundation.

In February 1975 Drs. Pino and Gary Toennessen of the Rockefeller Foundation met with the technical advisory commitee in Honolulu to consider ways in which ICLARM could best initiate its programs. It was decided to: 1) inaugurate three programs, 2) have the ICLARM staff travel

throughout Oceania and Southeast Asia to investigate, firsthand, the aquatic resource problems of the area and, based upon these observations, 3) prepare a comprehensive five-year program plan for ICLARM. It was also recommended that preparations be made for the incorporation of ICLARM as a legal entity and for its establishment at a permanent location in Oceania or Asia. The initial programs inaugurated by ICLARM during 1975 were: 1) an assessment of the skipjack tuna stocks of the Southeast Pacific; 2) an evaluation of the small boat programs in the Pacific Islands, including a workshop; and 3) a program to investigate the feasibility of salmon production at the southern tip of South America, with subsequent feeding on antarctic krill and final harvesting.

In addition to program establishment, the ICLARM staff traveled extensively to assess better the problems of the Pacific basin and to determine what programs could be inaugurated to assist people to utilize aquatic resources better to satisfy their nutritional needs. Some 30 countries were visited for consultations with national government officials, research workers, educators and officials of regional and international agency programs. Public and private laboratories, processing plants, research stations, universities, technical schools and aquaculture installations were visited, national and regional problems assessed, and the ICLARM organization and plans were explained. Visits were also made to FAO, UNDP and USAID headquarters to acquaint officials with ICLARM, its objectives and plans. Emphasis was placed on the ICLARM approach, which was to work through cooperation with existing institutions rather than to establish its own research and training facilities as was the case with the International Agricultural Research Centers of the CGIAR system.

Recognition was also given to the need to establish ICLARM as an independent Center, with its headquarters located in a developing country as soon as possible. Consideration was first given to the possibility of incorporating it in the State of Hawaii to give it a U.S. legal identity even though it might only maintain an office of record there with its principal operations based in one or more developing countries. That idea was dropped, however, when investigations revealed that it would be necessary for at least one-third of the trustees of the corporation to be residents of Hawaii. This would limit representation from developing and other donor countries. Consideration then shifted to incorporation directly in a developing country. While early emphasis for a headquarters location had focused on the Pacific Islands, further analysis indicated that the headquarters should have easy access to aquatic research and training institutions, development projects dealing with both aquaculture and capture fisheries as well as good air connections to the rest of the world. The Southeast Asian region with its large population, its dependence on fish and other aquatic products for both food and income and emphasis on aquatic research and development offered many advantages as a site for the Center. It was therefore decided that visits by officials of the Rockefeller Foundation and ICLARM should be made to selected countries in that region to assess the possibility of ICLARM's being located in one of them.

The process of identifying an appropriate site for the headquarters of ICLARM began during November 1975 when, in conjunction with other business, Dr. James Johnston[6] and Dr. Philip Helfrich visited Malaysia and the Philippines for preliminary discussions with officials of the government fisheries agencies and the ministries of agriculture and/or natural resources of the two countries. In both cases the government officials contacted expressed an interest in hosting the Center and a willingness to assist with arrangements for its incorporation in their country if a decision was made to do so.

By March 1976 a firm decision had been made by officers of the Rockefeller Foundation to establish ICLARM in Southeast Asia. The countries then under consideration were Malaysia, Singapore, the Philippines, Thailand and Indonesia. However, further discussions with fishery specialists familiar with the region led to a decision to concentrate discussions on incorporation on the first three. Arrangements were therefore made for Drs. Helfrich and Ziad Shehadeh (who had by then joined the ICLARM staff) and Dr. James Johnston representing the Rockefeller Foundation to visit these countries to review current fisheries related research, development and training activities and to meet with appropriate government officials to discuss possible arrangements for the incorporation of ICLARM and the location of its headquarters. These visits were made to Malaysia and Singapore during April 1976 and to the Philippines shortly thereafter. In each case both technical specialists and relevant government officials indicated an interest in having the Center's headquarters located in their country and a willingness to assist with the necessary administrative arrangements. Discussions were also conducted with officials and technical personnel of bilateral and multilateral assistance agencies. The team concluded that it would be possible to incorporate in any of the three countries but that there would be advantages in locating it in the Philippines. That country had the largest scale commercial and artisanal fishing industries including both aquaculture and capture fisheries, as well as effective national research, development and training agencies in the fisheries field. The establishment of the International Rice Research Institute near Manila had also created a useful precedent and would serve as a model for ICLARM incorporation and operation. Thus the decision was made to initiate arrangements to incorporate ICLARM in the Philippines as soon as possible.

Articles of Incorporation and By-Laws were drafted and taken to the Philippines in early July 1976 for discussion with Government officials. It was agreed that the process of incorporation should be preceded by a letter from the Foundation formally indicating to the Minister of Natural Resources an interest in incorporating ICLARM in the Philippines, providing assurance of continuing Rockefeller Foundation support to the organization to allow it to develop a wider support base and requesting his assistance in making arrangements.

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[6] After his transfer from the field staff in 1975 to the New York office of the Rockefeller Foundation, Dr. Johnston was assigned responsibility for contacts with ICLARM.

A letter to this effect dated 19 July 1976 was sent to the Honorable Jose J. Leido, Jr., Minister of Natural Resources by Dr. Sterling Wortman, Vice President of the Rockefeller Foundation. The Minister took the necessary action following receipt of that letter and responded with a letter dated 23 September 1976. He stated that the President of the Philippines had approved the proposal of the Rockefeller Foundation for establishment of ICLARM in the Philippines and indicated that a Presidential Decree for tax exemptions had been prepared for the President's consideration. He also authorized the Foundation to take the necessary steps for the incorporation of ICLARM and indicated that his Ministry would "extend such assistance as may be necessary". Given these assurances the Foundation initiated arrangements for incorporation. Discussions were also held with ICLARM staff concerning the move of the Center headquarters from Hawaii to the Philippines. It became clear that Dr. Helfrich, Director of the ICLARM program in Hawaii would prefer not to leave Hawaii. He agreed, however, to continue with ICLARM until 31 December 1976. A search for a replacement resulted in the appointment of Mr. John C. Marr effective about 1 November 1976. Since ICLARM was soon to become an independent international center, his position was designated as Director General in keeping with the designations of the Chief Executive Officers of the other International Agricultural Research Centers.

By the end of October 1976, arrangements in the Philippines had reached a point where action could be taken to initiate the process of incorporating ICLARM. A meeting was held on 3 November 1976 in Manila to take the necessary action. Philippine law required that there be at least five members of the Corporation, a majority of whom must be Philippine citizens. These were: Minister Jose J. Leido, Jr., Dr. Jose D. Drilon, Jr. and Dr. Manuel S. Alba. The non-Philippine members were Dr. Max F. Day (Australia) and James E. Johnston (USA). This group approved the Articles of Incorporation and By-Laws. A Board of Trustees was also appointed. Members included the five members of the Corporation, Mr. John C. Marr, Director-General of ICLARM (Ex-Officio) and Dr. H. Burr Steinbach (USA). Initial Officers of the Board were James E. Johnston (Chairman), Minister Jose J. Leido, Jr. (Vice Chairman), Dr. Manuel S. Alba (Secretary) and Dr. Harry T. Oshima, Rockefeller Foundation Representative in the Philippines (Treasurer). The Executive Committee of the Board was to be chaired by Minister Leido, and included Drs. Alba, Day and Steinbach. Others present for these proceedings were Dr. Ziad H. Shehadeh (ICLARM Senior Staff Member), Mr. William W. Sellew (U.S. Representative of the Oceanic Institute and Consultant to the Rockefeller Foundation on the ICLARM program), and Ms. M.J. Schad, Rockefeller Foundation. Thus definitive action had been taken to establish ICLARM as an independent international Center. This became an accomplished fact in March 1977 when government approvals of incorporation and exemptions from taxation had been received. Thus, in March 1977 the headquarters of ICLARM was moved from Honolulu to Manila and it became fully operational as an independent Center.

# INTERACTION, INCOMPATIBILITY AND CONFLICT RESOLUTION: MANAGEMENT TASKS IN THE TROPICAL COASTAL ZONE

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## Introduction

Since ancient times man has exploited natural resources in the coastal zone, the biologically rich and varied interface between land and sea. The shallow seas, in particular, have for millenia yielded protein resources, and their adjacent coastal lowlands have provided a rich and diverse base for the production or extraction of complementary foodstuffs and other raw materials needed to sustain societies. But in many such areas the relatively recent and rapid growth of marine transport, commercial fisheries and non-renewable resource extraction, combined with commercial agriculture, industry, tourism and recreation, and the burgeoning urban sprawl and its attendant waste disposal problems, has led to increasing incompatibilities or outright conflict among the various uses and modes of occupancy of coastal marine waters and their adjacent coastal lowlands.

Whereas in industrialized nations coastal zone management problems are commonly those of overcoming existing incompatibilities or dealing with environmental degradation, management in tropical countries still depends largely on foreseeing and preventing such problems. Yet some coastal resource problems in the tropics are caused not by development, but by the lack of it, such as where the continuous discharge of even small quantities of untreated sewage leads to serious local beach pollution and human health hazards. Further, many intensely settled urban-industrial pockets along tropical coasts suffer levels of environmental degradation and incompatibilities in resource use akin to those of the industrialized nations. Thus in managing the coastal zone the level of local development must always be considered closely.

The principal categories of incompatibility or conflict that can potentially arise in the coastal zone include competition among resource uses for the coastal space itself, and, as the result of close proximity of activities, environmental impacts of one activity adversely affecting another. Such

spatial interference can extend over wide areas, and any coastal environment can be potentially modified by a far distant use of resources. An added complication is that interactions frequently vary through time, as the use of resources invariably changes. Thus the present dedicated use of a resource, or the impairment of the use of one resource as a consequence of the use of another, may preclude other potential uses of the same resource. A particular resource may also be subject to synchronic competition from different users, such as commercial and small-scale fishermen.

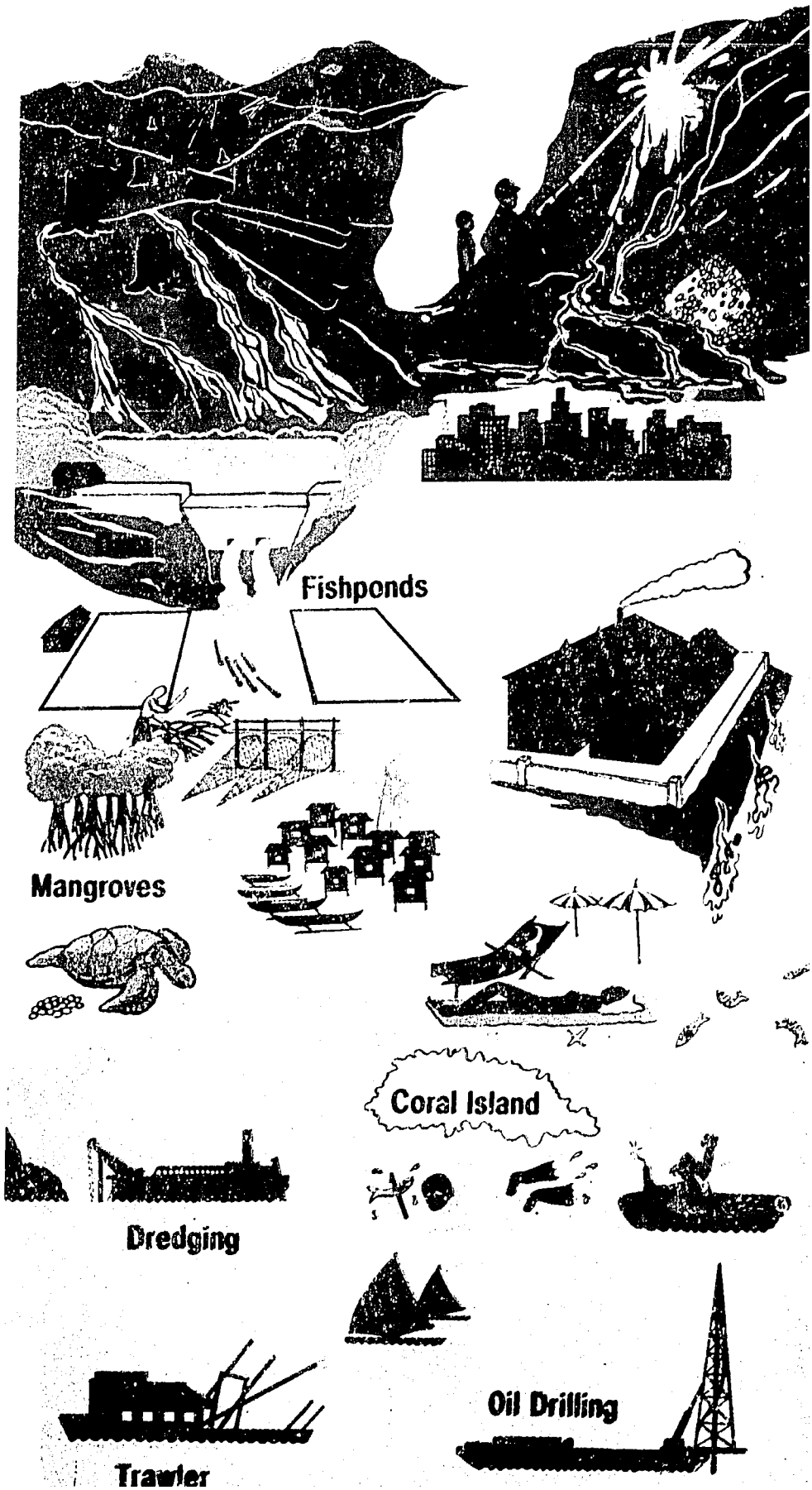
I will focus here mainly on the terrestrial components of coastal zones, and within them mainly on wetlands, which remain in many respects the most neglected, yet among the managerially most complex of tropical coastal ecosystems. I will also discuss briefly the linkages with upstream ecosystems that impinge on the coastal zone, as well as the complementary role of traditional knowledge and management systems in modern coastal zone management.

## Wetlands: Complex Coastal Resource Systems

For management purposes tropical coastal zones should always be regarded as complex and inherently fragile ecosystems. The limited nature of the resources and coastal space must be recognized and any development planned to maximize compatibilities and optimize the multiple use of resources. This is admirably illustrated by the use of tropical coastal wetlands.

The human occupancy of tropical wetlands reveals contrasting perceptions of their usefulness. Some of the world's highest population densities occur in long-reclaimed former wetlands on the deltas and coastal plains of South and Southeast Asia, but even in those regions vast, relatively unutilized areas remain. In contrast, ecologically similar regions, like the Orinoco Delta in South America, or the Niger Delta of West Africa, rank among the more sparsely populated regions. As regions containing large tracts of young alluvia, which result in tropical soils of above average fertility, many former wetlands have been converted into highly productive "bread baskets" in Southeast Asia, whereas in South America, for example, apart from relatively sparse and isolated human settlements, in recent centuries they have been largely regarded as marginal areas, if not as outright wastelands.

In most areas the potential high productivity and "true value" of tropical wetlands has been little appreciated outside local communities that utilize the renewable natural resources in a traditional manner. Commonly, the larger society has regarded wetlands as garbage dumps and wastelands, valuable only if reclaimed by bunding, draining, clearing and filling-in, and then usually devoted to a single economic use or to a simple combination of uses. Such actions, the hidden costs of which go largely unappreciated, may, if not performed judiciously, destroy a highly productive resource assemblage and indeed *create* a wasteland, as numerous cases have demonstrated.




Some of the activities that affect coastal zones and their aquatic resources. Tempera by Mark Anthony Go-Oco.

From both the natural and human perspectives tropical wetlands should always be understood as "multiple use" environments, some of the major natural functions and human uses of which include: a large production and large export to other linked ecosystems of energy and matter; a buffering of extreme changes in nutrient levels; an essential nursery habitat for many economically significant species of fish and other aquatic and terrestrial biota; the storage of water for dry season release; a major role in the biogeochemical cycles of nitrogen and sulphur; and the natural "treatment" of organic solid wastes and some chemical pollutants, such as phosphorus and nitrogen.

From the human perspective wetlands provide diverse, renewable natural resource assemblages that support mixed traditional economies based on capture fisheries, aquaculture, agriculture, animal husbandry, forest products, and hunting and gathering. Among the more specialized traditional uses of wetlands, and one that is virtually ubiquitous in Southeast Asia, has been the millenia-old conversion to irrigated ricefields, often in association with fish capture or culture.

It is important to recall that in wetlands, despite the seasonal dominance of the aquatic environment, large terrestrial ecosystems also exist, with forests and grasslands supporting game and useful plants, and levée soils providing fertile, non-flooded cultivable areas. As a consequence, many of the resource systems employed by traditional communities to exploit tropical wetland resources are basically agro-aquatic systems that mimic in sophisticated and "soft" ways the intimate and all-pervasive interaction between terrestrial and aquatic elements, the fundamental and outstanding characteristic of the wetland environment. A wide range of such systems has long been employed to sustain human communities, many of which use traditional and ecologically sophisticated means of procuring a principal foodstuff together with its nutritional and economic complements and other essential raw materials.

But policymakers generally foresee more specialized and "modern" uses for reclaimed tropical wetlands in terms of a combination of large-scale and unintegrated agriculture, aquaculture, animal husbandry or forestry; as sources of water for irrigation, industrial and domestic uses; and as sites for industry and human settlement. Few if any other wetland functions are ever perceived, let alone regarded as useful.

As a consequence of the *ad hoc* nature of development planning, itself not uncommonly the result of diverse vested interests, wetlands and the resource systems by which they have traditionally been exploited are increasingly endangered by two distinct kinds of threat. One is from programs to modify directly the biological and physical nature of the wetland environment itself; the other is from the impact of resource uses in upstream ecological systems with which the wetlands are linked via the hydrological system. In particular, the tropical wetland is threatened by *in situ* deforestation and its impact on soils, hydrology, vegetation and microclimates; upstream dam construction and irrigation; the exploitation of nonrenewable resources and land use practices both upstream and in the wetland; swampland reclamation

projects; excessive pressure on wetland primary resources; increased saltwater intrusion as a consequence of upstream interventions that reduce waterflow; excessive pressure on wetland primary resources; changing levels of naturally occurring compounds; and the introduction of pollutants.

Most traditional systems using the resources of tropical wetlands involve the balanced use of a primary resource as a subsistence base, together with sets of nutritional, economic and other complements. This raises the complicated problem of the multiple allocation of a common resource and the resolution of conflicts.

Conflicts arise and waste occurs when resource use strategies are not properly coordinated, potential alternative and complementary strategies not evaluated, and tradeoffs not made. Integrated resource management strategies are needed for wetland development and for environmental protection of interconnected ecosystems. However, such strategies are still in their infancy. Plans are likely to succeed only if the full use of the resource base can be brought about and sustained, since the productivity of individual resources is low and easily destroyed.

Compared with other ecological systems, it is only relatively recently that wetlands have been subject to sustained scientific attention and few studies have been conducted on tropical wetlands. More importantly, in terms of concepts and designs to guide formulation of alternative strategies for the use of tropical wetlands, precious little is known about their traditional use or of the impact of human interventions on the environment. This is one of the most neglected areas in wetland research.

Among the more effective strategies for using renewable natural resources in the humid tropics are those that transform natural communities into more specialized and managed ones which essentially maintain the fundamental structure and functions of the natural ecosystem but in which a few species of primary importance to the human community are cultured. In tropical wetlands or former wetlands this concept is exemplified by a wide range of adaptive strategies. One of the simplest forms is the widespread cultivation of irrigated rice and associated ricefield fisheries. Other systems are more mimetic of the wetland environment in that they maintain a wide diversity of biotic elements, while changing selected elements within it. This is exemplified by shifting cultivation and the transition to perennial crops in wetlands, as among the Banjarese and Buginese pioneer settlers in some Indonesian coastal zones, and especially by those systems that closely integrate agriculture and aquaculture. Yet other adaptive strategies, such as cattle herding, subsistence or small-scale commercial hunting, fishing and gathering, merely crop or cull naturally available resources, and if not overly intensive result in little modification of wetland ecosystems.

## The Importance of a Regional Perspective

The objective of any human intervention in a natural ecosystem is to direct the natural flow of energy and matter—the system's productivity or

potential productivity—into forms more readily exploitable by man. Manipulation converts natural ecosystems into resource systems; a set of actions that, by definition, both simplifies and destabilizes the natural system. Poorly planned or ill-advised interventions may so disrupt the natural processes and functions of an ecosystem that they bring irreversible disintegration and decline to its productivity and capacity to recover in the short and medium term.

The vast majority of incompatibilities or conflicts in coastal resource use occur in such intensively used and localized areas as estuaries, straits and lagoons. Although many problems arise directly from interventions in local ecosystems, an additional and far more insidious process is the destructive impact of inappropriate developments of "upstream" resources that affect closely linked "downstream" resources. In the more densely populated parts of Southeast Asia, for example, almost any river basin, from its watershed to the inshore coastal marine waters into which it flows, provides examples of environmental, resource and socioeconomic problems that have arisen from intervention in closely linked upstream ecosystems.

Relationships among linked resource systems comprise a particularly important part of regional management for sustainable coastal zone development. Interaction among resource systems is, however, an especially complex subject, for which the theoretical base and the data needed to frame hypotheses are largely unavailable throughout the tropics.

In most cases incompatibilities and even outright conflict in resource use have arisen because development of coastal zones and their associated river basins has proceeded haphazardly. Development projects have generally been planned in isolation, with little consideration or understanding of the larger regional system of which individual resource systems and seemingly isolated activities form integral parts. For the purposes of planning and managing resource development, coastal zones and river basins must be viewed as an assemblage of interacting resource systems.

Regional planning is necessary, moreover, because in the absence of policies or strictly enforced regulations on extraction rates and replanting, many watersheds are subject to intense pressures from forestry and shifting cultivation. Denuded slopes, exposed to intense tropical rainfall and insolation, suffer from accelerated soil erosion and landslides, and from a greatly diminished capacity to retain and gradually release water. The lost soil is rapidly transported by the now unregulated waterflow to both ecologically and economically more productive lower reaches of river basins, where floods destroy valuable investments, property and lives, and where silt, deposited in vast amounts and in an unusable form, fills reservoirs, clogs dams and irrigation systems, blocks harbors and wrecks coastal marine fisheries.

This set of problems is rampant throughout the tropics, where many formerly well-adapted traditional techniques of intervention in highland ecosystems, principally shifting cultivation, have now become maladaptive as a consequence both of population pressure and of greatly increased competition by alternative users for the resource space itself.

Many high-technology interventions, particularly when their environmental impacts are combined and synergistic as in a river basin, have caused and will continue to result in equal or even greater damage. Poorly designed and inappropriately located large dams and reservoirs, with their associated irrigation schemes, for example, have had serious impacts on river and coastal fisheries, increased the incidence and range of vectors of human diseases in coastal zones, seriously disrupted coastal zone watertables and agriculture and in drier areas have led to problems of soil salinization. Ironically, in the absence of upstream controls on watershed destruction, many such massive water resources development projects are themselves in severe jeopardy from siltation. Good coastal zone planning and management starts in adjacent and ecologically linked watersheds.

The multiple uses of coastal resources interact in varying degrees. Many of the common negative interactions are neither inherently conflicting nor mutually exclusive. Many undoubtedly arise from inadequate planning or from a lack of environmental safeguards. But when biological phenomena are involved in complex associations and interacting environments, as in the coastal zone, a large number of unalterable, uncertain and even unknown factors, like oceanographic conditions, biological cycles or water chemistry, preclude thorough planning. Moreover, the consequences of inappropriate uses are generally revealed only after a considerable time lag and often in locations far from the source of intervention. Causes are hard to pinpoint and cures equally difficult to effect.

This problem is exacerbated by poorly defined intra-governmental responsibilities and among those of different levels and forms (traditional versus modern) of government. Management responsibilities invariably overlap since most governmental departments and special agencies are organized by function; lateral linkages among them are rarely established. The common result is jurisdictional ambiguity. Clearly, a coordinated approach is required.

## Traditional Knowledge for Management: The Principal Human Resource

The demands of western-style, resource-extractive development strategies have inevitably conflicted unevenly with the adaptive strategies long employed by traditional societies for the sustained management of their local coastal resources. As a result, most such strategies either are already extinct or dying out. In the absence of viable alternative management models for tropical coastal resources, this represents the loss of a human resource of incalculable value, which has often accumulated over centuries.

Such traditional knowledge and management skills have a potentially great role in modern management designs; only a fraction of what is known about the nature, exploitation and sound management of coastal resources has been documented scientifically. On the other hand, as scientists have belatedly come to realize, the traditional users of such resources often

possess an encyclopedic knowledge and are, over much of the tropical world, the primary source of such data.

The traditional management techniques applied to coastal resources in many societies are another valuable example for modern managers to study, since many have stood the test of time for centuries. These include measures to manipulate and modify coastal ecosystems, as in many traditional systems of aquaculture, as well as closed areas and closed seasons, territorial use rights and gear restrictions in many traditional capture fisheries of the tropics. The progressive incorporation of such traditional techniques within a modern fisheries sector is perhaps best illustrated by the case of Japanese coastal fisheries.

It is not intended to imply that all traditional wisdom was necessarily wise or that traditional societies always exhibited restraint and used coastal resources in a sustained manner. Indeed, there are many examples that demonstrate just the opposite. But this does nothing to diminish the potentially valuable contribution of elements of traditional knowledge and management to solving or circumventing management problems in modern societies. Fortunately, there is now a growing awareness, as among many governments in Oceania, that research should be conducted urgently to record and support the best traditional coastal resource management customs, and where feasible to harmonize environmental legislation with those that remain appropriate to present-day conditions.

## Coastal Resources and Demographic Realities

Dramatic population increases are usually considered in terms of increased pressures on and therefore a decrease in quantity and quality of the renewable natural resource base. Only rarely is the issue turned around. It is more useful for immediate problem-solving to examine the population-resource equation in terms of the capacity of coastal resource systems to absorb manpower into productive activities and their economic spin-offs, that, in aggregate, lead to locally sustainable regional economic development.

For example, although integrated systems of agriculture and aquaculture are widespread in Asia they are not well known scientifically. Their socioeconomic aspects are complicated and little understood. Moreover, since these systems often exist where population pressures are intense, their labor demands and ability to absorb manpower require detailed analysis. Such basic information is urgently needed for a representative range of integrated systems in order to plan their further development as well as to effect successful technology transfer.

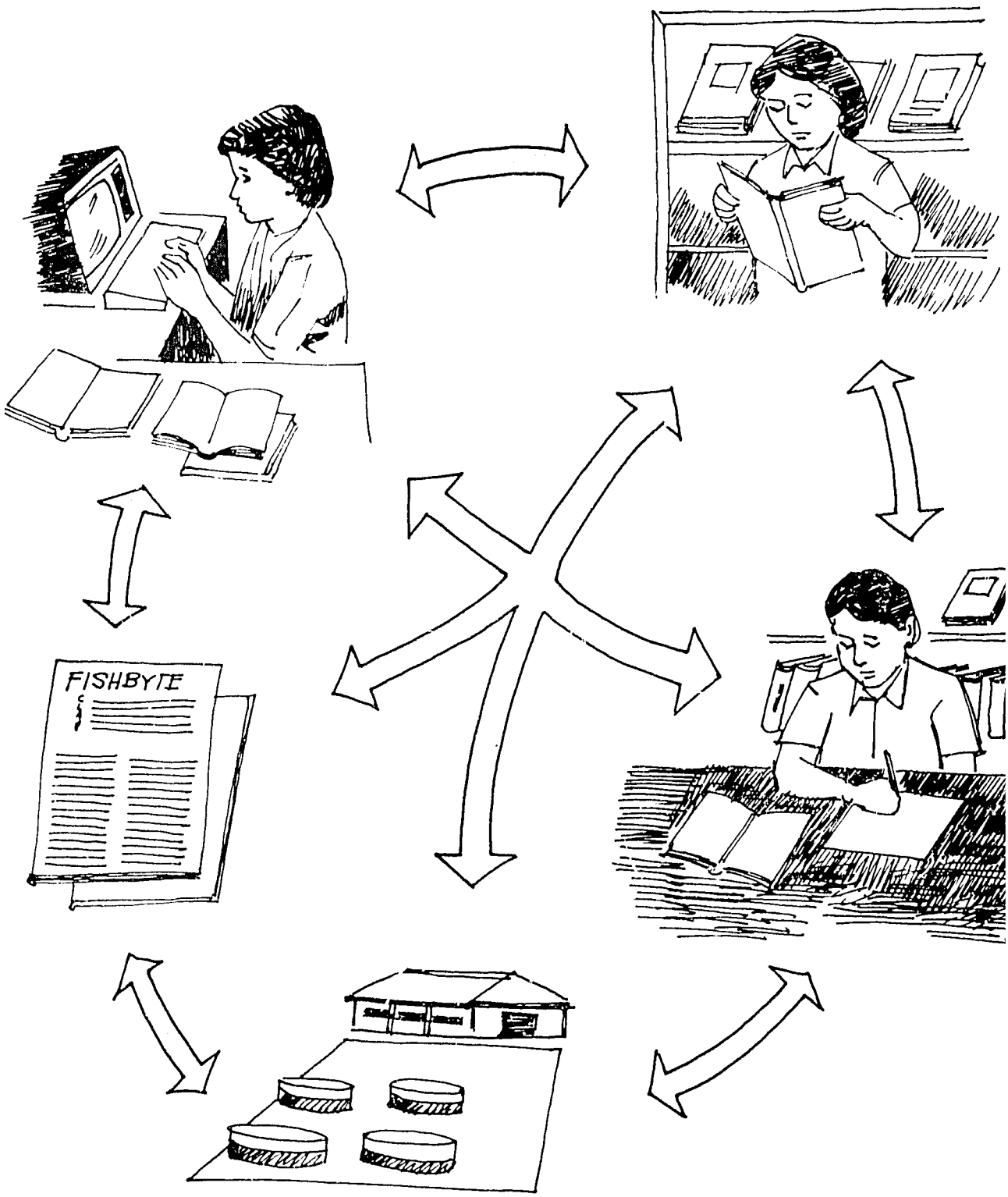
Elsewhere I have demonstrated a simple field methodology that provided a rapid and comprehensive assessment of the labor demand and absorption capacity of one complex integrated system, the dike-pond system of the Zhujiang Delta of southern China, which, although inherently labor intensive, under prevailing demographic conditions can absorb only 57% of the potential manpower available within the 20-39 years age group alone. I concluded that most households are heavily dependent on jobs outside

the system, which in some cases provide 50% of total net income. This work is now being replicated in traditional systems of aquaculture and integrated systems, as well as in fisheries in West Java, to assess their potential to absorb labor displaced by dam construction.

If the underlying objective of development is to improve and sustain at higher levels the socioeconomic conditions of myriads of communities throughout the tropics, then surely measures must be devised to generate remunerative employment to enhance household incomes equitably. Notwithstanding government policy and regardless of investment levels in industry and physical infrastructure, education, skill training and the like, and a massive and all-pervasive urbanization, vast numbers of jobs must still be created with low investment levels in rural areas, and mostly on the plains along the coast. But whereas there exist abundant census and other demographic data from which the supply of manpower can be calculated, there is virtually no useful information on the labor demands of resource systems. Although a painstaking task, it is one that must be undertaken urgently, along with the parallel acquisition of data on household economies for all the major rural resource systems in coastal areas. At present we are in the ludicrous situation of knowing the target population size, i.e., the manpower pool to be absorbed, but of not knowing the dimensions or characteristics of the most rapidly implementable logical solution, i.e., the labor absorption capacities and economic levels of the resource systems that exist all around that pool and which could be complemented, supplemented or upgraded, as locally appropriate, to use that manpower!

## Integrated Research and Integrated Management

To conclude, one cannot escape the fact that any solution to problems of managing coastal zone resources must be based on research, which is itself based on integrated biological and social models of coastal zone resource systems. Such models must be also integrated to include both the large-scale, regional perspective as well as the small-scale examination of household economics and decisionmaking with respect to resource use. Equally, there is no avoiding the fact that traditional knowledge and management systems potentially have much to contribute to the design of modern systems. The traditional and the modern must be integrated to go hand-in-hand in solving coastal zone resource management problems. To effect this approach some cherished stereotypes must be cast aside; and the sooner they are the better.


FISHBYTE

# NETWORKING AS A RESEARCH FACILITATOR

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Networking has become a "buzzword" in international research and with good reason. As funds tighten worldwide, administrators and donors are searching for ways to foster more efficient research. International collaboration in research, both informal and under the umbrella of formal agreements, is also stirring the interest of some scientists who see tangible benefits from sharing information, new technologies and research responsibilities.

## Network Types

Three main types of networks currently operate in scientific research. The typology presented here was recently proposed by Ralph Cummings, Jr. and Calvin Martin in a report of the US Agency for International Development to the Special Program for African Agricultural Research.[1] Information networks (type 1) are essentially passive operations in which information is fed out from a coordinator to individuals on a mailing list. Type 1 networks operate in a hub-and-spoke manner with minimal interaction between participants. In some instances, a two-way flow of information develops when individuals on the mailing list provide items to the coordinator for distribution to other network members. Information is disseminated through newsletters or, potentially, for scientists with access to computer terminals and the appropriate software and hardware, by electronic mail.

In scientific consultation networks (type 2) individuals involved in pre-existing, autonomous research thrusts agree to share information and

ideas. Scientists working in isolation increasingly have come to realize that new insights can be gained by sharing experiences. Changes may be implemented in independent research programs as a result of interactions with colleagues in different regions working on similar issues. Workshops or symposia are often organized to facilitate discussion of topics and problems of common concern, but research projects remain under local control and may utilize different methodologies from other participants in the network.

The major distinguishing feature of collaborative research networks (type 3) is that research is jointly-planned and coordinated. Most type 3 networks organize new research programs, although they generally use existing facilities. Because collaborative research networks are organized afresh, participants generally adhere to the same or very similar methodology. Also, research tends to be more sharply focused. As in the case of type 2 networks, participants may join regular monitoring tours or training courses.

Collaborative research networks have great potential for making research advances that lead to increased food production over large areas. Type 3 networks tend to tackle problems of broad significance, and sharing of information and technology is more systematic than in type 1 or type 2 networks. Also, because researchers in type 3 networks usually adopt the same methodology, results may be more transferable.

All networks can be highly dynamic, and research agendas and protocols can be changed quickly to meet the needs of the participants or the problems faced. Ideally, some networks progress from purely information sharing to more collaborative research. In one sense, collaborative research programs are an ideal form of networking since participants work closely together in planning and conducting research so as to reach a common goal. In practice, however, only a few networks today in agricultural research can realistically be classified as type 3. Most fall into the type 2 category or are simply information dissemination networks (type 1). Type 1 networks are the easiest to establish and probably only a few of these will eventually evolve into type 2 or 3 networks, although there is no reason why a type 1 network could not evolve into one of the other types. Type 2 networks are not as difficult to set up as collaborative research networks since they usually are established to link pre-existing research efforts, but often the ultimate goal of a type 2 network is to move on to collaborative research. Such a transformation may not be easy. Scientists have legitimate reasons for maintaining current research projects, and are often reluctant to restructure radically their research approach to accommodate a type 3 strategy. Therefore, when interest is keen and widespread it may be easier to set up a new collaborative research network than to try to move from a type 2 to a type 3 mode of operation.

Over the past decade or so, all three kinds of networks have multiplied spectacularly, particularly in the agricultural sciences, where over one hundred type 2 and type 3 networks are currently operating.[2, 3] The sharp decline in cost of microcomputers and letter quality printers with graphics capability has fueled the proliferation of type 1 information networks.[4]

The impressive growth of networking has been stimulated by a number of benefits which are not possible, or are at least more difficult to achieve, when working in isolation.

Six main factors have fostered the proliferation of networking in agricultural research. First, networks have a comparative advantage in tackling problems of broad regional or international scope. Second, networks can increase research efficiency, a major asset in an age of tight research funding. Third, insights can be gained from collaborative efforts, insights that would be difficult to achieve with the more limited activities of individual researchers. Fourth, networks facilitate the development of improved methodologies. Fifth, all networks improve communication between scientists, vital for the identification of significant problems and for the development of new ideas and research procedures. Finally, scientific consultation and collaborative research networks can facilitate research by organizing specific courses that upgrade national capacity in research, particularly in developing countries.

## International Problems

Networks usually have a significant advantage over isolated, individual research efforts in achieving a coherent understanding of widespread problems or issues. Experiments conducted at several locations enable researchers to identify general patterns, such as the genetic variability of a pest, and to extrapolate results with greater confidence. In the case of international nurseries, for example, crop breeders are able to get a reading on the yield performance of lines across a broad spectrum of environments. Specialized disease and pest nurseries enable breeders to gauge whether materials with some indication of resistance will really hold up under different ecological pressures or in "hot spots" where specific disease or insect pressures are greatest.

The Trypanotolerance Network, coordinated by the International Livestock Center for Africa (ILCA), and the International Laboratory for Research on Animal Diseases (ILRAD), also exemplifies the manner in which networking can facilitate the better understanding of a widespread problem. Trypanosomiasis severely restricts livestock production over vast areas of subSaharan Africa. Traditional control measures, such as spraying insecticides to kill the tsetse fly vector of the disease, removing vegetation where they rest and destroying wild animal populations that serve as reservoirs for the disease, have all had limited impact and in some cases have raised fears of exacerbated environmental problems. The Trypanotolerance Network, which spans 13 nations in West, Central and East Africa, explores the potential of cattle and other livestock breeds that can withstand the disease. Researchers in the network follow a common research protocol laid out in the network training manual. Before the network began in 1981, the ability of certain West African cattle breeds to tolerate trypanosome parasites was thought to be an interesting phenomenon, but not a very practical alternative since the trypanotolerant breeds were usually small

and considered of low productivity. Network researchers, by studying trypanotolerant cattle breeds in widely scattered sites with varying degrees of trypanosomiasis transmission, and under different management systems, have established that resistance is intrinsic and thus a heritable trait. Further, collaborators in this type 3 network have found that trypanotolerant cattle perform much better than larger but highly susceptible breeds under heavy trypanosomiasis challenge and, indeed, can be quite productive under these difficult conditions.

Another example of networking in agricultural research that has furthered our understanding of an issue of widespread concern is the transferability of information about crop yields from soils that are widespread in tropical regions. IBSNAT (The International Benchmark Sites Network for Agrotechnology Transfer), the coordination for which is funded by the US Agency for International Development, is a successor to an earlier network, the Benchmark Soils Project, which, like IBSNAT, was coordinated by the University of Hawaii and the University of Puerto Rico. IBSNAT spans soil sites in Africa, Latin America and the Pacific Islands. Five major soil families were identified for study, and widespread sites where these soils were located were selected. At each site, the crops were planted at similar times and were given identical fertilizer regimens to ensure that the main differences observed could be ascribed to the research site and thereby ensure a good measure of the effect of the soil itself. In this manner, it has been possible to predict yields of certain food crops on soils of similar type with reasonable confidence, thereby improving the basis for transfer of agricultural technology from one part of the world to another.

Another soil-related network, the International Soil Fertility and Fertilizer Evaluation for Rice (INSFFER), coordinated by the International Rice Research Institute (IRRI), is concerned with improving soil fertility and fertilizer use in rice. Different rice varieties are grown with various fertilizer treatments on numerous irrigated sites in tropical Asia and elsewhere. Multilocation testing helps to confirm yield levels on different kinds of flooded soils and helps uncover unforeseen problems with different treatments. Collaboration with scientists at dozens of sites in this type 3 network has produced a clearer picture concerning fertilizer application methods that produce the highest yields as well as providing new information about fertilizer efficiencies under different conditions.

## Cost Effectiveness

Networks rely on existing facilities and staff, rather than the construction of new buildings or the hiring of additional staff. In some cases, facilities or equipment such as greenhouses or microcomputers may be needed, but such investments are generally modest. In the case of INSFFER and IBSNAT for example, most of the facilities and personnel are part of national programs so no construction or new staff have been required.

Another way that networks maximize research effectiveness is by making better use of existing information. Many networks are set up to

expand the frontiers of knowledge, but one of the benefits of networks is that existing information can be better evaluated, more widely shared and, hopefully, used. Type 1 networks are particularly useful in this regard.

Networks are also cost effective because they can help to reduce redundancy in research. Research conducted in isolation can have pitfalls; one of these is repeating research that really does not need repeating. The soil fertility networks exemplify the advantage of identifying significant research questions and then jointly undertaking research over wide geographical areas to understand potential answers. The Lima-based International Potato Center (CIP—Centro Internacional de la Papa) supports a series of regional research networks with a view to boosting potato production. Research responsibilities are divided up among participants, ranging from 3 to 10 countries, according to their capabilities. One country may pursue research on a potato disease, another explores improved methods of storing potatoes, while another investigates rapid multiplication of superior potato varieties employing tissue culture. It would be difficult, and extremely costly, for each country to conduct adequate research on all these constraints to increased potato production, but sharing the work through the networks provides a way to conduct linked, purposeful research on a cost-effective basis.

## New insights

Advances in science occur by incremental increases in our knowledge base through repeated, careful experiments and by insights into processes and new procedures. Scientists in networks do not have a monopoly on insights, but scientists from several countries working in collaboration with each other are more likely to achieve significant improvements in understanding of major problems and, hopefully, find solutions for those problems.

Networks can expose scientists to a broader base of relevant information, particularly if they are participating in a collaborative research network. Patterns and interrelationships are often only discernible when data from widely scattered sites are assembled and analyzed. Periodic review of results, typical of both scientific consultation and collaborative research networks, allows scientists to identify issues for further research and often to drop fruitless efforts more quickly.

Specific insights have been gained from several type 2 and type 3 networks in agricultural research. In soil fertility and international nursery networks, for example, the need for better site characterization so that results can be extrapolated more reliably is now widely recognized. Scientists involved in the recently formed West African Farming Systems Research Network (WAFSRN) realize that the network's progress hinges on thorough study of agroecological zones in the region.

## Improved Methodology

Collaborative research can be an effective design facilitator and testing ground for new methodologies. Type 2 and type 3 networks expose scientists to methodologies they may not be familiar with, and provide researchers with opportunities to try them out and modify them as needed. The Trypanotolerance Network has published a training manual with research protocols that are used by all collaborators in the network. The IRRI-coordinated Asian Rice Farming Systems Network (ARFSN), which involves hundreds of scientists in Asia, has been instrumental in disseminating modern research methods in agronomy, fertilizer trials and socioeconomic surveys of farmers. Network scientists have been instrumental in designing and modifying methods for onfarm research under differing degrees of researcher and farmer control.

Standardized research methodologies can be very helpful in obtaining a clearer understanding of widespread problems. Networks do not force participants to adopt a methodology; indeed, rigid adherence to a preconceived mode of operation can be stifling. Network participants are encouraged to follow a standard methodology, but consideration is given to adapt research procedures to local conditions. The advantages of a common methodology are especially apparent in the soil fertility and trypanotolerance networks where generalizations can be made with much greater confidence.

## Improved Communication

Network participants should automatically receive feedback on results from all network sites on a regular basis. International nursery networks, such as the IRRI-coordinated International Rice Testing Program, which links close to 800 researchers in some 60 countries, produce interim reports on the results of nurseries in addition to an annual tabulation of all the returns. Further, newsletters keep collaborators posted on developments within the network and on other developments in their research fields.

Networks also facilitate communication by organizing workshops and conferences. Most type 2 and type 3 networks arrange an annual meeting for at least some of the participants to review progress, discuss problems and chart future directions for research. External donors play a key role in improving communication between developing-country scientists by funding travel for participating scientists to research planning conferences.

External funding is also crucial in supporting monitoring tours, another way in which networks facilitate communication. ARFSN, INSFFER, IRTP and many other type 2 and type 3 networks bring together some network collaborators to look at each others' study sites and to exchange ideas. IRTP, for example, operates a monitoring tour composed of about a dozen participants to several countries every year. Each IRTP monitoring tour has a theme, such as deepwater rice, and appropriate individuals are invited to participate.

## More Training Opportunities

Once a network is set up, it often becomes apparent that the scientific skills of participants need to be upgraded. The ultimate success of a network depends on the quality of participants, since collaborative research efforts tend to function at the level of the lowest common denominator. Networks should not be considered as a substitute for the long-term need to improve the scientific capacity of research institutions in developing countries.

In the meantime, however, networks often organize short-term but highly specific courses to help fill manpower gaps. The Trypanotolerance Network operates an annual course in Nairobi for participants. The International Maize and Wheat Improvement Center (CIMMYT—Centro Internacional de Mejoramiento de Maiz y Trigo) provides training for farming systems specialists in its eastern and southern Africa Economics Program (CIMMYT/ESA). CIMMYT/ESA organizes courses for administrators as well as for researchers.

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# EMPATHY AND STRUGGLE: ELEMENTS IN A FUTURE FOR SMALL-SCALE FISHING COMMUNITIES

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My intimate association with small-scale fishing communities began over a decade ago; the initial quinquennium was spent living and working among them in my home province—Kerala State, India. My first contacts with ICLARM and the possibilities of introducing its work to small-scale fishing communities came during this initial period.

To my mind the future of small-scale fishing communities the world over will depend on two key processes: empathy and struggle. Empathy from politicians, policymakers and scientists and struggles of their own not only to generate sociopolitical pressure for change but to create new vistas and new alternatives for their own wholesome development. These are mutually dependent and reinforcing processes. As the core of my essay I wish to elaborate on this idea after first exploring the causes and consequences of the sordid plight of small-scale fishing communities today.

## State of Small-Scale Fisheries Today

Small-scale or artisanal fishermen in developing countries are today the largest segment of the class of fishworkers. They number 15-20 million persons. Dispersed along coastal areas, they harvest a quarter of the world's fish catch in their pursuit of a livelihood. Their harvest provides the fish supply of local, rural consumers; it may also find its way to the homes of elite New Yorkers and to posh Tokyo restaurants. Despite their importance as food producers, small-scale fishing communities the world over share the common fate of having to survive at a quality of life often far below that of other citizens in their respective countries.

### *Cause of Poverty*

The cause of their poverty arose initially from a low asset position, particularly the lack of sufficient fishing gear, leading in turn to low pro-

ductivity. Small-scale fishermen harvest on the average only 2-3 tonnes of fish a year.

Added to this, their near total lack of control over marketing the produce of their hard labor resulted in unfair prices yielding low incomes and leading to indebtedness and total dependence on merchant financiers. The only saving grace in their vicious poverty circle was that Mother sea always held out the prospect of a bumper harvest. This helped to keep hopes alive.

With the onset of the "development decades" many governments of developing countries opted for the western path of modernization as the means to increase fish production. Traditional technology, accumulated knowledge of the sea and fishing, traditional socioeconomic forms and the conservation ethic of small-scale fishing communities were considered barriers to development and hence totally discarded.

Abandoning the 'small' in pursuit of larger-scale operations was considered the logical path to economic growth. The technological artifacts of the West were expected to alleviate all problems Raising production and productivity were seen to be the sole requisite for alleviating fishermen's poverty.

*Results of Development*

Substantial finances were mobilized and investments made on modernization programs. An evaluation of their impact on the socioeconomic condition of small-scale fishermen in the developing world yielded a variety of results.

The new technology in harvesting which led to higher productivity was introduced without providing adequate working capital and also without any change in the merchant-controlled marketing structure. This, coupled with the new and rising costs of production (particularly for fuel, repairs and maintenance) increased the dependence on merchant financiers often leading to a gradual loss of control over the means of production. A new class of nonworker owners emerged.

The higher capital and operating costs coupled with the increasing demand for fish, particularly for export, led to greater fishing effort to maximize short-run profits. The pressure to "exploit" nature intensified; more fish were exported; and the conflicts between fishermen using different levels of technology over fishing space and fish increased alarmingly.

In short what came to be termed "fisheries development" was inimical to the development of the majority of the small-scale fishermen, the long-term sustainability of fish resources and the nutritional status of the local consumers of fish. This was the situation which confronted most developing countries at the end of the 1970s.

*Globalization of New Concerns*

The dawn of the 1980s found most developing countries in a dilemma. On the one hand, largely as a pre-emptive step, they had to declare exclusive economic rights over vast territories of ocean to initiate nationally controlled industrial fishing and deep sea operations. On the other hand, since fisheries development had not yielded the desired results, they had to renew the emphasis on the basically inshore small-scale fisheries.

We have seen a growing internationalization of this concern for small-scale fishing communities and their future. Developed countries and international organizations have also been playing the small-scale fishery tune in the recent past. Much of this new-found relevance of the small-scale fisheries sector has centered around statements which emphasize that being labor-intensive it is more suited to the countries with surplus labor; that it produces nearly all the fish used as food in developing countries; and that having been ignored earlier now deserves a better deal.

My contention is that much of this renewed attention is at best a partial expression of concern for the social desirability of the sector. I find it hard to attribute sentiments of *empathy* to these waves of euphoric concern which emanate from the top of the new pyramidical structure of the fish economy particularly when most of this new concern has come only after the base of small-scale fishing communities rose in social and political upheavals against the weight of the superstructure!

## Empathy: In Action

Empathy is essentially the emotional identity we share with another's experience. For a more wholesome future for small-scale fishing communities such empathy from the state (politicians, policymakers) and from scientists is a necessary condition. The now very fashionable call for the development of small-scale fisheries and the participation of the communities in this process will remain mere slogans without the necessary structural changes in the fish economies of developing countries. These changes can be brought about only when empathy is transformed into positive action.

*Basis for Empathy*

To my knowledge the clearest and the most unambiguous statement about the desirability of the small-scale fishery sector comes from the small-scale fishermen themselves and those who have a proven record of genuine empathy with their cause.

The International Conference of Fishworkers and their Supporters (ICFWS) held in Rome in July 1984 alongside the FAO World Fisheries Conference stressed several functionally inherent advantages of the sector. Putting together the points scattered in the ICFWS report we have a basis

for empathizing with the small-scale fishery and the communities that it supports:

> The small-scale fishery is labor and local-skill intensive; it is capital and fuel-saving (particularly with the option of multiple energy use). Its technology and mode of organization and management are well mastered by local fishing communities and give rise to a decentralized settlement pattern. It does not promote large income disparities.
>
> Small-scale fishery operations are well adapted to tropical aquatic ecosystems. When its techniques are capable of destroying fishing grounds, local fishing communities frequently possess built-in mechanisms and rules for preventing overfishing.
>
> The small-scale fishery, far from being a stagnant one, has amply demonstrated in the past that it is innovative and easily amenable to efficient improvements. It is characterized by a high degree of flexibility.
>
> The sector is also well integrated into small-scale marketing channels which are low-cost, highly efficient and catering to local food needs. These are managed in many countries by women from the community.
>
> Thus the desirability of small-scale fisheries and fishing communities should be advocated for economic, ecological, technical, organizational as well as social reasons.

The most fruitful source of empathy for small-scale fishing communities is the state itself. The stand of politicians and policymakers in developing countries and the concrete measures they take to prove their bias in favor of the small-scale fishing communities is imperative. Certain crucial areas of action are exclusively in the purview of state power and no amount of autonomous efforts will substitute. Such political commitment has come from a few developing maritime states. The effect of this should be considerable.

There are three realms of state action, discussed below, which can greatly contribute to ensuring a secure future for small-scale fishing communities.

### *Aquarian Reform*

Like the now widespread agrarian reforms, aquarian reform solely on the basis of economic and social rationality can be undertaken by any popular government which genuinely considers strengthening the small-scale fishery a priority for fisheries and rural development.

There are two facets to aquarian reform. First is granting the right to own fishing assets exclusively to those who are willing to fish. With one stoke the breed of absentee fishermen, largely a product of the fishery development decades, will be pushed out, very significantly reducing the excessive fishing effort. The salutary effect of this measure will go a long way to enhance the ecological productivity of the inshore fishing zone and the economic productivity of the active, small-scale fishermen.

Second is the creation of an exclusive economic zone for small-scale fishermen in which the rights and the responsibilities for development and

management be theirs. This measure will give new significance and meaning to the now rediscovered 'Fishermen's Law of the Sea' and provide the basis for a new look into the usefulness of traditional forms of sea tenure practiced by small-scale fishing communities the world over.

*Control over Produce*

Rights at sea to become fully effective must extend to rights over the produce of labor at sea. The legal right to decide on the mode, structure and price of the *first* sale transaction of their fish should rest exclusively with small-scale fishermen. This legal confirmation of right will provide the foundation for them to organize the forms of producer control appropriate to their respective contexts. In the face of pressures from trade interests--whose track record with respect to fair dealing with small-scale fishing communities is hardly commendable—this legal entitlement will provide a basis for more zealous unity of action on the part of small-scale fishermen wherever and whenever it becomes necessary.

*Social Control over Export*

A related realm for state action pertains to the desirability of a greater degree of social control over the marine export industry. An excessive preoccupation with export-oriented fishery development models has been an important factor in the socioeconomic and technological marginalization of small-scale fishing communities. The initial benefits were quickly dissipated away due to the anarchic and imbalanced development in this sector. Larger social control over the export industry, particularly in the harvesting and processing activities where small-scale fishing communities tend to be greatly involved, is desirable to bring back the balance and also to complement the measures of aquarian reform and producer control over first sale.

## Role of Scientists

Empathy for small-scale fishing communities must also be forthcoming from the large contingent of social and biological scientists working on fishery issues. This is, however, no new phenomenon.

Persons like Fredrick Nicholson (a natural scientist and first Director of Fisheries of Madras State, India, in 1907), Raymond Firth (the anthropologist who wrote about the peasant economy of the Malay fishermen in 1940s) and C.C. John (marine biologist and fisheries advisor to the Governments of Ceylon and Travancore in the 1940s) were some of the prophets whose close associations with small-scale fishing communities led them to realize the synergic potentials of this sector. They emphasized the need to build up the fish economies of developing countries by stressing and building on the strengths of the small-scale fishing communities rather than discarding them for their weakness.

But discard them we did!

Fortunately for us today, since these small-scale, artisanal communities scattered all over the globe have always been involved in fishing primarily as a source of livelihood and food, they survived the neglect of being in the backstage of the modern fisheries development drama and continue to be with us in large numbers. Their rediscovery by our Ben Yamis, Panayotis, Thompsons, Ruddles and Willmanns as potential actors who know their lines and really *live* their parts calls for celebration. The views of these scientists and social activists--some of them closely associated with ICLARM--has produced many recent converts to "small-scalism". This has helped to bring small-scale fishing communities from the periphery to the center of the stage in discussions on fisheries development in developing countries. I want to highlight again three of the less emphasized aspects which need the wholehearted support of concerned scientists.

*Rightful Role of Women*

Let me start with the most neglected aspect: that of the place of women in fishing communities. One important lesson I learnt in my involvement with small-scale fishing communities was to look for the women behind the households of successful and happy small-scale fishermen. Often it is the wife, sometimes with the help of an elder daughter, that shoulders the prime responsibilities for the sustenance of the household--keeping it together as a contented social and economic unit. The fisherman's success is a function of his skills, perseverance and the integrating and supportive role played by his wife.

Women in small-scale fishing communities tend also to be more open and receptive to change, primarily because they interact more regularly with the larger social forces in society than do the men who spend more time away at sea. This is particularly so when women are involved in the marketing of the fish. I have also found that women in small-scale fishing communities are more sensitive to the deteriorating quality of life and the environment. Consequently they have more educated hearts when it comes to the rationale of conservation and the need for a more harmonious relationship with nature.

Many of the good intentioned programs tailored to the development of small-scale fishing communities have a strong gender bias stressing excessively the role of the *fishermen* and thus fail to appreciate the dynamic role that women play in the economic, cultural and moral life of these communities. With the increase in the number of women social scientists and activists in different developing countries, now working closely with small-scale fishing communities, we should expect more action on this front.

The recently formed International Collective in Support of Fishworkers (ICSF), which discussed fisheries development from a feminist perspective, recorded in its statement of shared concern:

> "We acknowledge the important role that women play in the sustenance of the marginalized fishery sector and are aware that they remain

> out of the mainstream of the decision making processes. We feel strongly that the condition of the fishworkers will not improve unless the situation and the potential contribution of women are given primary attention".

It is not too late for the rightful role of women to be stressed and accorded appropriate attention.

*Reinstating Artisanal Knowledge*

The second area pertains to rehabilitating and strengthening the time-honored fund of knowledge of small-scale fishermen. We are just beginning to see a trickle of literature highlighting the rationality of many traditional practices and skills and stressing the relevance of the encyclopedic fund of unwritten knowledge accumulated by small-scale fishing communities over centuries of learning-through-labor. The artisanal fishworkers' ability to catch fish rests more on their comprehension of the natural processes with which they interact than on the complexity of their artifacts. It is their holistic grasp of the nuances of their ecosystem and an understanding of the behavior of their "prey-in-context" that distinguishes their fishing for a livelihood from that of modern fishing ventures which are largely oriented to making quick profits.

Resurrecting something that has been shunned by strong forces is itself a herculean task. Giving it new respectability will be an even greater challenge. But it must be taken up and faced. As scientists and social activists our efforts should not be merely to remove the dust from artisanal practice and precept. A serious attempt to verbalize and systematize this artisanal knowledge--basically a people's science--will not only contribute to putting it at par with what is considered today as "scientific" but will recreate for small-scale fishing communities a renewed confidence in themselves and their abilities.

*Small is Here to Stay*

The third aspect which warrants greater empathy is the inherent merit of a small scale of operation in tropical waters.

The renewed thrust to promote small-scale fisheries in developing countries is largely premised on socioeconomic factors alone. I would venture to suggest that small-scale operations need to be encouraged for a very different reason: the ecological characteristics of tropical marine living resources, particularly the wide dispersion of numerous species each available in small quantities, ensures Mother Nature's inherent bias in their favor.

Small-scale fishermen forming a network of decentralized producer organizations, having community control over coastal resources, using small sail-cum-engine driven craft with photo-voltiac powered fishfinding and sea-to-shore communication devices and catering to the protein needs of the vast local populations in developing countries is a distinct scenario of the future.

## Struggle: Its Ingredients

If empathy in action was all that was required to ensure a bright future for small-scale fishing communities then the above six-point agenda for action would probably suffice. In the hard realities of our world, however, the final onus of responsibility for a secure future of a community must necessarily be the central concern of that community itself. This is a constant struggle.

In the past, the ingredients of this struggle and its very basis included the ethics of self-sufficiency; a working symbiosis between people and environments; maintaining ecological, economic and sociocultural diversity; and the focus of the fruits of labor on meeting the basic needs of people. These elements of the struggle must necessarily continue. The genuine empathy of policymakers, politicians and scientists will add up to a bright future for small-scale fishing communities only if it isolates and strengthens these ingredients of the struggle.

### *Ripples and Repercussions*

Struggles of small-scale fishing communities today in their attempt to create a brighter future most often go as unnoticed as quiet ripples in a sea. This new genre of struggles has not been restricted to the narrow realm of the politics of classes and social groups. Alternative paths to development are necessary and indeed have been shown to be possible. Here are some examples from across the globe:

- In the northern Philippines, a small-scale fishermen's organization, CALARIZ, has taken up the call for aquarian reform, demanding that the trend towards privatization of the bays with fish pens, curtailing the area of their common fishing grounds, be stopped. Along with their supporters they investigated the details about licenses for fish pens, pollution of the bays, and the unauthorized operation of trawlers. Armed with their findings they have resorted to various nonviolent forms of protest against the injustice of depriving them of their traditional source of livelihood. With the greater democratization of their country hopes are high for a better deal.
- The small fishermen of Kuala Juru in Malaysia hosted in 1985 an exchange program at which small-scale fishermen from neighboring Thailand and from the Philippines spent two weeks learning the art of cockle culture. This fishermen-to-fishermen technology transfer is a small but right step in the direction of adopting appropriate technology. Language, cultural and religious differences were no hindrances to mutual learning—on the contrary it greatly reinforced the need for greater south-south solidarity to solve the common problems of the small fishermen.
- The South Indian Federation of Fishermen Societies (SIFFS), a nongovernmental apex body of genuine fishermen organizations, is helping its members to market their fish collectively. The intervention is so designed that the bulk of the fish reaches the local urban and rural consumers. With the outboard engine revolution only just reaching small-scale fishermen in South India, SIFFS has embarked on a training program for fishermen to

demystify this new artifact by teaching them how best to handle it to minimize fuel consumption and maintenance costs. SIFFS's newly built beach-landing plywood boats (on which engines are used) are designed to use efficient sails, encouraging fishermen to use multiple-energy sources which cut operational costs and help retain their traditional expertise in sailing.

- African fishworkers from 13 countries met in Cape Verde recently to discuss the impact of foreign fishing vessels operating in their territorial waters on the fish harvesting capabilities and incomes of the small-scale fishermen. The issue of appropriate forms of economic organization for small fishermen was also a topic of concern. The exchange helped fishermen to compare notes regarding the pros and cons of the varied experiments now in operation in their countries which include total state control, quasi-government cooperatives and complete free enterprise.

- ANPAC is the association of artisanal fishermen in Colombia. With years of rich experience they have taken the initiative to support and strengthen the fishermen's organizations in other Latin American countries. Issues considered priority include: pressing governments for better planning of coastal industrial development which will reduce pollution of coastal waters; technology transfer between fishermen of different countries aided by technologists committed to the cause of the small fishermen; lobbying to ban trawling in nearshore waters—for which they will depend heavily on experiences of small fishermen from other parts of the world.

- In Chile a congress of small-scale artisanal fishermen associations was held in late 1986 to take stock of their common problems and work out a concrete alternative plan for development of the sector which would have at its center the interests of the fishing communities and local fish consumers. One important fallout of the congress was the formation of a representative national body with the help of supporters to give the desired element of continuity to the struggles initiated to create a new tomorrow.

There is a view that these actions of small-scale fishing communities from different parts of the globe are insignificant and quiet ripples creating no repurcussions beyond their own limited circle. No assessment of the potentials of these communities could be more off the mark than this. Over the last decade the growing ability of small-scale fishing communities to have their voice aired both at regional and international forums, as well as the support and empathy they have received from several quarters, is ample proof of the fallacy of the above view.

## ICLARM's Future: Beyond Empathy

Small-scale fishing communities will no doubt continue to be at the heart of plans for ICLARM's future activities. To be relevant to the aquatic realities of developing tropical water countries this is an association that must necessarily be strengthened. My plea is that there be in the future a conscious attempt to go beyond empathy: to move from a level of association implicitly required for the nature of the research priorities of ICLARM to an expression of concrete forms of solidarity with the struggles of small-scale fishing communities. The distance between empathy and solidarity is small. The problem is that the strong resistance between them is often

unsurmountable. The attempts and the progress made in crossing it will certainly be one measure to evaluate ICLARM's second decade of involvement, at least from the viewpoint of the small-scale fishing communities.

"The fisherman's success is a function of his skills, perseverance and the integrating and supporting role played by his wife".

# SOME RESEARCH NEEDS FOR AQUATIC RESOURCE DEVELOPMENT

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This article presents a donor country perspective, highlighting some issues of aquatic resource development in developing countries, which can, perhaps, be approached best through highly collaborative long-term research, using approaches similar to those often utilized by ICLARM.

Programs of the Agency for International Development are focused on improving the incomes and employment opportunities of the poor majority in developing countries. Our orientation, therefore, is toward approaches that are labor intensive rather than capital intensive, with a bias towards micro-enterprises rather than large-scale industry. Many developing countries choose to harvest their fishery resources through large-scale industrial fishing or to rent their resources to foreign fishing fleets. While this approach may be most appropriate for some countries, it is not considered in this paper.

## Benefits to the Poor Majority

Fisheries in developing countries may be categorized into two general situations. In the first situation, exploitation of new species or stocks is still economically profitable. Private investment can be attracted easily if markets are available. Generally, existing technology is suitable and development offers no special problems, at least in the short run. The second situation, unfortunately, is much more commonplace in developing countries today: resources are already heavily exploited or overexploited; net profits are very small because of overcapitalization (too many boats and too much gear are being used); and the costs of harvesting are excessively high in relation to income. The dual causes of this situation, the common-property nature of the fishery and its open access to all fishermen, have been discussed by many authors. This paper addresses one aspect of the problem that has been largely neglected by researchers. That is, what can be done to address the problems of the poor fishermen under such circumstances; particularly, what can be done to increase incomes of the large numbers of coastal fishermen now only

subsisting in the sector? The central issues are those of property rights (moving away from the common property nature of the fishery) and equity (distribution of income from the fishery among large numbers of participating fishermen).

Both issues are sensitive, national issues deeply rooted in tradition and accepted practices. Often the decisions have political consequences as well as social implications. The problems have been addressed squarely and directly so few times that possible solutions, based on successful precedents, are hard to identify. In the following paragraphs, both issues are explored to encourage open discussion and research in a subject area that has often been viewed as "off-limits" for fisheries researchers.

## Research on Property Rights

The traditional view is that fish, like air and water, are common property resources, available to everyone for the taking. Historically, when fishery resources were abundant relative to the demand for food, the practices which flowed from this view were acceptable. However, this view is slowly being modified, first at the international level and more recently within some countries. Early claims of fishery jurisdiction of 3 to 12 nautical miles have given way to recent claims of 200-mile jurisdiction by those nations which have signed the Law of the Sea Convention. This first step away from the international common property view of fisheries resources puts most of the world's fishery resources under the ownership of individual coastal nations.

Nevertheless, the common property concept persists within most nations, perpetuating the related problems, i.e., competition for the harvest, overcapitalization and loss of economic rent from the resource. Enforcement of laws or regulations set by central government is prohibitively expensive, especially on the high seas. In practice, there has been insufficient enforcement of regulations, thus permitting such extremely destructive fishing practices as poisoning and use of explosives.

There is a ray of hope in this bleak scene, in that exceptions are being made to the open access tradition. Most commonly, exceptions have been made where the adverse consequences of open access are most apparent. Examples are:

- *Shellfish harvesting and farming.* Ownership rights are assigned to sea bottom, space occupied by floats, or coastal land for harvesting or farming of molluscan shellfish.
- *Weirs and traps.* Concessions are granted to individuals to harvest fish in narrow entrances to lakes, rivers and estuaries, sometimes on the basis of historical fishing practices.
- *Fry collection.* Sole privileges to harvest fish fry may be assigned to municipalities or groups of fishermen.
- *Reef fisheries.* Families or communities may have traditional exclusive rights to fish reefs adjacent to their land.

Researcher interviewing fishermen. Questions of property rights and equity are central issues.

- *Aquaculture.* Space in public waters or in public land for cages, pens or ponds is granted to individuals or companies.
- *Limited entry.* Numbers of fishermen harvesting a resource are limited through one of several mechanisms.

Research on allocation of fishery resources property rights should be focused on what is needed in particular country situations. One approach fishery managers could consider is the further assignment of exclusive fishing rights to local governments, fishermen's groups or individuals. Among the potential advantages suggested by proponents of this approach are:

- reducing excessive harvesting costs related to competitive fishing for limited resources;
- improving compliance with regulations which can be set and enforced by the local "owners" themselves;
- improving possibilities for careful husbandry of resources to maximize sustained productivity for the benefit of the "owners";
- reducing costs of management and enforcement to the central government;
- allowing extended harvest times to optimize prices, to provide full-time employment, and to permit full-time use of harvesting vessels and equipment;
- opening opportunities for determination of equity issues on a local basis by fishermen themselves.

Resistance to change is strong and disruption of existing socioeconomic practices may result in drastic politicial repercussions which few government officials are willing to risk. If changes are to be made, careful research must first be conducted, perhaps associated with local trial modifications of traditional practices, to fully document the positive and negative socio-economic consequences of proposed changes. Innovative research plans and new ideas are clearly needed.

Several institutions (Resources for the Future, ICLARM, FAO, the University of Rhode Island and others) have laid the educational groundwork for eventual changes and for research on property rights issues through their publications, preliminary research, and training on fisheries economics and sociology. The FAO/UNDP Bay of Bengal Programme has moved boldly toward participation of community members in all aspects of fisheries development and is providing a valuable model for related research.

Specific research opportunities and needs in this subject area could focus on the "exceptions" to common property status listed above and other cases of fishery ownership rights. The successes and failures, including their economic, social and cultural aspects, should be thoroughly studied and documented as a basis for new research. The structure and functions of fishermen's organizations require additional research as some organizations have proved viable while others have not. Additional documentation of historical and current legal practices is also required. The educational processes required to increase understanding of fishery management and to increase amenability to changes of traditional legal and social systems are themselves poorly understood and could be a topic for research. (National

governments and their agencies are key to making changes, and the best approaches for educating personnel in these agencies are not always understood.)

Where fishing grounds are clearly defined (e.g., bays, reservoirs or lakes) and where local fishermen are well organized through fishermen's associations or cooperatives, opportunities exist to introduce experimental changes in fishery management concepts. (Possibilities include participation of fishermen in the establishment of regulations, education of fishermen in terms of basic principles of fishery management and direct involvement of the fishermen's organizations in law enforcement.) To the extent that any initial steps are successful, other changes can be introduced gradually until the fishermen's organization has full responsibility and exclusive ownership rights to the natural resources upon which they are dependent.

In some instances long-term leasing of resources to private individuals or firms may be a valuable topic for research.

An alternative approach which fishery managers could consider in assigning property rights is to limit the number of fishermen who participate in a given fishery. Licenses can be limited in number or priced to reduce numbers of fishermen and/or fishing vessels, or licenses can be retired upon the death of a fisherman. These and related practices can prevent open access or the addition of newcomers to the fishery, but they do not address problems of allocating the catch among licensed fishermen or of managing the fishery for sustained benefits. These issues can perhaps best be addressed by the fishing community itself in light of a sound understanding of the resources and the fishing industry.

Modification of legal frameworks and institutional systems is not easy or simple as it often requires central governments to relinquish authorities, including the authority to levy fines, and central control. Perhaps one of the most difficult tasks facing researchers will be to persuade national resource managers that the potential benefits of new approaches outweigh the difficulties of testing these systems. If fishermen understand their long-term relationship to the resources and are able to cooperate effectively to maximize community benefits through local control, the experiments will be successful. While the introduction of local resource management poses some difficult problems, it appears to offer a far better hope for sustained resource utilization than existing systems which are based on central controls.

### Research on Distribution of Income

The options open to governments in terms of distribution of incomes from fishery resource utilization are many and diverse. It is important that these options be understood and considered.

Where fishery resources are already fully utilized, the addition of more sophisticated and larger gear simply divides the pie in a new way. Owners of newer gear will take a greater share of the harvest while those using traditional gear will have less to divide among themselves. The typical,

continual entry of additional small-scale fishermen into a fishery means that an ever-increasing number of fishermen progressively reaps a smaller portion of the total catch. This is equally unsatisfactory. Some resources can be harvested only with expensive vessels having high seas capabilities and some can be harvested more economically with small vessels requiring relatively small inputs. The economics of fishery utilization are interwoven with equity considerations; a full understanding of the economics of a given fishery is a prerequisite to addressing distribution of income from the fishery.

If prior governmental decisions have been made to favor development of large-scale fishing for economic, political or other reasons, the government involved may not be prepared to address questions of equity. If, on the other hand, the government places a high priority on distribution of income and is willing to implement changes in policy that may be politically sensitive or economically damaging to large investors, research may suggest the best approaches and illuminate the risks. While in the ideal situation questions of equity are addressed before the fishery is fully exploited, only a few countries still have an opportunity to follow this approach.

The research needs are first to describe fully the economic parameters for each fishery, including all inputs and benefits, so that the existing situation can be fully understood by resource managers and government administrators. Such descriptions should include the numbers of participants contributing to and benefiting from the fishery and the distribution of inputs and benefits by income groups. Secondly, the studies should describe the likely course of resource harvests and industry economic welfare under existing and modified fisheries management practices. (Existing knowledge of tropical fisheries population dynamics and fisheries economics is sufficient, in most cases, to permit development of reasonably accurate scenarios.) Finally, opportunities for government interventions should be identified and both positive and negative consequences of such interventions on income distribution by income class should be documented.

The effects of the interventions, such as gear restrictions, control of energy usage, and area or time limitations on fishing, should be described in terms of the resources as well as in terms of the combined long-term effects of all policies and regulations on individual productivity, fishermen's incomes, net economic rent captured nationally from the resource and alternative uses of resources, labor, capital and other inputs.

There are many alternatives for harvesting fish and distributing the derived income, and the choices among alternatives must be made by national governments. One difficulty facing today's resource managers, or decisionmakers, is that the various alternatives have not been clearly documented and explained in terms of their possible benefits and risks.

The research challenge is to develop an information base, with reliable data from developing-country fisheries, that is available for use and can be readily interpreted by resource managers and national decisionmakers.

The problem of distribution of income is inseparable from the problem of property rights; thus the research on these two issues will overlap as

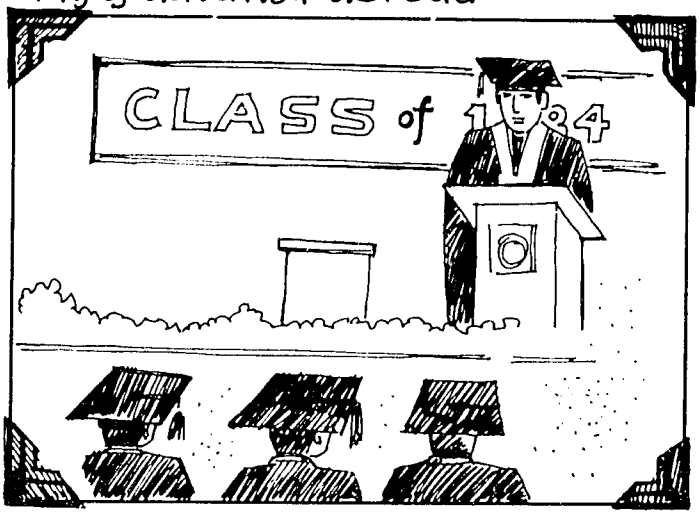
well. If authority to allocate property rights is given to local fishermen's organizations, it can be expected that these organizations will begin to address income distribution issues. Both issues impact very heavily on the livelihood and life style of what in many countries is a very independent group of people, the fishermen. Corrective steps are unlikely to be successful without the active participation of the fishermen themselves.

## Conclusion

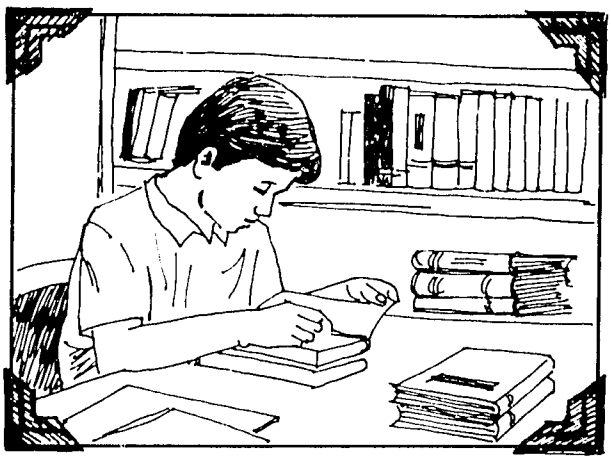
Research in this neglected area is needed if real progress is to be made in improving the lives of the poor in many developing countries. Needed research is not just in the traditional lines of biological research, where most fisheries scientists have been trained, but also in social science research. Even social scientists may find that this area of research demands innovative and bold initiatives to change traditional thinking. The results of a strengthened research effort may revolutionize fishery resource management practices.

Research will be a difficult, expensive and time consuming task, perhaps generating adverse political repercussions in some cases. Nevertheless, failure to address issues in the allocation of property rights and income distribution will lead to continuing deterioration of the fishing industry in developing countries and a dismal economic outlook for the small-scale fishermen.

My graduation abroad

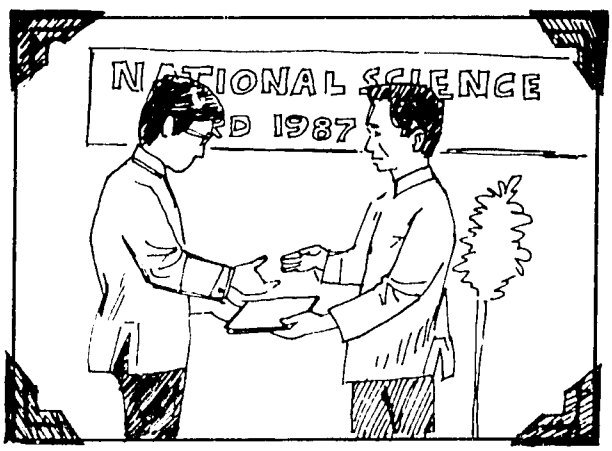



The facilities were not very good back home



But the library was a great help

My award for developing the new technology




Snapshots of the beginning of the successful career of a developing-country scientist, after graduating abroad and returning home. The many difficulties along the way are described in the following pages by Dr. Santelices.

# DOING SCIENCE IN DEVELOPING COUNTRIES: SOME PROBLEMS AND SOLUTIONS*

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## Introduction

Over the last 30 years several generations of Latin American scientists have been trained abroad and returned to their respective countries to assume academic responsibilities. There have been different outcomes, but frequently personal as well as institutional expectations have been frustrated, scientific production has been low and emigration and brain drain have been frequent. There are many causes and some of them have been discussed in previous reviews.[1-5] Sometimes the problem has been approached from the viewpoint of the researchers' personal experience and the difficulties they have to cope with when starting a new research line in their country.

The following analysis is a summing up of personal experiences during ten years of scientific research in Chile, from my return after completing postgraduate training abroad. The absolute certainty that many other investigators are facing similar problems led me to conceptualize and arrange the relevant issues and possible solutions hierarchically. The aim of this analysis was to identify common problems whose solutions may improve the quantity and quality of scientific research in developing countries. This is not intended to be a comprehensive analysis and it is recognized that there are also chronic, paramount, economic constraints.

I have distinguished two periods each with very different constraints. The first period is from when the returning researcher begins work in an academic center until he or she has achieved a certain level of development. During this period, there are three main factors: the academic characteristics of the institution receiving the researcher, the "landing syndrome"; and the first manuscript.

Once the research activities have attained a certain level of development the researcher may attempt qualitative changes in scientific progress. There are many possible qualitative changes but I shall refer here only to three processes, namely: the passage from research microprojects to multi-institutional macroprojects; the attempt to contribute to the management

and development of resources through scientific research; and passage from a research project to scientific creation.

## The First Period

### *The Receiving Institution*

Three characteristics of the institution receiving the young researcher after his or her postgraduate training are particularly important.

One, named here as the institutional research tradition, implies recognition by the authorities and other members of an institution that research is not only good or desirable for academic development but that it is indispensable. This implies the harmonious organization of all academic activity permeated by this concept. At present in several universities and higher education institutes in developing countries, research councils and science faculties have been or are being created for the support and the development of scientific research. However, it is commonly accepted in our Universities that scientists still have to face the following issues, all derived from the lack of an adequate institutional research tradition, and which can neutralize research-oriented budgets or efforts:

- excessive teaching and administrative loads that do not leave time for research;
- the teaching is essentially to undergraduate level;
- the research budgets have symbolic rather than real importance;
- the research budgets are alloted to an excessively large number of microprojects, with emphasis on university statistics rather than on a real scientific advance;
- inadequate facilities (equipment, bibliographic material, support personnel);
- academic positions often held by people with limited or no capacity for scientific research and a slow attrition;
- lack of a critical mass of researchers able to exchange ideas, improve methods and discuss results;
- university authorities and executives often have little understanding of the actual meaning of science and scientific research.

This institutional reality is decisive for the future scientific development, therefore it is important to find out whether a scientific tradition does exist in the institutions of which we are expecting good research results. If absent, the most adequate strategies for its development should be promoted. Such development frequently implies a conceptual change, encompassing several generations of professors devoted to its progress, often to the detriment of their own research lines. This may mean a long period, not only for obtaining resources and for training students, but also for thorough planning and changing structures. A continued effort is needed so that the whole university community may become aware of the importance and need for research within the academic activities.

Stability of institutional policies is a second important characteristic to consider. Political changes in developing countries are frequent and they often result in frequent changes of academic authorities, instability in internal policies and changes in development priorities. These changes always have slowed down scientific development, often with losses of whole research groups, of professors with good research tradition, or of promising young collaborators.

The third important character is institutional flexibility. The current academic structure in many places is often the result of a historical process initiated long before there was any awareness of the importance of scientific research. Accordingly, when this organization is rigidly maintained, it becomes a serious limiting factor for institutional development. It must be recognized that the basic working units, the so called "laboratories", should be opportunistic groups of individuals sharing similar research interests and whose getting together allows a better use of the limited human and material resources available. Thus, the number of researchers within a given laboratory and their relationships can change as their interests in research also change or as scientific advances make them withdraw obsolete lines of research and promote the development of new approaches.

*The "Landing Syndrome"*

Graduates returning to a developing country will eventually join the staff of some institution, becoming integrated into an environment with more or less scientific tradition. At the time, they will probably lack institutional perspective and, having come back full of ideas and projects for scientific development, will try to implant the institutional reality that prevailed in the place where they graduated. Obviously this may generate false expectations which can easily frustrate them. Not knowing the implications of an institutional scientific tradition, their first contacts with reality will be often too disappointing, resulting in "academic mortality", i.e., emigration to another academic center (generally abroad) or abandoning attempts at pursuing research.

People surviving after this initial "shock" will attempt to publish papers derived from their training period and try to start research work. Due to the current level of science development in developing countries it is very likely that, in practice, this will mean initiating a new research line. Thus, the researchers will have to face a variety of problems, among which:

- budgets will be limiting, since they will require new equipment, new bibliographic material and new installations;
- manpower (collaborators, students, etc.) also will be limiting, the number of researchers per area is too few; also, assistants and potential collaborators are not adequately trained;
- the new research will depend on biological knowledge of the organisms involved, which is often only at the taxonomic level, requiring additional lateral research;

- capacity for such lateral research will depend, among other factors, on the quality and depth of training abroad;
- all the other limiting factors related with the level of institutional development.

Obviously, it is not easy to solve these problems. However, some experiences allow us at least to reduce the limitations mentioned. Some Latin-American universities and several international institutions have designed special support programs for young researchers on their return to their country. Usually these are research projects with budgets under 10,000 dollars, but they allow postgraduate researchers to settle down and start activities; they also allow them to start training students which, in the long run, will be the only productive effort helping to diminish the limitations of human resources.

The new researchers may have to spend time, effort and resources in order to learn some biological aspects of the organisms under study, for which they may not have been trained. The funding agencies often ignore this fact and can disqualify a project due to its taxonomic-descriptive component, thus misunderstanding the actual situation and the need to fill up this gap. This is also frequently misunderstood by program designers unable to perceive the need for ample and deep training programs abroad so that the researchers may cope with the multiple technological, scientific and managerial problems they have to face on the first stage of their return to the mother country. Finally, even the researchers may ignore this reality and fail to understand that they should propose several research lines parallel to their main interest instead of trying to replace their interest in scientific creation by minor taxonomic or descriptive works.

*The First Manuscript*

Despite all the constraints mentioned above, it is possible that the young scientists may produce a first manuscript based on research pursued in their country. Most likely, they will intend to publish it in an international scientific journal, preferably foreign. This choice is partially influenced by their own expectations and also determined by the local policies of scientific development which, in an attempt at raising the quality of research, may have unduly emphasized the need of publishing in "international journals with an editorial board". In many cases this paper shall be accepted after the usual process of manuscript revision. However, it may occur that the manuscript will be thus qualified: ". . . the work is only locally important . . ." or ". . . this kind of study has been already widely documented . . ." Even if the manuscript is accepted, the author has the feeling of "being too late" with the scientific findings; or that he or she is working only on the periphery and not in the core of the scientific progress in that field. In either case, they feel that their final product lacks importance, is peripheral to the development of the subject and that science could perfectly well follow its course without them having spent such energy, time

and resources in producing their work. Such feeling is stronger when the researchers have been obliged to deviate from their main research interest in order to cover basic aspects of the biology of the organism under study.

In some cases this will produce additional academic mortality and a number of researchers will refuse to produce a new manuscript. It may induce other investigators to disconnect themselves from international patterns and standards, leading them to publish only in local journals where their findings are more readily accepted. In other cases still, it will lead the scientists to select subjects of research acceptable by international journals, but which do not help to solve their own local problems. Perhaps it would be advisable to revise the traditional academic policies of assessment and allocation of research resources that emphasize "publication" to the detriment of other aspects of development.

A sound alternative would be the creation of local publications whose editorial boards, besides maintaining a high quality according to international standards, may better understand the interests and problems of the region.

Experience shows that once researchers have overcome this battery of problems, and have published their first manuscript, they can keep up this action more or less indefinitely, and will acquire local and sometimes international prestige as well. Finally, the number of students will increase, generating a local school of ideas and work.

## Qualitative Changes

Researchers who wish not only to publish papers but also to modify substantially their scientific role will face other problems. Three of these are discussed below.

### *From Research Microprojects to Multi-institutional Macroprojects*

One of the ways suggested for obtaining higher productivity in developing countries is the possibility to coordinate multi-institutional programs which are more productive than a mere sum of individual efforts as they are carried out under less limiting conditions. However, the following must be considered:

- Institutions, like people, have personalities. It is necessary to understand such "personalities", which are expressed in their policies for resource utilization, relationships between individuals, etc., in order to achieve an adequate multi-institutional interaction. Also, differences between institutions should be recognized, specially with regard to their strong and weak points in the work to be carried out. This should help to define the reasons why a given institution or a given research group ought to participate in the projects.
- The heterogenous institutional development must be particularly taken into account. It is frequent that important aspects of research in a given institution are delayed because they depend on processes

and actions of another institution with a significantly different level of development.

- Similarly, professional jealousies, and other forms of incommunication between researchers, have to be checked for the sake of harmonious development of the project.

*From Miniproject to Management and Development of Resources*

Different problems arise when projecting the results of research work to the management and development of renewable resources. The main problems are lack of communication, lack of adequate training, institutional intertia and other limitations in the application of results.

In many developing countries most research is carried out in universities. Historically this has meant less development of applied research compared to so-called "basic research". Government officials responsible for the management and development of resources are not always clear enough with respect to research priorities. This often results in a lack of specific goals for the researchers, with consequent lack of communication, loss of resources and in general, poor planning in the design and execution of the studies required. In addition marine resources usually investigated by university researchers are benthic littoral organisms of less economic importance than pelagic resources, which are at the foundation of the fisheries industries.

Often the results, though interesting from an academic viewpoint, have been of little practical use. On occasions, management recommendations were only based on the biologic knowledge of the resource, without considering the need of multidisciplinary approaches including economic, legal, social and political aspects. It is sometimes surprising to find that competent and skilled researchers, who are outstanding in the design and management of their own experiments, may express rough and subiective judgments concerning policies for resource management. Besides reflecting a lack of training in these areas, this attitude reveals their lack of interest in studying cultural aspects that go beyond the scope of their scientific routine.

On other occasions, after having overcome the problems of training and communication, the recommendations about the management of resources have not been put into practice because the people responsible did not understand them, or did not know how to do it, or were restrained by institutional inertia or rigidity. Or else, recommendations and plans of management and development were not accomplished because they depended on other factors, like the economic model in force in the country and employment levels. This has provoked a growing feeling of frustration and resource managers and biologists have come to distrust one another with respect to methods, results and approaches to resource problems. A multidisciplinary approach and better communication are needed to break this circle.

Significantly different problems arise when the researcher attempts to generate what is called a new concept. Generally postgraduates tend to imitate their major supervisor, whose influence becomes manifest in many forms, such as discussions, equipment and literature available, way of looking at the world and at science, and prior training. Once settled down young scientists intend to show to the world that their research work may become as good as that of their major professor. The next years can be rich in multiple activities and publications. In developed countries, young scientists normally continue overspecializing, gradually producing new contributions. For lack of imagination or strength, many researchers slow down their research during that stage. Others are able to start the whole process again taking another subject, which will also be exhausted after some years. When the new postgraduate returns to a developing country the challenge is even greater. The obvious differences in technology and resources are often used as a good explanation for not producing satisfactory results, and many times this is justified. The problem is that, at the bottom of the argument lies the conviction that a good scientific work consists of continuing the same research that the major supervisor did, which requires sophisticated equipment.

The greater aspiration of scientists in developing countries frequently consists of having facilities as good as those of their professor and to produce papers that will be accepted in those journals that accept their professor's papers. Some scientists may spend their whole life in this process, and they may become totally unproductive due to the economic deficiencies of their countries. Although these expectations are legitimate, they restrain the actions of the young researchers and prevent them from passing from the status of just professionally productive scientists, winners of mini-projects and authors of papers, to that of individuals setting out to produce their own creative works in science.

The first kind of scientists, who have settled down and are regularly working, usually produce scientific work that represents only quantitative additions to knowledge. Basically, these small steps constitute the way in which science normally progresses; but many such efforts may be sterile, not being conceptually innovative. Researchers measure their contributions by comparing themselves with either local or foreign professors. It also reflects the "professional" approach to science, where scientists are more concerned about the number of items in their curriculum vitae than with the quality of research or the conceptual changes they may have introduced.

A significantly different scientific contribution deals with qualitative modifications to the conception of a given phenomenon. Here the effort is directed to achievement of one's own creation, rather than imitation of the professor. This kind of work implies an ample conceptualization of a global phenomenon by the aggregation of many small, particulate works. Rather than to a hypothesis, it corresponds to a conceptual frame within which "particulate" works acquire some meaning. The individuals that

produce such changes are generating—in a strict sense—schools of ideas both at the international and local levels.

This distinction between the two scientific processes impinges directly upon several aspects of scientific development policies currently accepted. Generally speaking, most of these policies are not oriented to global conceptual creation. With the current systems—where quantity predominates over quality—researchers take too many risks if they challenge the scientific "establishment"; they may fail to publish for a long time, or fail to approve projects, in order to devote their time and energy to the theoretical elaboration of a new concept. This phenomenon, which started by being evident and surprising in developed countries, has also extended to developing countries due to the cultural dependence our scientists feel (or are forced to feel) in the performance of their work. Hence, the efforts to achieve "international level science" are not only enormous, they are also unproductive by being directed to the external form of the scientific process rather than to the creative essence implied in the generation of new concepts.

## Final Comment

I am aware that his brief synthesis does not cover the full diversity of problems and limiting factors that have to be currently faced to do science in developing countries. Nonetheless, I do hope that these reflections may help to set clearer boundaries of some essential issues, different from the chronic economic limitations. To develop institutional research tradition, to help young researchers start their career, to increase multi-institutional efforts, to force the dialog between and joint maturation of researchers and resource managers, and—above all—to rescue the creative essence of the scientific process, seem obligatory steps towards developing an active and rich body of researchers who may apply their findings to the development, preservation and utilization of renewable resources.

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*Based on the paper Problemas para hacer investigación ecológica en Chile: una visión personal. 1987. Revista Chilena de Historia Natural 60(1).

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[3] Roche, M. 1976c. Early history of science in Spanish America. Science 194: 806-810.

[4] Smith, J.L. and D.A. Ross. 1976. Technological transfer in marine science. Interscience 1: 38-42.

[5] Zamitti, C. 1976. O grande equivoco do almejado prestigio cientifico. Dados e Ideas. Abril-Maio, 1976: 5.

# UNDP AND ICLARM

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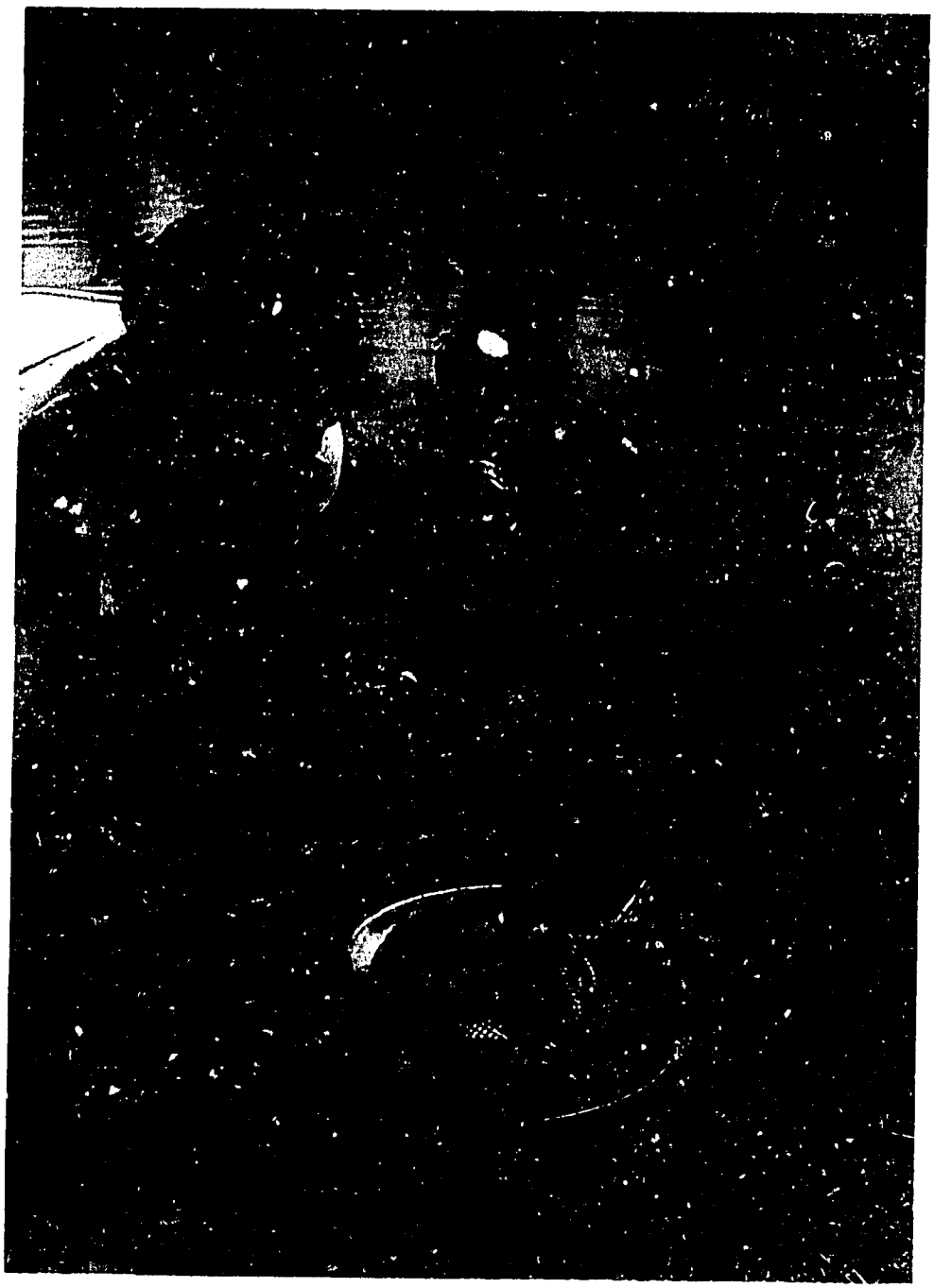
*and*
*Chairman, ICLARM Support Group*

Over the past ten years, UNDP has had the opportunity to observe the development of ICLARM from several different perspectives. For many of these years, UNDP was an interested observer. The creation of ICLARM and the Center's successful use of networking for long-term interdisciplinary research represented a potentially useful development. The fisheries component of UNDP's country and regional programs, particularly for Asia, were considerable and fisheries represented approximately 20% of UNDP's Interregional Programme over this period. ICLARM's major publications were inputs into our own programs while the ICLARM Quarterly, Naga, helped keep us abreast of new developments. The ICLARM office soon became an essential port of call for all major fisheries missions in Asia. The UNDP/FAO Aquaculture Development and Coordination Programme (ADCP) and its global network of seven regional centers for training, applied research and information, began to cooperate with ICLARM, particularly in training, and the potential for further useful collaboration became increasingly apparent.

Therefore, when ICLARM approached DGIP for project funding in 1985 we had already developed considerable knowledge of and respect for the Center. A UNDP/ICLARM project for the development of a research framework for integrated aquaculture/agriculture farming systems is now well underway. UNDP is pleased with progress to date and we are particularly hopeful that the framework will be useful in Africa, where improved agriculture/aquaculture farming systems could have such a positive impact on nutrition and income.

In 1986 when ICLARM asked me to chair their Support Group, the link between our two organizations became even stronger. Following the first meeting of the Support Group and related followup consultations, the financial status of ICLARM has improved considerably. Nevertheless, we all realize that funding will remain a major concern.

Just as ICLARM has taken this occasion to review its past and consider options for the future, a Review of Fisheries Development Support



ICLARM and UNDP are developing a research framework for integrated agriculture/aquaculture farming systems. The results could have a large impact on nutrition and income in Africa, where ICLARM is also developing projects to improve aquaculture technology with support from the German Agency for Technical Cooperation (GTZ).

by the United Nations Development Programme over the last 15 years was issued by UNDP in 1986. The lessons of this Review, together with past and present trends in the fisheries sector, provided an indication that in the future, UNDP should:

- recognize the need for long-term support to fisheries projects;
- place priority on the development of fisheries in developing countries;
- increase assistance to small-scale fisheries development;
- provide additional support for aquaculture development;
- provide long-term support for fisheries management, particularly through intercountry projects attached to viable fisheries bodies;
- ensure that costly resource survey projects are followed up by test fishing; and
- take account of investment followup requirements.

It is clear that many of these recommendations are relevant to UNDP/ICLARM relations.

In October 1986, UNDP joined with the World Bank, EEC and the African Development Bank in sponsoring the Fisheries Development Donor Consultation. The consultation established a fisheries information exchange system based on agency focal points and made recommendations on the effective use of consultations through the World Bank Consultative Groups, UNDP Round Tables and initiatives by the regional development banks. The consultation also welcomed the initiative of the World Bank and FAO to prepare the terms of reference for a broad-based review of all research needs in fisheries to be conducted by an expert group under the guidance of an advisory committee. It is clear that the innovative work done by ICLARM will represent a necessary input into this study. The donor consultation also reviewed the UNDP/FAO ADCP project and took note of potential contributions from ICLARM, particularly in the field of genetic research on tropical aquaculture and integrated farming systems research.

Over the last ten years, UNDP has progressed from an interested observer to one of ICLARM's donor agencies to a partner for future activities. Our respect for this innovative and respected institution has consistently increased. While it is impossible to predict the state of ICLARM ten years hence, there is every indication that the encouraging trends of the past will continue and that ICLARM's service will benefit developing countries in Asia and elsewhere for many years to come.

## RESOURCE ASSESSMENT AND MANAGEMENT PROGRAM

### Background

There are basic socioeconomic and environmental trends worldwide which give increasing importance to a program devoted to the assessment and management of tropical living aquatic resources. These trends are:

- continued population growth both based on growth of resident coastal populations and coastward (internal) migration of landless farmers;
- continued or increasing poverty of coastal, rural populations;
- concomitant, accelerated deterioration in many aquatic environments, reducing their ability to sustain high levels of production;
- the desire of the majority of less wealthy people to participate in the benefits of modern technological advances and enjoy a wealth similar to that of the developed nations. These same people are often the unwilling victims of technological improvements, principally in the major industrial trawl and purse seine fisheries, which often decrease stock densitites and consequently reduce catch rates of nearshore fisheries, depress market prices and render small-scale fisheries unprofitable.

The Resource Assessment and Management Program and its predecessors, the Traditional Fisheries Program and the Resource Development and Management Program, now combined, have contributed to the mitigation of these problems by:

- undertaking interdisciplinary investigations of multispecies, multigear tropical fisheries and by formulating program statements identifying and aiming at solutions of the main problems of these sectors;
- developing and disseminating methods by which technical staff in fisheries laboratories, as well as other institutions involved with the management of aquatic resources, can straightforwardly assess these resources and formulate options for managing them;
- helping resource managers to evaluate appropriate resource management options and implement management programs.

From its inception, the Resource Assessment and Management Program has put emphasis on the management problems of tropical small-scale fisheries, especially those in the coastal zone. These fisheries employ the majority of fishermen, and fish primarily for human consumption (Fig. 1).

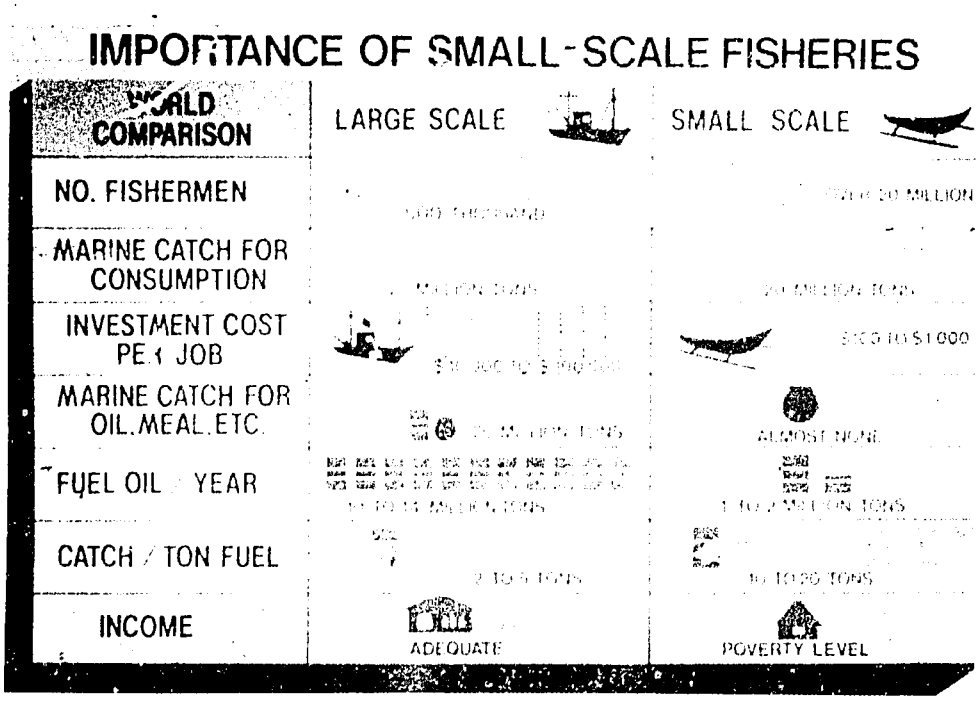



Fig. 1. Tropical small-scale fisheries employ the majority of all fishermen and produce catch primarily for human consumption.

This is in contrast to industrial fisheries, many of which are from developed countries, with fleets ranging worldwide, producing half of their catch for reduction to animal feed and oil. Contrary to prevailing opinion, small-scale fishing fleets in many locations are economically more efficient than their larger competitors which are often directly or indirectly subsidized.

ICLARM's activities began in the late 1970s amidst widespread views that the low incomes and productivity of coastal and inland fishermen could be raised through technological interventions. ICLARM has been at the forefront of organizations arguing that these problems were not solvable through solely technical means, but required management approaches that integrated technical, biological, economic and institutional dimensions. Of particular importance from ICLARM's point of view is the need for community participation in management design and implementation.

## Program Themes

*Management-oriented fisheries research.* Most tropical fisheries research conducted until the 1970s had a strong bias towards basic biology and oceanography. ICLARM coined the term "management-oriented research" to draw attention not only to the management gap mentioned in the above paragraph but also to the need for research itself to be reoriented towards more concrete objectives of likely benefit to fishing communities. The

research base from which to begin, however, was weak. Temperate zone single-species methodologies were simply not appropriate for tropical multi-species fisheries. ICLARM has, therefore, put a major emphasis on developing research methodologies that are appropriate for the tropics. This emphasis has been highly successful with ICLARM stock assessment methodologies, particularly those that are microcomputer-based, now in wide use around the tropics. Efforts are now underway to more fully integrate these methods with social science research, the second leg upon which successful management-oriented research must stand. A good beginning was made in a recent ICLARM project with Philippine institutions which examined management options for a highly competitive coastal fishery in San Miguel Bay, in the central part of the country.

Another theme is the assessment and management of small pelagic fish stocks in the Philippines, where these fishes (herring and mackerel-like) account for about 40% of the total landing from both marine and freshwater fisheries. Virtually, all of this production is destined for human consumption, either as fresh, dried and canned fish or fermented into fish sauces and pastes. Small pelagic fishes form about 15% of the animal protein consumed by Filipinos and landings are currently estimated to be worth US$200 million per annum. However, catches have remained stagnant for the last decade, despite a major increase in fishing effort and management action is urgently needed.

*Network of Tropical Fisheries Scientists.* Additionally, a major objective of the Program is to promote increased confidence and self-dependence amongst scientists who are nationals of developing countries. The principal vehicle for achieving this objective is the international Network of Tropical Fisheries Scientists (NTFS) and complementary training activities. The network now serves as a major vehicle for communication among nearly 700 members in over 80 countries. ICLARM also serves as a major source of information, reprints and database searches for NTFS members. Training programs in stock assessment techniques have been promoted in a variety of ways including short courses and longer-term in-house work experience programs at ICLARM in Manila for more senior scientists.

## Progress of Work

The NTFS and complementary training and methodology development activities of ICLARM headquarters staff have remained key elements in ICLARM's Resource Assessment and Management Program. Increasingly, specific cooperative projects with national and regional institutions, possibly with outposted ICLARM staff members, will be undertaken.

Two such major externally funded projects are presently operational. These are in the area of small-scale fisheries and coastal zone management, and they serve to illustrate how the Center has been able to maintain program continuity as the level of unrestricted core support available to it declined.

*Coastal Resources Management Project.* In the tropics, the coastal zone is characterized by highly productive ecosystems which support a broad range of economic activities. Possibly no other region in the world is more dependent on the utilization of living coastal resources than the Association of Southeast Asian Nations (ASEAN) region comprising Brunei, Indonesia, Malaysia, the Philippines, Singapore and Thailand. Given the growing populations and rapid economic growth in these countries, the living resources must be used on a sustainable basis in order to meet present and future development opportunities. It is against this background that the integrated Coastal Resources Management Project (CRMP) was formulated, with funds from the United States Agency for International Development (USAID). ICLARM was selected by ASEAN and USAID as the executing agency and the project officially began in May 1986 with the signing of the ASEAN-USAID agreement and the first meeting of the project's steering committee made up of ASEAN representatives.

The CRMP adopts an interdisciplinary, multisectoral approach, aimed at developing management strategies for the long-term sustainable utilization of living coastal resources. It aims to strengthen the capabilities of ASEAN national institutions, including their manpower bases and information dissemination channels, to manage these resources.

The CRMP has two interlinked programs. The first program is a number of national site-specific resource assessment activities including planning and cooperative research among national and international institutions. Second, there is a regional component which is geared towards information dissemination and manpower base development through publications, training courses, workshops and seminars.

Implementation of project research, training and information activities in each of the participating countries is coordinated through the national lead agencies. A number of additional national institutions are involved in resource assessment, research, planning and development of management strategies. These agencies participate in one or numerous aspects of pilot site studies and are responsible for the development of coastal resource management plans for the site chosen. It is the expectation of the national institutions and ICLARM that this activity will serve as a model approach to coastal zone management problems elsewhere in the tropics.

*Small-scale fisheries management.* ICLARM has recently received Ford Foundation support to extend its successful small-scale fisheries research from previous Southeast Asian focus to other parts of the world, especially South Asia.

Emphasis is placed on the analysis and identification of components leading to successful management programs. It is expected also that these efforts will lead to the formulation of integrated and interdisciplinary procedures or frameworks for generalized application.

Design of minimum-cost database systems for integrated management purposes and identification of hardware/software required for data storing, processing and retrieval is also emphasized. Microcomputer software designs

for management purposes at different levels of the decisionmaking process are expected to be developed as additional tools for management.

Two major research projects within the Bay of Bengal region (in Bangladesh and on the west coast of Thailand) were initiated, in which small-scale fisheries management policies will be conceptualized, and subsequent monitoring and evaluation procedures will be implemented. These management projects will provide an empirical base for the design of methodologies leading to appropriate management programs in small-scale fisheries.

In addition, work on a manual for a "database system for small-scale fisheries management" has been initiated in collaboration with FAO and tested in the Bangladesh and the Thailand projects.

*Latin America and the Caribbean.* ICLARM has had since 1981 an active cooperative project with the Instituto del Mar de Peru, funded by GTZ and concentrating on the assessment, through detailed analysis of time series data, of the effect of El Niño on Peruvian marine fisheries. This project, which has a training component, has led to several publications, and a multiauthored book presenting the project results is currently in preparation. It is hoped that this work will shed new light on the dramatic fluctuations in catch of the anchovy, the world's largest single fishery, at its peak comprising over 10% of global fish harvest.

Another major linkage is with the Instituto de Sciencia del Mar y Limnologia of the National Autonomous University of Mexico, with whom an agreement formalizing and expanding our previously informal cooperation in training and fish stock assessment will be signed in early 1987.

*South Pacific.* ICLARM's first involvements in the South Pacific region were in supporting the development of the South Pacific Commission's Regional Skipjack Survey and Assessment Programme and in convening, in collaboration with the SPC, a conference on Small Boat Design which was held in New Caledonia in 1975. Another important ICLARM project on the problems of industrialization of a fishery examined the early problems and conflicts in the joint venture tuna fishery in the Solomon Islands and suggested guidelines for future avoidance of conflict areas.

Although virtually all of ICLARM's activities are relevant to the South Pacific region, the first undertaking of direct and major importance to the region began in January 1983 when the International Giant Clam Mariculture Project was formally initiated by Dr. John Munro, then Director of ICLARM's Resource Assessment and Management Program. This now forms a major component of the Aquaculture Program and has led to the development of the ICLARM Coastal Aquaculture Center in the Solomon Islands, for which a regional role is foreseen.

ICLARM's current activities in the South Pacific include not only aquaculture but also the preparation by Dr. J.L. Munro of two reports (one in conjunction with Mr. S.T. Fakahau, Principal Fisheries Officer, Tonga) for the Forum Fisheries Agency. They deal with the rationale for implementation of cost-effective stock assessment systems in the South Pacific region. It is hoped that they will form the basis for some model assessment and management projects in selected South Pacific island groups.

*Africa.* ICLARM has had a modest impact on African fisheries science through the development of microcomputer-based stock assessment methods applicable to marine and inland fisheries. Training in microcomputer techniques at ICLARM of an officer of the Zambia Department of Fisheries, and provision of a microcomputer and software for analyzing Zambian databases has been extremely successful. ICLARM's methods are being spread throughout Africa through ICLARM's Network of Tropical Fisheries Scientists and several training courses.

## Training

Training activities within the Resource Assessment and Management Program were rather extensive in 1986 and included the following:

- Dr. Pauly's participation as lecturer in the FAO/DANIDA course in Tropical Fish Stock Assessment held in Hirtshals, Denmark on 4-24 May 1986.
- Supervision and guidance by Dr. Pauly of M.Sc. and Ph.D. students at the University of the Philippines and Kiel University, Federal Republic of Germany (including a one-week visit to the latter on 29 April-3 May 1986).
- Lectures on fish population dynamics at the College of Fisheries, University of the Philippines (second semester 1985/1986), and lecture in a one-week course in computer-based fish stock assessment held in September/October 1986 for participants from regional fisheries colleges, both on behalf of the GTZ-supported Philippine-German Fisheries Project.
- Participation of Dr. Max Aguero as lecturer in the FAO/China Training Course on the Management of Marine Fisheries, Shanghai Fisheries University, 4-29 October 1986.
- Supervision by Dr. Max Aguero of the Doctoral Dissertation of Mr. A.K. Mahfuzuddin Ahmed ("A Simulation Model for Evaluating Benefits from the Use of Open Water Inland Fishery Resources of Bangladesh").
- Dr. Pauly taught at the University of Trujillo (Peru) a three-day course on "Metodos simple en la Dinamica de poblaciones de peces e invertebrados" (October 1986).

The extensive activities of the ASEAN Coastal Zone Management Project are documented in a relevant project summary.

## Advisory Services

Dr. Munro performed a consultancy for the Forum Fishery Agency, while Dr. Pauly advised, in late 1985/early 1986, the Kuwait Institute for Scientific Research on fishery research and, in October 1986, the Instituto del Mar de Peru on stock assessment methodologies, on behalf of the GTZ-supported Programa de Cooperacion Peruano-Aleman (PROCOPA).

## Program Plans for 1987 and the Next Decade

The activities of ICLARM's Resource Assessment and Management Program in the next decade will be directed towards assistance in establishment of coastal zone management plans and fisheries resource management programs in a number of countries. Several externally funded projects will help towards this end. Other major activities will be the continued development and dissemination of methods suitable for tropical stock assessment and resource management, with particular emphasis on integrated microcomputer software for use in fish stock assessment and management decision-making in developing countries. Examples of such software are the package recently published by Vakily et al. through FAO (see list of publications below), the Compleat ELEFAN programs, and the microcomputer suite of programs for the analysis of mark-recapture data, as well as the template for stock assessment through spreadsheet analysis recently developed by J.L. Munro. It is planned to consolidate all ICLARM activities related to software development into a single project, the "ICLARM Software Project", which will maintain, document and distribute the "Compleat ELEFAN" and other programs written by ICLARM staff, as well as public domain software of potential usefulness to tropical fisheries science (including aquaculture and economics).

## Meetings Attended, Papers Presented

New Marine Technology and Social Change in the Pacific, Australian National University, Canberra, Australia. 13 March 1986. (J.L. Munro)

Paper presented:

Munro, J.L. Fishery resources of the Pacific islands.

GTZ/UPV Workshop on the Production of Cured Fish in the Tropics, University of the Philippines in the Visayas, Quezon City, Philippines, 14-25 April 1986. (J.M. Vakily)

Paper presented:

J.M. Vakily. Processing and marketing of green mussel *(Perna viridis)* in Thailand.

IREP/OSLR Workshop on the Recruitment of Tropical Coastal Committee, Campeche, Mexico, 21-25 April 1986. (D. Pauly)

Papers presented:

Pauly, D. Some concepts and methods for the study of recruitment in tropical demersal communities.

Pauly, D. and J. Ingles. The relationship between shrimp yields and intertidal vegetation (mangrove) areas: a reassessment.

Navaluna, N.A. and D. Pauly. Seasonality in the recruitment of Philippine fishes as related to wind patterns.

The First Asian Fisheries Forum, 25-31 May 1986, Manila, Philippines. (M. Aguero, T.E. Chua, A. Cruz, R. Dubois, L. Palomares, D. Pauly, J. Paw, M. Soriano)

Papers presented:

Aguero, M. and B. Lockwood. Resource management is people management.

Bagarinao, T. and Chua, T.E. Egg size and larval size among teleosts: implications to survival potential.

Chua, T.E. An overview of the fisheries and aquaculture industries in Asia.

Mines, A., I.R. Smith and D. Pauly. An overview of the San Miguel Bay fisheries.

Moreau, J., C. Bambino and D. Pauly. Indices of overall fish growth performance of 100 tilapia (Cichlidae) populations.

Pauly, D. Concepts that work: some advances in tropical fisheries research.

Pauly, D. and M.L. Soriano. Some practical extensions to Beverton and Holt's relative yield-per-recruit model.

Indo-Pacific Fishery Commission, Fifth Session of the Committee for the Development and Management of Fisheries in the South China Sea, Bangkok, Thailand, 28-30 July 1986. (J.M. Vakily)

GERMA Conference on Small Scale Fisheries and Economic Development, Rimovski, Canada, 10-15 August 1986. (M. Aguero)

Paper presented:

Aguero, M. and G. Costello. Constraints to the development of effective fisheries management in the LDC's: Implications for training and research.

Chapman Conference of El Niño: an International Symposium, Guayaquil, Ecuador, 27-31 October 1986. (D. Pauly)

Paper presented:

Pauly, D., I. Tsukayama and H. Tovar. Some preliminary results from an international multidisciplinary project aimed at reconstructing time series on the Peruvian ecosystem, for the years 1953-1982.

Interdisciplinary workshop on Issues in Fisheries Development, Centre for Development Studies, Aakulam, Trivandrum, India. 20-25 November 1986. (M. Aguero)

WESTPAC symposium on Marine Science in the Western Pacific, Townsville, Australia, 1-6 December 1986. (G. Silvestre, College of Fisheries, UPV)

Paper presented:

Silvestre, G. and D. Pauly. Estimates of potential yield and economic rent from Philippine demersal stocks, 1946-1984.

Workshop on the Assessment of the Coastal Profile of Lingayen Gulf. ASEAN/USAID/ICLARM Coastal Zone Management Project, Batangas, Philippines. 5-7 December 1986. (M. Aguero)

## Publications and Consultancy Reports

Aguero, M. 1986. Bangladesh fisheries: a challenge to resource managers. Naga, The ICLARM Quarterly 9(3): 11-12.

Aguero, M. 1986. Training for fisheries management in developing countries. Naga, The ICLARM Quarterly 9(4): 14-15.

Aguero, M. and B. Lockwood. 1986. Resource management is people management, p. 345-348. *In* J.L. Maclean, L.B. Dizon and L.V. Hosillos (eds.) The First Asian Fisheries Forum. Asian Fisheries Society, Manila, Philippines.

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Aprieto, V.L., J. Saeger and D. Pauly, editors. 1986. Selected papers on Philippine marine fisheries resources (1947-1986). University of the Philippines in the Visayas, College of Fisheries, Tech. Rep. Dept. Mar. Fish. 9. 436 p.

Bagarinao, T. and Chua Thia-Eng. 1986. Egg size and larval size among teleosts: implications to survival potential, p. 651-656. *In* J.L. Maclean, L.B. Dizon and L.V. Hosillos (eds.) The First Asian Fisheries Forum. Asian Fisheries Society, Manila, Philippines.

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Caverivière, A. 1986. Bigger net mesh size will mean bigger catches in the Ivory Coast trawl fishery. Naga, The ICLARM Quarterly 9(3): 19-20. (Translated from French and edited by D. Pauly).

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Dubois, R. 1986. Coastal resources management and ASEAN: the need for alternative approaches. Tropical Coastal Area Management 1(1): 4-6.

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Moreau, J., C. Bambino and D. Pauly. 1986. Indices of overall fish growth performance of 100 tilapia (Cichlidae) populations, p. 201-206. *In* J.L. Maclean, L.B. Dizon and L.V. Hosillos (eds.) The First Asian Fisheries Forum. Asian Fisheries Society, Manila, Philippines.

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Munro, J.L. 1986. Workshop synthesis and directions for future research, p. 639-659 (Chapter 13). *In* J.J. Polovina and S. Ralston (eds.) Biology and fishery management of tropical snappers and groupers. Westview Press Inc., Boulder, Colorado. 659 p.

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## Resource Assessment and Management Program
## Project Summaries

Project Title : Tropical Fish Stock Assessment Project

Cooperating Institution : Predominantly in-house studies, with informal linkages with various research institutions

Duration : Continuous from July 1979

Key Personnel ICLARM : Dr. Daniel Pauly; Dr. John L. Munro; Ms. Maria Lourdes Palomares; Ms. Mina Soriano

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

The list of publication and conference papers by staff of this project demonstrate the productivity and breadth of the topics covered. Noteworthy were the 1986 series of method and concept-oriented papers presented at the IREP/OSLR Workshop on the Recruitment of Tropical Coastal Communities, Campeche, Mexico, April 1986, and at the First Asian Fisheries Forum held in Manila, May 1986, as well as the project's contribution toward editing two multiauthored reports by the College of Fisheries of the University of the Philippines in the Visayas.

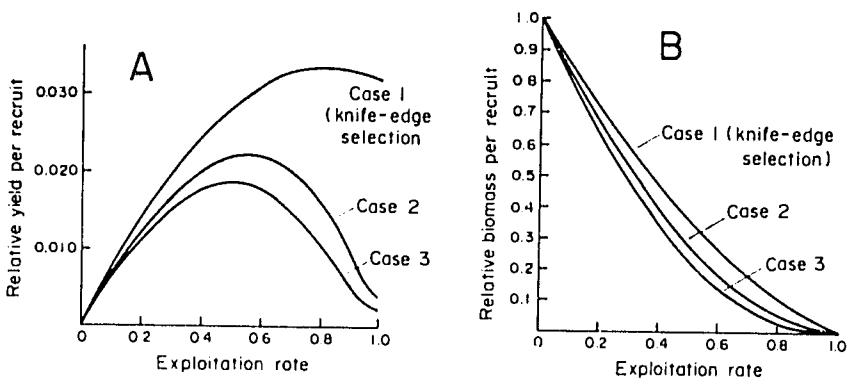


Fig. 1. Difference between estimated yields (A) and catch-per-effort (B) computed based on the assumption that all animals caught, e.g., shrimp enter the fishery at the *same* size ("knife-edge selection", Case 1), and assuming that entry into the fishery occurs over a narrow (Case 2) or wide (Case 3) range of size. The model in Case 1, adopted from temperate fisheries predicts higher catch and suggests small mesh size to be appropriate. Cases 2 and 3 give opposite, but correct results.

**Project Title** : Network of Tropical Fisheries Scientists

**Cooperating Institutions** : Fisheries Resources and Environment Division, Fisheries Department, FAO; FAO/DANIDA Training Course in Fish Stock Assessment in the Tropics; Norwegian Agency for International Development (NORAD)

**Duration** : Continuous from April 1982

**Key Personnel ICLARM** : . Ms. A. Cruz (Network Secretary)
Dr. J.L. Munro (Fishbyte Editor)

Objectives

- To enhance communication between fisheries scientists working on the assessment, conservation and management of tropical stocks.
- To enhance output of these scientists by improving access to literature, providing free database searches, distributing manuals and other literature and publishing a newsletter at regular intervals. The technical focus is on the estimation of the biological, fishery 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

Growth of the Network of Tropical Fisheries Scientists (NTFS) has been remarkable in 1986 with over a hundred new members joining, bringing the total to 680. The network now covers over 80 countries with 51% of the membership coming from Asia and Africa, a quarter from USA and Europe, while the remaining percentage is scattered over Latin America, the Caribbean, Australia and the Pacific.

Following a severe funding problem in late 1985, the Network secured continued support from the FAO/DANIDA Training Course in Fish Stock Assessment in the Tropics and from the FAO Regular Program. To this will be added, from 1987, a generous grant from the Norwegian Agency for International Development (NORAD).

This support has allowed the Network to intensify distributions of FAO manuals and other materials, inclusive of reports by members. The average requests reached 40 per month in 1986.

The Network has clearly enhanced communication among members, reinforced ongoing research, and helped libraries, which would not have been possible otherwise, given the present dearth of foreign exchange and exorbitant cost of mailing. Three issues of Fishbyte were produced in 1986. The newsletter has been successful in filling the information gap on resource assessment methods and microcomputer software developments.

| | | |
|---|---|---|
| **Project Title** | : | Management-Oriented Fisheries Research Project |
| **Cooperating Institutions** | : | Marine Fisheries Research Institute (BPPL), Jakarta, Indonesia; Instituto del Mar de Peru (IMARPE); Programa Cooperativo Peruano-Aleman de Investigacion Pesquera (PROCOPA); Department of Fisheries, Zambia; Skaggs Foundation (Indonesian Module) |
| **Duration** | : | Continuous from April 1982 |
| **Key Personnel** BPPL | : | Mr. A. Dwiponggo |
| IMARPE | : | Ms. I. Tsukayama |
| PROCOPA | : | Mr. Jaime Mendo |
| Zambia | : | Dr. S.P. Subramaniam and Mr. R. Matipa |
| ICLARM | : | Drs. Daniel Pauly and J.L. Munro |

**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**

Three modules were operational in 1986.

*Indonesian module.* Mr. Dwiponggo of BPPL visited ICLARM in September 1986 to assist with the finalization of the project's main output, an atlas of the "growth, mortality and recruitment of commercially exploited fish and penaeid shrimp of Indonesia", which after several delays, one of which was destruction of much of the original material in a fire at the press, is expected to be published in mid-1987.

*Peruvian module.* The acquisition, standardization and analysis of time series data on the Peruvian anchoveta and its ecosystem continued through 1986. Intermediate results were presented on behalf of the project at the Chapman/El Niño conference held in October 1986 in Guayaquil, Ecuador (see Fig. 2). Also, Dr. Pauly visited, in December 1986, the Pacific Fisheries Environmental Group (NOAA, NMFS, Monterey, California, USA) both to help finalize contributions to be included in the book that will contain the project results and to arrange for the visit of a Peruvian scientist, Mr. Jaime Mendo, to that institution, where he will complete a major contribution for the project in cooperation with NMFS staff.

As a result of the great strides made by the project, and the likely completion in mid-1987 of the planned book on "The Peruvian anchoveta and its upwelling ecosystem: three decades of changes", the senior management of IMARPE has formally requested the assistance of ICLARM in assisting with the organization of an international workshop to be sponsored by IMARPE, PROCOPA (GTZ) and ICLARM and to be held in August 1987 in Lima, Peru, and whose aim it will be to help with the formulation of a draft management plan for the Peruvian upwelling ecosystem as a whole.

*Zambian module.* This module, equipped (as was the Indonesian module) by ICLARM with a TRS 80 microcomputer, a printer, software and other materials, has been operational since July 1984. The first phase came to an end on 30 June 1985 and by mutual agreement was extended to the end of 1986. Adaptation to the TRS 80 computers of some software recently developed at ICLARM for use with Apple and IBM computers was initiated in 1986; once completed, it will be given to the Zambian Department of Fisheries, as well as to BPPL in Jakarta, Indonesia.

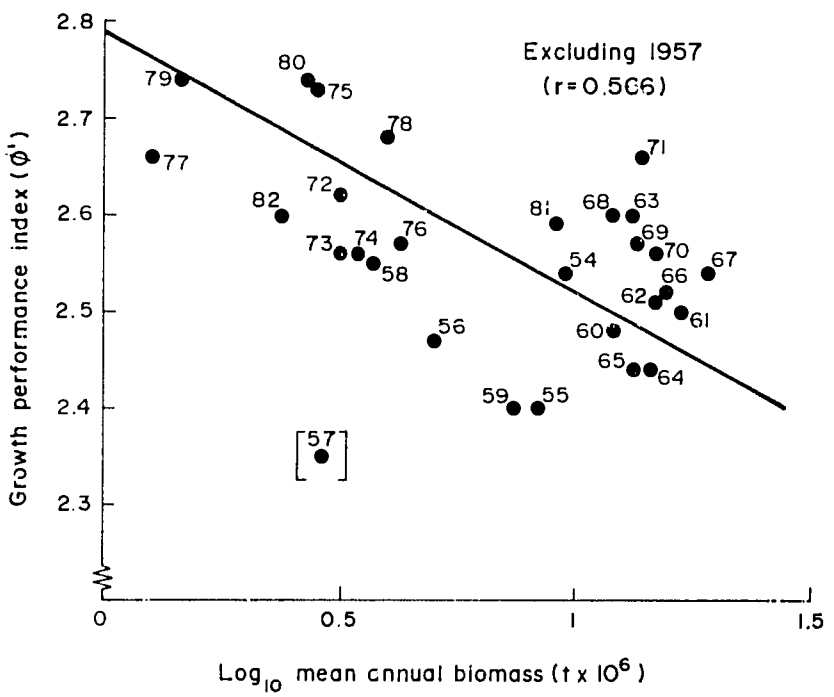


Fig. 2. Relationship between the growth performance of the Peruvian anchoveta and its mean annual biomass, 1954 to 1982. The results, whether one includes the point for 1957 or not indicate a close correlation, suggestive of density-dependent changes of anchoveta growth performance.

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|---|---|---|
| Project Title | : | Growth Studies on Cultured Marine Bivalves of Thailand |
| Cooperating Institution | : | Chulalongkorn University, Department of Marine Science |
| Duration | : | December 1985-May 1987 |
| Key Personnel Thailand | : | Dr. Suraphol Sudara; Ms. Jintana Nugranad |
| ICLARM | : | Mr. J.M. Vakily |

## Objectives

- To develop and apply to as many important species as possible, methods for the age determination and growth parameter estimation of Thai bivalves, inclusive of methods based on daily shell rings.
- To analyze extant length-frequency data on Thai bivalves and to derive management options for the stocks investigated.
- To train Thai marine scientists in microcomputer-based stock assessment methods, particularly in analysis of size-frequency data.

## Results

In early 1986, growth experiments were started with marked animals of two shellfish species, namely cockles *(Anadara granosa)* and mussels *(Perna viridis)*. Their growth in length was monitored monthly. Field surveys were carried out with the participation of students of the Department of Marine Science. Of particular interest was whether tidal differences in water level affect the growth of cockles.

Preliminary results indicate that the growth of cockles is remarkably slowed down at sites that regularly fall dry during low tide. On the other hand, it was observed that cockles were subject to increased mortality in areas that did not fall dry but remained covered by only a thin water layer which exposed the animals to very high water temperatures. This suggests that cockle culture is probably best done in areas with a water level of at least one meter during low tide.

Green mussels were kept in net bags. An interesting observation during the field experiment was that handling of green mussels resulted in induced spawning. The spat were then found the following month attached to the net bags. This may allow spat production on an experimental scale in places where natural spatfall does not occur.

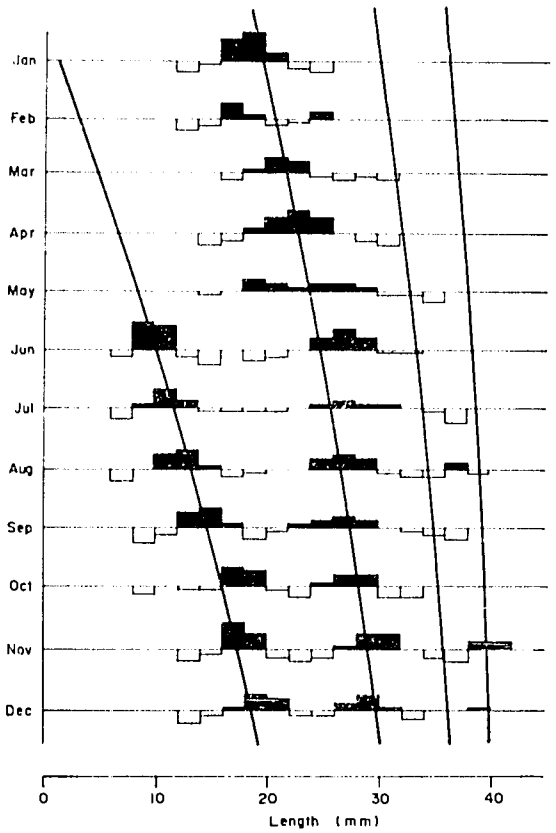
During the experiments, cockles grew at a rate of approximately one mm per month, whereas green mussels reached nearly four mm per month.

During the concluding phase in early 1987 an attempt will be made to identify periodic "growth rings" in the microstructure of the shells and these related to the known growth performance of each animal. This, eventually, will allow to use the periodicity of the formation of growth rings to gain insight in the life-history of tropical bivalves.

From 19 to 23 May 1986 a training course was held on the use of commercial software packages for scientific research at the Department of Marine Science of Chulalongkorn University. This course was planned in response to the growing interest of researchers in the use of modern computer technology and its application in scientific research. The course lasted for six days and was well attended by both students and professional staff of the department.

As a follow-up to the training course, a second microcomputer was purchased by the project and made available to students for data analysis, along with personalized assistance to use of both hardware and software.

Cockles, *Anadara granosa*. Photo by Wong Tat-Meng.




Growth rate of cockles (sloping lines) in Malaysia, as shown by the LLEFAN I microcomputer program here applied by Mr. Ng Fong Oon in a Bay of Bengal Programme report completed during a stay at ICLARM. Bar graphs show monthly length-frequency data.

| | | |
|---|---|---|
| **Project Title** | : | ASEAN/US Cooperative Program in Marine Science; Integrated Coastal Resources Management Project (CRMP) |
| **Coordinating Agencies** | : | BRUNEI—Department of Fisheries of Ministry of Development; INDONESIA—Indonesian Institute of Science; Directorate General of Fisheries (Lead Implementing Agency) Center for Oceanological Research and Development; University of Indonesia; Bogor University of Agriculture; Research Institute for Marine Fisheries; MALAYSIA—Ministry of Science, Technology and Environment; Fisheries Department (Lead Implementing Agency); Universiti Kebangsaan Malaysia; University of Malaya; Forest Research Institute; Universiti Pertanian Malaysia; PHILIPPINES National Science and Technology Authority; Philippine Council for Agriculture and Resources Research and Development; University of the Philippines: Marine Science Institute/ Institute of Social Work and Community Development/University of the Philippines in the Visayas; Bureau of Fisheries and Aquatic Resources; SINGAPORE Science Council of Singapore; National University of Singapore; Primary Production Department; THAILAND Office of the National Environment Board, Ministry of Science, Technology and Energy; Tourism Authority; Fisheries Department; Forestry Department; Land Development Department; Kasetsart University; Chulalongkorn University; Mahidol University; Mineral Resources Department; Thailand Development Research Institute |
| **Duration** | : | 4 years beginning January 1986 |
| **Key Personnel** Brunei | : | Awang Matdanan bin Haji Jaafar/Pengiran Sharifuddin bin Pengiran Haji Yusof |
| Indonesia | : | Dr. Purwito Martosubroto, Dr. Kasijan Romimohtarto |
| Malaysia | : | Dr. Abu Bakar Jaafar, Ms. Ch'ng Kim Looi |
| Philippines | : | Dr. Rafael D. Guerrero III, Dr. Edgardo D. Gomez |
| Singapore | : | Mr. Leslie Cheong, Dr. Chou Loke Ming |
| Thailand | : | Mr. Arhtorn Suphapodok, Dr. Teerayut Poopetch |
| ICLARM | : | Dr. Chua Thia-Eng (Project Coordinator); Dr. Random DuBois (Technical Advisor) |

**Objectives**

The goal of the CRMP is to increase existing capabilities within the Association of Southeast Asian Nations (ASEAN) 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;
- promotion of institutional arrangements that bring multisectoral planning to coastal resources development.

## Results

The initial phase of project activities commenced after the signing of the Memorandum of Agreement between USAID and ICLARM in August 1985. This was followed by a 10-month period during which the following major activities were undertaken: establishment of the project office at ICLARM; preparation of guidelines for in-country program and annual work plans as well as the development of a program plan for training and information; formation of the Project Steering Committee; and preparation of the project implementing guidelines.

Participating countries then took steps to set up their own project management structures, refined annual work plans, identified pilot sites, implementing institutions, agencies and personnel to be involved in the project, and formed their own national steering committees.

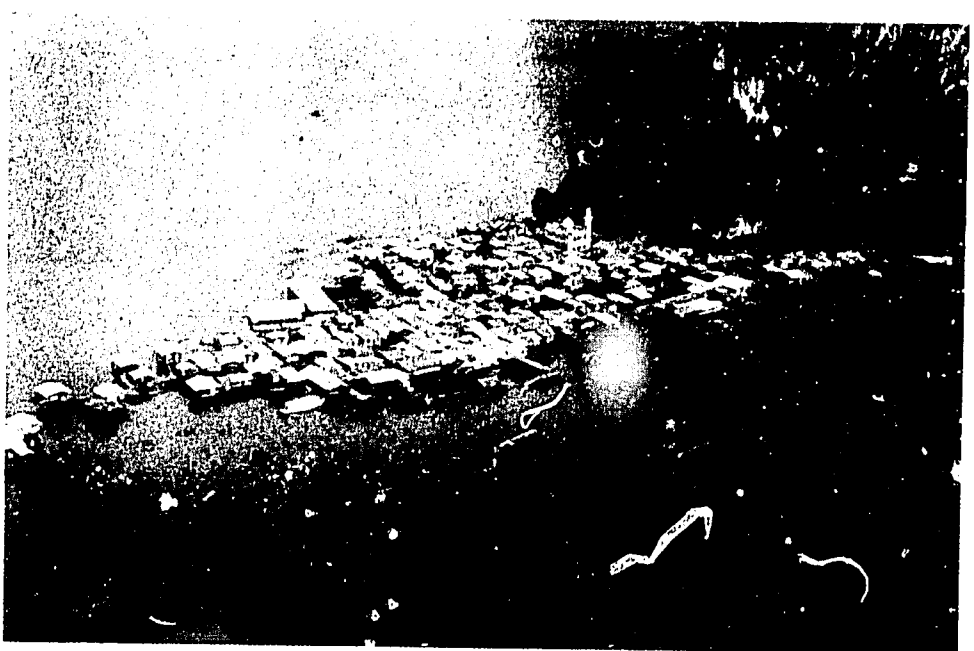
A major activity during the past year was the preparation of the country environmental profiles which were presented during national workshops. Another major undertaking was the preparation and organization of training activities and programs. A two-week training course on Information Research and Management was conducted from 29 September to 13 October 1986 at ICLARM attended by 13 participants from five ASEAN countries. The course primarily focused on aquatic resource information collection, retrieval and dissemination as well as the use of microcomputers.

Medium-term academic training (Masters degree level) was also initiated. Under this scheme, each participating country nominates one candidate for higher degree training in resource management in a US university. Participating countries have already made arrangements to carry out the scheme.

For its part, ICLARM, as the executing agency of the project, concentrated its efforts in the following areas to facilitate smooth operation of the project: (1) providing technical assistance to each in-country project annual work plan preparation; (2) assisting each participating country in establishing fund disbursement procedures; (3) assisting countries in the data-gathering and synthesis phase leading to environmental profile preparation, refinement of research proposals and development of site-specific coastal resources management plans; (4) assisting in the preparations for in-country workshops; (5) initiating and organizing training courses scheduled throughout the project; (6) publication of the project brochure; (7) establishment of linkages with related international and regional agencies; (8) preparation of a roster/directory of experts from ASEAN and the USA whose expertise is related to coastal zone management; (9) initiation of a CRM bibliography with emphasis on the ASEAN region; (10) publication and dissemination of the project newsletter, "Tropical Coastal Area Management".

These activities will be followed up in 1987 by further training activities, preparation of educational material and other specific activities to support the general theme of sustainable use of coastal resources in the ASEAN countries.

Participants in the Information Research and Management Training Course for the ASEAN Coastal Resources Management Project held at ICLARM, 29 September to 13 October 1986. *Left to right (standing):* T. Ferrer, A. Olandez (Philippines), C. Kwauk Yu Pin (Singapore), N. Metra, C. Tocino (Philippines), N.R. Harahap (Indonesia), L. Shu Hwee Luck (Singapore) and S. Kajornatiyudh (Thailand). *Left to right (seated):* Z. Bin Midun (Malaysia), L. Cinco (Philippines), S. Mongkol (Indonesia), P. Tejarati (Thailand) and M.N. Mohd. Taupek (Malaysia).



Human settlement at one of the islands in Phangnga Bay, Thailand, showing integration of coastal cage culture in augmenting fish production. This bay is one of two project sites in Thailand.

**Project Title** : Management Options for Tropical Small-Scale Fisheries

**Cooperating Institutions** : The Ford Foundation; Bay of Bengal Programme; Food and Agricultural Organization (FAO); Ministry of Fisheries and Livestock, Bangladesh; and other institutions to be identified.

**Duration** : 2 years, beginning March 1986

**Key Personnel ICLARM** : Dr. Max Aguero; Project specialist (to be hired)

Objectives

- To develop further suitable interdisciplinary research methodologies for analysis of management options within an integrated approach to 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 information system guidelines to improve the decisionmaking process in small-scale fisheries management.
- To develop a training curriculum and courses in the use of these methodologies and application of microcomputers in fisheries management.

Results

The fulfillment of the wide range of objectives established above imply that a number of different activities must be conducted. Several of them have already been accomplished under different subprojects:

*Bangladesh project.* A unique and independent monitoring and evaluation research project is in progress in cooperation with technical staff of the Ministry of Fisheries and Livestock of Bangladesh, a highly qualified team of Bangladeshi experts, and several organized groups of fishing communities of the New Management Inland Fishery Policy of Bangladesh. The project expects to identify key factors leading to success or failure of the alternative management options implemented on an experimental basis and to explore possibilities of generalizing from these experiences to other fishing communities (of other developing nations) where similar conditions exist.

Arrangements and preparation of several activities which will take place during 1987 have been finalized. They will lead to the implementation of an intensive training program on the "Methods, Problems and Solutions on Data Acquisition"; finalization of a benchmark report; testing of the monitoring and evaluation methodology; acquisition of the microcomputer facilities needed for the information/data storage, retrieval, processing and analysis activities; and an intensive training program on Fisheries Economics and Management for senior officers of the Government of Bangladesh, which will include visits to important fishing nations of Asia.

Simulation and programming techniques are being used to model the inland fisheries of Bangladesh in a doctoral disseration being conducted at ICLARM by University of Chittagong's resource economist Mr. A.M.K. Mahfuzuddin Ahmed, who finished his Ph.D. course requirements at Universiti Pertanian Malaysia (UPM). Guidance and supervision are conducted at ICLARM.

*Bay of Bengal desk study.* Identification, analysis and evaluation of self-regulatory mechanisms as management options for small-scale fisheries are being conducted under the sponsorship of the Bay of Bengal Programme. Several experiences of the region (Thailand, Indonesia, Malaysia, Bangladesh and the Philippines) are being discussed and compared. Preliminary results will be presented at the Conference on People's Participation to be held in Bangalore, India, 5-10 May 1987.

*Manual on data and information needs for small-scale fisheries management.* A Manual intended to provide guidelines for the acquisition of information and implementation of a database system for small-scale fisheries management purposes has been discussed and drafted between ICLARM and FAO. The final version is expected to be finished by mid-1987 and jointly published by FAO and ICLARM.

*Training on management of marine fisheries.* Cooperating with FAO experts, Dr. Aguero lectured at the Shanghai Fisheries University on socioeconomic aspects of fisheries management. The successful completion of this course has led to requests from Shanghai Fisheries University authorities for collaborative activities and training on the application of microcomputers to fisheries management to be implemented by ICLARM.

Traditional vessel used in inland fisheries, Bangladesh.

Opening ceremony of the FAO/China Training Course on the Management of Marine Fisheries, Shanghai, October 1986. *L to R:* Mr. Ciu Jian-Zhang, Head, Department of Marine Fisheries, Shanghai Fisheries University; Mr. Wang KeZhong, Vice President (speaking), Shanghai Fisheries University; Dr. Max Aguero N., ICLARM; Mr. Song Zhi Wen, Deputy Director, Bureau of Fisheries Management, Beijing; Dr. Shiro Chikuni, FAO, Rome; Dr. Frank Nagasaki (behind), Japan Whaling Association; Dr. Serge Garcia, FAO, Rome; Dr. William Mackenzie, Consultant; Mr. Jan Tessel, FAO, Beijing; Mr. Cong Chunquan, Deputy Division Director, Bureau of Fisheries Management, Beijing; and Dr. Francis Christy, FAO, Rome.

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| **Project Title** | : | Assessment and Management of Small Pelagic Stocks of the Philippines |
| **Cooperating Institution** | : | Bureau of Fisheries and Aquatic Resources (BFAR) with funding from the World Bank |
| **Duration** | : | August 1986 to February 1988 |
| **Key Personnel ICLARM** | : | Mr. Paul Dalzell |
| **BFAR** | : | Mr. Reuben Ganaden |

Objectives

- To collate and review the 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 and fishing effort and length-frequency data on small pelagic fishes.
- To suggest means by which the economic performance of the fishery may be improved.

Results

During 1986, catch data pertaining to small pelagic fishes, as well as their biology in the Philippines and elsewhere in the Indo-Pacific region were reviewed; the corresponding publication is expected to be published in early 1987.

A companion review of secondary economic data for small pelagic fisheries will be made in 1987 based on published statistics and large collections of important unpublished data.

The members of the field sampling teams to be trained at six sites were interviewed and selected during 1986. Eighteen people were chosen, twelve biological and catch samplers and six economic data samplers. Each team will consist of three people, two biologists and an economist.

Field samplers will collect catch and effort data, species composition and length-frequency data, and wholesale price of different small pelagic fishes from day to day. The economists will also conduct a cost-benefit survey for different combinations of boats, men and gear to examine the profitability of small pelagic fisheries. Field sampling will last for 14 months, the first two of which are regarded as an orientation period for the sampling teams after training.

An analysis of the relationship between catch and fishing effort of the commercial fleet was made. Catch data are shown in Fig. 3 (p. 85). The index of effort used was adjusted fleet horsepower since direct estimates of effort began only in the 1980s. The analysis clearly showed that Philippine small pelagic stocks were being fished beyond the level of their maximum sustainable yield.

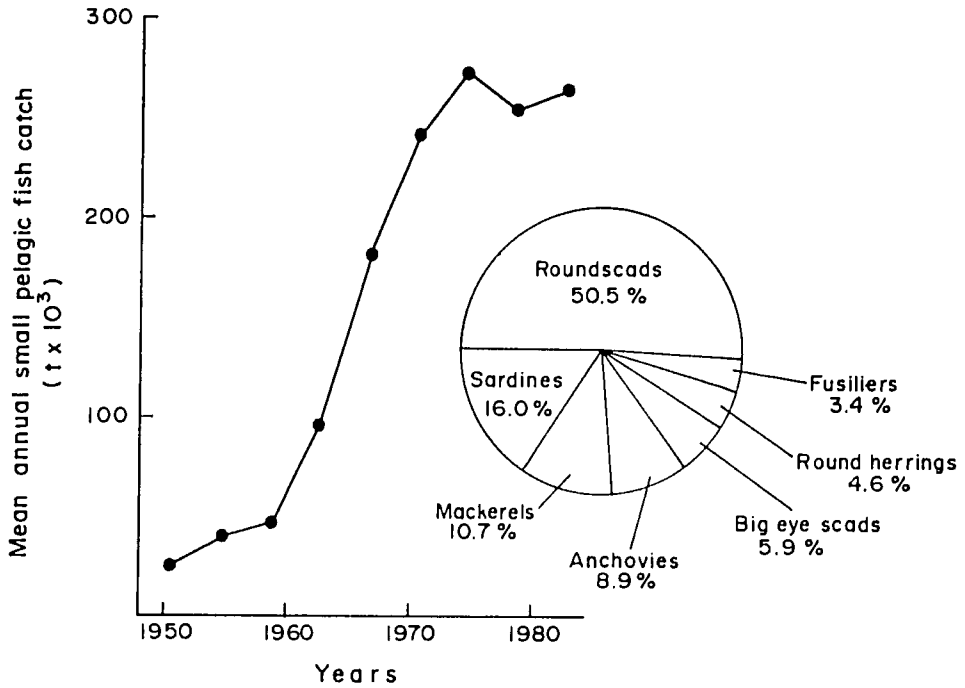


Fig. 3. Commercial catch of small pelagic fishes in the Philippines from 1949 to 1984. Catches are averaged over four years. Catch composition based on data from 1976 to 1984.

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| Project Title | : | The Compleat ELEFAN |
| Cooperating Institution | : | Philippine-German Fisheries Project (College of Fisheries, University of the Philippines in the Visayas, and German Agency for Technical Cooperation (GTZ) |
| Duration | : | One year beginning January 1986 |
| Key Personnel GTZ | : | Dr. J. Saeger; Mr. F. Gayanilo, Jr. |
| ICLARM | : | Dr. D. Pauly; Ms. Mina L. Soriano |

Objectives

- To revise and expand all routines that are part of ELEFAN microcomputer programs, based on the recommendations of the participants of the ICLARM/KISR Conference on the "Theory and Application of Length-Based Methods in Stock Assessment" (Mazzara del Vallo, Sicily, Italy, February 1985).
- To implement the expanded and revised routines on IBM-compatible microcomputers inclusive of high resolution graphic routines.
- To develop a revised version of the ELEFAN programs for use on Apple II microcomputers.
- To prepare, print and distribute a detailed user's manual for this software.

## Results

The bulk of the Compleat ELEFAN was written in 1986. The programs, which will be exhaustively tested during the forthcoming FAO/DANIDA follow-up training course in tropical fish stock assessment (to be held in January-February 1987 in Manila), will be completed in 1987 as a part of the ICLARM Software Project and are expected to be ready for distribution to selected users in mid-1987.

To allow interested scientists to work, in the meantime, with updated versions of the ELEFAN programs, a compact, single-disk version of these programs originally developed by T. Brey and D. Pauly has been upgraded and widely disseminated. This version runs, in compiled BASIC, on both IBM PCs and Apple II and their compatibles. The project also encouraged the work of Mr. Liew Hock-Chark of Universiti Pertanian Malaysia, who developed high-resolution graphics routines to supplement the Apple II version of these programs. (See: Liew, Hock-Chark. ELEFAN with hi-res graphics for Apple II (CP/M) user. Fishbyte 4(3): 10-12.)

Dr. Daniel Pauly *(right)* at the international symposium on "El Niño" in Guayaquil, Ecuador, October 1986. With him are Dr. Horst Salwedel, Team Leader GTZ Fisheries project at IMARPE *(left)*, and Mr. Jaime Mendo, GTZ staff, based at IMARPE and former ICLARM Intern, 1986 *(center)*. Details of project on p. 75.

## AQUACULTURE PROGRAM

### Background

Aquaculture, the raising of aquatic organisms under controlled or managed conditions, has vast potential for raising nutritional standards and incomes in tropical developing countries. Fish are excellent converters of low-grade feedstuffs and agricultural residues into high-grade animal protein and they grow fastest in the tropics. However, the research base for aquaculture development is weak. ICLARM's Aquaculture Program aims to remedy this by defining and resolving key problems through collaborative research with developing-country scientists.

The Program began nine years ago amidst considerable diversity of international opinion on aquaculture research priorities. ICLARM sought first to establish a successful track record in collaborative activities, sharing and, wherever appropriate, strengthening the facilities of existing institutions, whilst developing a strategy for long-term work. During this period, 25 projects were completed with 20 cooperating institutions, together with various ancillary activities: training, workshops, conferences, reviews and advisory services. Details are given in past ICLARM Reports.

The spectrum of aquaculture research issues is extremely broad. However, ICLARM identified three research themes as being of major importance for the expansion of tropical aquaculture and on which it chose to concentrate. These are:

- The genetic improvement of cultured fish, especially tilapia.
- The development of technology for low-cost culture systems in which fish can be grown on organic wastes and natural aquatic foods (bacteria, detritus, plankton and plant material).
- Aquaculture economics and policy, including production and marketing aspects as well as broader development issues.

The first two themes, improvement of cultured organisms and of appropriate culture systems for tropical developing countries, are highly interactive. A similar research focus on genetic improvement/systems development has been the main basis for increased crop and livestock production. ICLARM envisages comparable success with cultured fish. The third theme ensures that aquaculture is viewed in the broader context of the whole available range of food producing systems. Only within such a context can aquaculture fulfill its potential as a food producing system within the mainstream of agriculture.

The Program concentrates on tropical finfish and molluscs appropriate for less capital-intensive aquaculture by small-scale farmers supplying domestic markets; notably tilapia (an African fish, viewed as the "aquatic chicken"), carps and bivalve molluscs (clams, cockles, mussels and oysters). ICLARM's research on the development of giant clam culture, appropriate for the South Pacific, is the sole exception to the domestic market orientation of the program. This remarkable self-feeding mollusc yields high value export as well as affordable domestic products, even in small-scale operations.

Overall, the program has only a small involvement in research on shrimps and other luxury foods, and this is primarily from a broad economic and social feasibility viewpoint.

The main program activities are multidisciplinary, collaborative research and training, combining the biological and social sciences. In addition to generating important research results and strengthening developing-country institutions, the various projects undertaken provide leadership in the improvement of research methodology.

Up to 1985, program activities were largely confined to Asia. However, the chosen research themes and commodities have broader geographical focus. For example, the established traditions and modern improvements in Asian aquaculture have tremendous relevance for aquaculture development in Africa. Closer cooperation between the two continents would be further beneficial because Africa holds the tilapia genetic resources from which the aquaculture industry worldwide could develop improved breeds. Coastal aquaculture of bivalve molluscs, again historically most developed in Asia, could be much more widely implemented in other tropical waters of suitable quality. Thus, ICLARM aquaculture activities are expanding in Africa and the South Pacific from their initial base in Asia and are focusing on establishing mutually beneficial linkages amongst these regions.

## Program Themes

*Genetic improvement of cultured fish.* Little attention has been paid to genetic improvement of farmed fish, particularly in tropical developing countries, most of which lack professional fish geneticists and the facilities to initiate and carry out research programs. This is arguably the greatest hindrance to increasing cultured fish production. Genetic improvement has been a key factor in increasing agricultural production. Genetic improvement of rice and other crops has become a highly developed science producing disease-resistant, adverse soil-tolerant and temperature-tolerant varieties, while in modern livestock production, crossbreeding programs have given superior performance with respect to survival, growth rate, feed utilization, carcass composition and fecundity. In contrast, tropical aquaculture uses breeds of unknown genetic makeup, most of which are undomesticated wild types. There is also evidence that genetic deterioration, resulting from inbreeding and uncontrolled interbreeding between wild and farmed fish, is widespread.

A common misconception is that it will be many years before fish genetics research can impact on production, but this is not so. The documentation, conservation, evaluation and use of African tilapias in simple hybridization and breeding programs could lead to significant yield increases within a few years. In addition, the emerging bivalve culture industries need immediate genetic diversity studies for selection of the best stocks for culture. Positive action and international cooperation are needed to address these issues and ICLARM is assuming a lead role.

*Technology for low-cost culture systems.* Organic wastes (composts, livestock manure and human sewage) have been used as fishpond fertilizers for centuries in Asia. They stimulate production of natural aquatic feeds, and therefore reduce or eliminate completely the need for farmers to provide inorganic fertilizers and fish feeds, which are often prohibitively expensive.

Wastefed aquaculture and integrated farming, combining crop and livestock production with fish culture, are particularly attractive. For example, in an ICLARM cooperative research project within the Philippines, yields of up to 10 tonnes of fish/ha/year have been demonstrated with livestock manure as the sole input. Yields of 7-8 t/ha/year are regularly attained on Asian farms; backyard ponds (approximately 200 $m^2$) in Thailand, supplied with farm and household wastes, have yielded an average 175 kg of fish/year, a valuable nutritional supplement to the family, sufficient to supply the entire animal protein needs of a rural household of five members.

Although these systems are known to be highly productive and lead to increased incomes for farmers who adopt them, the biological and chemical basis of their productivity is little understood. Research groups investigating this in the tropics are scattered and lack access to information, ideas and linkages which could accelerate their progress. In most aspects of systems technology, animal husbandry and waste management, these groups face common problems. Above all, they lack appropriate methodologies to investigate and improve these interactive systems.

Increased international cooperation and coordination of efforts in research and training are needed to maximize efficiency of use of research facilities and support. The most exciting prospects are:

- Improvement of existing integrated farming systems, such as livestock-fish, crop-fish (especially rice-fish) and crop-livestock-fish.
- Transfer and adaptation of successful Asian technology to Africa.
- Development of systems models, based on analysis of existing data and new experiments which are interactive with the modelling work.

Throughout such activities, economic and socioeconomic factors must be considered along with biological factors.

Bivalve molluscs are attractive organisms for coastal aquaculture since they require no artificial feeding. ICLARM has already undertaken extensive cooperative research and training activities on coastal bivalve culture in Southeast Asia. ICLARM's principal current involvement in coastal aquaculture is the International Giant Clam Mariculture Project, which is coordinated through ICLARM's South Pacific Office.

This involvement arose from recognition of the technical feasibility of nonintensive giant clam culture in a coral reef environment. Giant clams are phototrophic, like plants, and therefore the world's only self-feeding potential farm animals. Stocks of the two largest species have been seriously depleted throughout the Indo-Pacific region and in some cases extinguished by intensive harvesting and poaching by foreign fishing vessels: the latter because of extremely high prices paid in Southeast Asia for the large muscle which closes the shells. This overexploitation of natural stocks suggested that giant clam culture for local food production and export could have major potential in the tropical Indo-Pacific. It appears to offer islanders in relatively remote areas the possibility of export earnings and local food supplementation from an activity which is in harmony with traditional lifestyles.

This project is now well underway with most of the major activities currently being conducted in partnership with James Cook University of North Queensland, Australia. Other participating institutions currently include the University of the Philippines and Silliman University in the Philippines, the University of Papua New Guinea, the Fisheries Division of Fiji, the Fisheries Department of the Solomon Islands and the University of Newcastle upon Tyne, UK, working with Universitas Diponegoro in Indonesia.

The principal objectives of the giant clam project include development of economically viable hatchery and nursery techniques, investigations of growth and mortality rates under different conditions, seasonality of spawning, predation and parasitism, larval nutrition, genetic variability, symbiosis and all aspects of marketing, product development and socioeconomic considerations. Substantial progress has been made since 1983, and the four largest species have already been reared to juvenile stages.

An increasingly important component of this project is the development of ICLARM's Coastal Aquaculture Center on Guadalcanal Island, Solomon Islands, which began in mid-1986 in cooperation with the Solomon Islands Ministry of Natural Resources. The first major activity of this Center is the ongoing development of a pilot-scale giant clam hatchery, at which emerging clam culture technologies can be tested on a semi-commercial scale. Apart from the availability of land, the Solomon Islands was selected because it is located close to the geographical center of diversity of Indo-Pacific marine fauna and flora and offers an immense diversity of pristine marine habitats, ranging from atolls to deep fjords.

*Aquaculture economics and policy.* During the early 1980s, ICLARM's cooperative research on economic aspects of aquaculture focused primarily on microeconomic analysis based on industry surveys. Prominent among these were analyses of milkfish and tilapia systems in the Philippines and Taiwan and of catfish in Thailand. By the mid-1980s, ICLARM's aquaculture economics research was being conducted almost exclusively through the Asian Fisheries Social Science Research Network and by the national institutions that belong to this network.

ICLARM's aquaculture research is increasingly interdisciplinary. Research on genetic improvement and especially technology for low-cost

systems has an explicit social science component, and this component will be pursued as funding permits.

## Training and Advisory Services

Advisory services given by Program staff during 1986 were somewhat reduced in comparison with previous years, largely due to the increased time spent on planning and developing ICLARM's future activities.

The Program Director visited Cameroon, Ghana (twice), Indonesia, Ivory Coast (twice), Israel, Malawi (three times), Zambia, Zimbabwe and the Solomon Islands. Many of these visits provided opportunities for information exchange and seminars.

Dr. Pullin served as a member of the Research Working Group of the Network of Aquaculture Centers in Asia (NACA) and represented ICLARM at NACA's First Provisional Governing Council Meeting in Surabaya, Indonesia. Dr. Pullin also assisted the Bundesminsterium für Wirtschaftliche Zussamenarbeit (BMZ) of the Federal Republic of Germany in preparing project documents for technical cooperation involving German, Israeli and developing-country scientists and ICLARM. Dr. Pullin participated in a Consultation on Fishery Policy and Research of the National Economic and Development Authority of the Government of the Philippines.

At the invitation of the Government of the Federated States of Micronesia, Dr. John L. Munro visited Pohnpei and Kosrae to advise on the development of an aquaculture program and participate in an aquaculture planning workshop.

## Program Plans for 1987 and the Next Decade

In 1986, ICLARM's Aquaculture Program shifted towards a more integrated and sustainable research and training effort. This called for the preparation of detailed written interdisciplinary frameworks for future activities in the chosen research themes: genetic improvement of farmed fish and low-cost aquaculture farming systems technology. These frameworks, like the International Giant Clam Mariculture Project, will provide a set of activities over the next decade through which international cooperation will be developed, particularly between African and Asian scientists.

The developing countries of Africa lack a history and tradition of aquaculture comparable to those of Asia. They have common problems of protein malnutrition and poverty with many of the developing countries of Asia, but have relied largely on traditional agriculture and capture fisheries for food production. Africa is the world's least developed region with respect to aquaculture. The reasons for this are complex and include lack of a strong research base and institutional support for aquaculture development and lack of trained personnel.

Africa needs low-cost aquaculture technology suitable for broad implementation in rural areas. The criteria for suitability are success in fish production and income improvement over a wide range of conditions of input availability, experience, social circumstances and markets. Systems are needed which are insensitive to changes in inputs and management skills. Pond and cage systems and methods for improving fish production from the numerous farm dams and small reservoirs have excellent possibilities.

In this respect, the Asian experience is invaluable. Tilapias and carps, which are available throughout Africa, will thrive in wastefed pond systems which do not depend on availability of expensive inputs such as inorganic fertilizers and feeds. Coastal aquaculture in brackishwater lagoons also has considerable potential, especially in West Africa.

The advancement of African aquaculture requires considerable research and training efforts. ICLARM is seeking a major role in this process and has received a Preparatory Assistance Grant from UNDP through the World Bank, which complements support already received from Germany for cooperative integrated farming research in the Southern Africa Development Coordination Conference (SADCC) countries from a Malawi base. Further support is also expected from the Asian Development Bank for cooperative research on rice-fish culture in South and Southeast Asia.

During 1986, ICLARM senior staff and consultants undertook planning missions to Cameroon, Ghana, Ivory Coast, Malawi, Zambia and Zimbabwe. A base is being established in Malawi, the lead country for fisheries and aquaculture for SADCC and linkages are being established in eastern, southern and western Africa. Plans are in progress for research and training activities in integrated farming systems and fish genetics. A planning consultancy for tilapia genetics research in Africa and Southeast Asia was supported by the Rockefeller Foundation in 1986. A major feature of future activities will be workshops, study visits and conferences involving African and Asian researchers. In 1987, the program will also launch a Network of Tropical Aquaculture Scientists (NTAS) following the example of the highly successful Network of Tropical Fisheries Scientists.

## Meetings Attended, Papers Presented

Federated States of Micronesia Aquaculture Planning Workshop. Pohnpei and Kosrae, 2-12 April 1986. (J.L. Munro)

The First Asian Fisheries Forum, Manila, Philippines, 25-31 May 1986. (J.B. Capili, R.S.V. Pullin, M.C. Paguio)

Network of Aquaculture Centers in Asia Research Working Group Meeting, FAO, Bangkok, Thailand, 16-19 June 1986. (R.S.V. Pullin)

Southern African Development Coordination Development Conference (SADCC) Workshop on the Development of Village Level and Commercial Aquaculture in the SADCC Region, Kariba, Zimbabwe, 29 September-3 October 1986. (J.D. Balarin, J.L. Maclean, R.S.V. Pullin and I.R. Smith)

Papers presented:

J.D. Balarin, R.D. Haller and A.T.C. Armitage. Baobab tilapia farm, Kenya: a case study.

R.S.V. Pullin. Research and training for aquaculture development in Africa.

R.S.V. Pullin. Choice of species for African aquaculture.

R.S.V. Pullin. Case studies on aquaculture in Southeast Asia. a. Better diets through integrated farming: a village trial with ducks and fish (videocassette prepared by the Asian Institute of Technology, Bangkok); b. Tilapia farming and rural change in Santo Domingo (tape-slide presentation prepared by Ateneo de Manila University and ICLARM).

I.R. Smith. Aquaculture development: it's a matter of broader context.

ICLARM/UNDP Planning Workshop, Towards a Research Framework for Tropical Integrated Agriculture-Aquaculture Farming Systems, Manila, 15-17 October 1986. (J.D. Balarin, B. Costa-Pierce, J.L. Maclean, M.C. Paguio, R.S.V. Pullin and I.R. Smith)

Papers presented:

J.D. Balarin. Research priorities for the development of rural aquaculture in Africa.

R.S.V. Pullin. International research cooperation in wastefed aquaculture and integrated farming.

I.R. Smith. Social science and economics research needs for the development of wastefed aquaculture and integrated farming.

Consultative Group on International Agricultural Research; International Centers Week, Washington DC, 3-7 November 1986. (D. Pauly, R.S.V. Pullin, B.M. Rodriguez, I.R. Smith)

First National Symposium and Workshop on Tilapia Farming, Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna, Philippines, 24-26 November 1986. (J.B. Capili)

Network of Aquaculture Centers in Asia, First Provisional Governing Council Meeting, Surabaya, Indonesia, 25-28 November 1986. (R.S.V. Pullin)

Consultative Meeting on Fishery Policy and Research, National Economic and Development Authority, Manila, Philippines, 9 December 1986. (D. Pauly and R.S.V. Pullin)

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## Aquaculture Program Project Summaries

**Project Title** : Evaluation of Farmed Tilapia Stocks

**Cooperating Institutions** : Marine Science Institute, University of the Philippines (UPMSI); National Freshwater Fisheries Center, Philippines Bureau of Fisheries and Aquatic Resources (NFFC/BFAR)

**Duration** : Continuous from April 1984

**Key Personnel** UPMSI : Ms. Julie M. Macaranas; Ms. Ma. Josefa R. Paate; Ms. Ma. Luisa A. Virata

NFFC/BFAR : Mr. Melchor M. Tayamen

ICLARM : Dr. Roger S.V. Pullin; Ms. Josephine B. Capili; Ms. Mary Ann C. Paguio

### Objectives

- To investigate the genetic characteristics of cultured tilapia stocks in the Philippines.
- To identify electrophoretic and other genetic markers for monitoring of experimental and commercial stocks.
- To provide baseline information for the initiation of tilapia stock improvement projects in the Philippines.

### Results

During 1986, the UPMSI/ICLARM team continued investigations on biochemical genetic characterization of tilapia stocks in the Philippines as an effective means of identification. Levels of genetic variation for existing tilapia populations and introduced species and strains are being monitored for future stock improvement programs. The techniques used are starch gel electrophoresis and polyacrylamide gel isoelectric focusing.

Muscle biopsy and blood sampling techniques were tried on live tilapia stocks being kept at NFFC/BFAR. The mean survival rates two months after the fish were sampled were 70% for biopsy and 84% for blood sampling. Thus, tilapia broodstock can be genetically typed and kept alive. Muscle tissue and sera were subjected to starch gel electrophoresis and five of the six divergent loci between Nile tilapia *(Oreochromis niloticus)* and *O. mossambicus* (Gpi-1, Mdh-1, Sp-2, Sp-3 and Ck) were resolved. All were present in muscle tissue; only Gpi-1 was located from serum. Although the survival rate was lower for the muscle biopsy technique than for blood sampling the former allows more diagnostic loci to be scored.

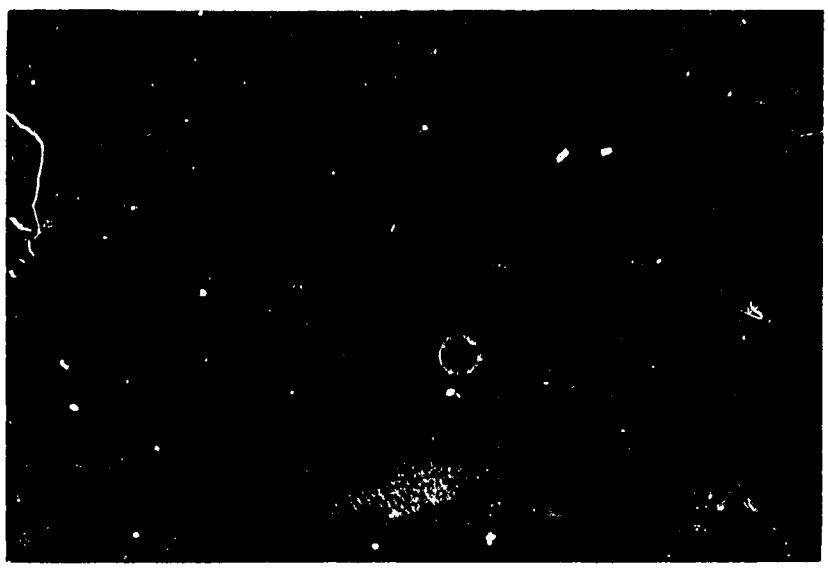
In addition to work on Philippine tilapias, samples were received from other countries. Frozen *O. mossambicus* samples from Papua New Guinea (PNG) were analyzed. Electrophoretic analysis showed that Aat-1 was polymorphic with a frequency of 0.950 for allele B. Previous allele frequency analysis of Philippine populations of *O. mossambicus* at the Aat-1 locus had a range of 0.250 to 0.538. These differences may reflect natural selection under environments of differing salinity because Aat has a role in the osmoregulative processes of the fish. The PNG fish, supplied by David Coates, have given valuable new information.

Frozen *Oreochromis urolepis hornorum* samples were supplied by Dr. Gideon Hulata from Israel. Twenty-one protein loci were examined and two (Est and Gpi-1)

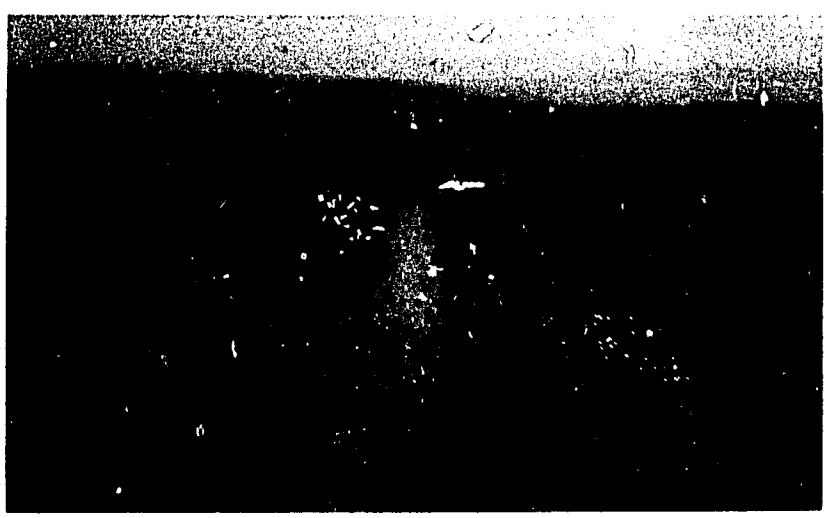
were found to be polymorphic. Most of the loci examined were monomorphic, the most common alleles shared with *O. niloticus*, except at the Mdh-1 locus: both *O. mossambicus* and *O. urolepis hornorum* have allele A as the most common while *O. niloticus* has allele B as the most common.

In 1986, the project team increased its activities on using morphometric and meristic data to characterize tilapias. Miss Ma. J.R. Pante visited the genetics laboratory of Dr. L. James Lester, Houston University, Clear Lake, to analyze and interpret the data collection so far. The results are very promising but the methodology requires further development.

Field trials with different tilapia strains included a four-month growth performance test in two culture systems: rice-fish culture and tank culture. Data gathered from the study are being processed.



Nile tilapia *(Oreochromis nilioticus)* at the National Freshwater Fisheries Center, Nueva Ecija, Philippines, the main broodstock improvement and fry distribution center of the Philippine Bureau of Fisheries and Aquatic Resources.



Rice-fish culture in the Philippines: a central trench is provided for the fish. ICLARM's integrated farming research activities include a reappraisal of Asian rice-fish culture with a view to improving fish production.

**Project Title** : Israeli-German Agriculture Research Cooperation Program to Benefit Technical Cooperation with Third World Countries: Aquaculture Project

**Subproject 1.** : Optimal Management of Aquaculture Pond Systems in Developing Countries

**Cooperating Institutions** : Agricultural Research Organisation (ARO), Israel; Technion, Israel Institute of Technology (T/IIT); University of Kiel (KU); African and Asian institutions (to be identified)

**Duration** : 1986--ongoing

**Key Personnel** ARO : Dr. Gerald L. Schroeder; Dr. Giora W. Wohlfarth; Dr. Ana Milstein; Dr. Gideon Hulata
T/IIT : Prof. Yoram Avnimelech; Dr. Shoshana Mokady
KU : Mr. Mark Prein
ICLARM : Dr. Daniel Pauly; Dr. Roger S.V. Pullin

## Objectives

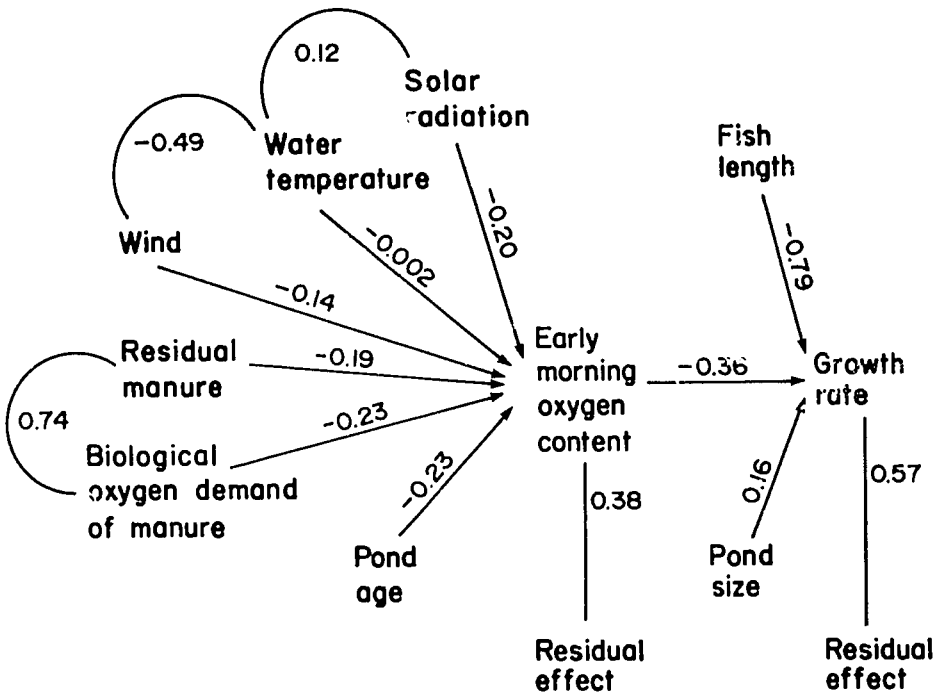
- To identify and quantify the effects of major variables affecting production in aquaculture ponds.
- To develop methods applicable to developing countries for monitoring and increasing the yield in fish ponds, especially in those fed with organic residues and agricultural byproducts.
- To understand 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 in ponds without supplemental feed above the currently attained plateau.
- To develop management techniques for aquaculture in developing countries.
- To develop diagnostic techniques, kits and instrumentation.
- To train scientists from other developing countries in these techniques.

## Results

Israeli data were available from two main sources: (a) experiments performed over the last ten years at the Dor Research Station, and (b) fish ponds in commercial farms in Israel. A further large data set was available from an ICLARM/CLSU Project on Integrated Farming, which has been described by Hopkins and Cruz (1982, the ICLARM-CLSU integrated animal fish farming project: final report. ICLARM Tech. Rep. 5, 96 p.).

After strong editing of a first part of the available data sets, analyses were started using multiple regression and canonical correlation, path and factor analysis: some of the most powerful statistical methods presently available.

The figure on p. 98 shows some effects on tilapia growth rate of factors that were identified and quantified in a preliminary analysis of the ICLARM/CLSU data, presented




A causal path diagram showing the direction and relative strength of influences on fish growth in a manured pond system, based on a linearized model. Early morning oxygen content correlates negatively with trophic state (i.e., plankton content) of the pond environment and the challenge is to increase the trophic state (through manuring) without depleting early morning oxygen.

as an MS thesis at KU "The influence of environmental factors on fish production in tropical ponds, investigated with multiple regression and path analysis" (M. Prein 1986).

Detailed analyses will be performed in 1987 based on additional data presently being entered into computer files, both at ICLARM and at the Dor Aquaculture Research Station. Standardization of data format was achieved through a four-week visit of Mr. Prein to the Dor Station in November/December 1986. It is expected that the bulk of the results of the joint data analyses to be performed on the data entered will be available before the end of 1987.

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|---|---|---|
| Subproject 2 | : | Utilization of Tilapia Genetic Resources for Expansion of Aquaculture |
| Cooperating Institutions | : | Agricultural Research Organisation (ARO, Israel); University of Hamburg (HU); African and Asian research institutions (to be identified) |
| Duration | : | 1986–ongoing |
| Key Personnel ARO | : | Dr. Gideon Hulata |
| HU | : | Prof. Wolfgang Villwock |
| ICLARM | : | Dr. Roger S.V. Pullin; 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**

This subproject commenced in December 1986 and only planning activities have been undertaken so far. The main event planned for 1987 is a workshop entitled 'Tilapia Genetic Resources for Aquaculture' to be held on 23-24 March 1987 in Bangkok, Thailand, immediately after the Second International Symposium on Tilapia in Aquaculture (ISTA II). ICLARM is a co-organizer of ISTA II and will also organize this workshop. The participants will be Israeli, ICLARM and German personnel associated with this project, invited participants from African and Asian institutions and other expert researchers and field biologists.

Missions will be then undertaken to selected African countries to examine and collect tilapias and to establish working relationships with African researchers. Project personnel from Israeli, ICLARM, German and African and Asian cooperating institutions will meet in September 1987 to review progress and to formulate detailed proposals for evaluation and utilization of promising material. This will include appraisals of research methods and selection of appropriate work sites.

**Project Title** : Research for the Development of Tropical Aquaculture Technology Appropriate for Implementation in Rural Africa

**Cooperating Institutions** : Department of Fisheries, Malawi (DOF); Chancellor College, University of Malawi; other African institutions to be identified; German Agency for Technical Cooperation (GTZ)

**Duration** : Planning Phase, November 1985-April 1986; Startup Phase, May 1986-October 1986; Main Project, November 1986-October 1987 (with provision for extension)

**Key Personnel** DOF : Mr. O.V. Msiska; Mr. M.K. Nyirenda
ICLARM : Mr. J.D. Balarin; Dr. R.S.V. Pullin

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

Planning missions were made to Cameroon, Ghana, Ivory Coast, Malawi, Zambia and Zimbabwe to establish research linkages with institutions interested in integrated agriculture-aquaculture farming systems. Malawi was chosen as the country in which to establish ICLARM's African Project Office. Malawi is the lead country for fisheries and aquaculture for the Southern African Development Coordination Conference (SADCC) countries: Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe.

In September, Mr. Balarin and ICLARM headquarters staff Dr. I.R. Smith, Dr. R.S.V. Pullin and Mr. J.L. Maclean participated in the SADCC workshop on "Development of Village Level and Commercial Aquaculture in SADCC Region," held at Kariba, Zimbabwe. Eight papers supported by audiovisual aids were presented.

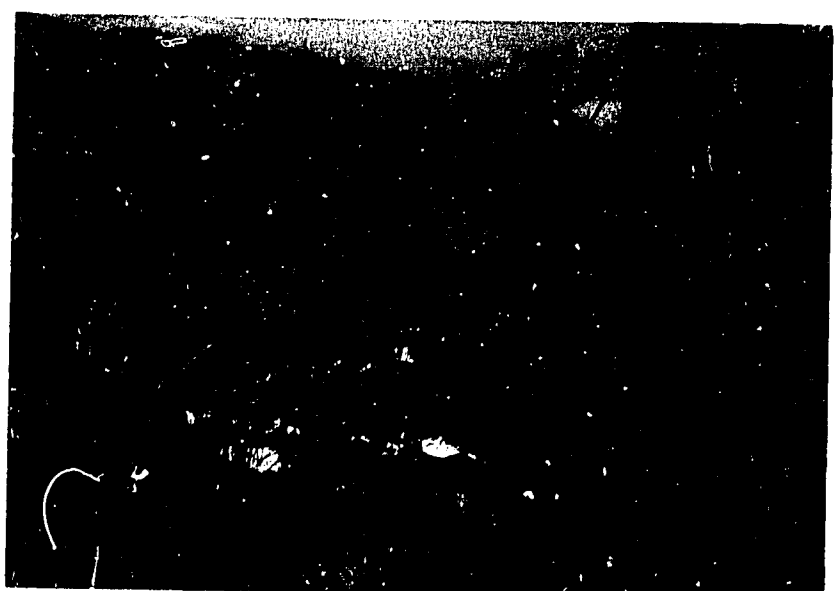
On October 7, a Memorandum of Understanding was signed between the Government of Malawi and ICLARM and a work plan proposed, involving cooperative activities with the Department of Fisheries (DOF), the University of Malawi, Chancellor College and institutions in other SADCC countries.

The most promising area of research appears to be the development of integrated agriculture-aquaculture technology using farm residues (manures and crop wastes) as nutrient inputs for ponds. Availability of livestock manure is likely to be limited. Most

livestock farmers in Africa are nomadic. Most settled farmers keep few animals. The project will therefore investigate other resources such as crop residues, composts, domestic wastes and ash from cooking fires.

In 1987, the project plans to build new experimental ponds at the DOF's Domasi Station in Malawi, undertake literature reviews, establish a reference library and begin training activities.

ICLARM Director General Ian Smith with extension officers of the Malawi Fisheries Department discusses records of tilapia production in small-scale farms close to Domasi, Malawi. ICLARM's first project on African aquaculture is based in Malawi and supported by the German Agency for Technical Cooperation (GTZ).



Malawi has scope for integration of fish culture into existing farming systems. For example, these wet areas adjacent to ricelands can be made into fishponds.

**Project Title** : Development of a Research Framework for Integrated Agriculture-Aquaculture Farming Systems

**Cooperating Institutions** : The United Nations Development Programme (UNDP) Global and Interregional Programme and the World Bank (WB)

**Duration** : One year, beginning July 1986

**Key Personnel** UNDP : Mr. Tim Rothermel
WB : Mr. Eduardo Loayza
ICLARM : Dr. Roger S.V. Pullin

**Objectives**

- To evaluate the applicability to integrated agriculture-aquaculture farming systems research of the analytical methodologies being used in farming or cropping systems research.
- To develop interdisciplinary research and data analysis methodologies appropriate for the examination of integrated agriculture-aquaculture farming systems (i.e., crop-fish, animal-fish) and for the development of systems modelling, involving biological and economic factors.
- To prepare an extensive literature review on integrated agriculture-aquaculture farming systems.
- To publish the results of these investigations in the form of a research framework.
- To develop a fundable plan for the application and further refinement of this research framework through cooperative research, workshops and on-farm testing.

**Results**

The project made considerable progress during 1986. The main event was a workshop on integrated agriculture-aquaculture farming systems held at ICLARM, Manila, 15-17 October. A group of invited experts from various agencies and institutions, including the Asian Institute of Technology (AIT) and the Aquaculture Development and Coordination Programme of FAO (ADCP) presented papers and discussed research and education needs and priorities. The idea of an Africa-Asia interregional cooperation was a major theme.

During 1987, three publications will come from the project: a research and education framework, an annotated bibliography for integrated farming research and a review of the application of systems modelling techniques to integrated farming. Discussions on future AIT/ADCP/ICLARM cooperative activities are continuing under this UNDP umbrella.

**Project Title** : Development of Aquaculture and Fisheries Activities for Resettlement of Families from the Saguling and Cirata Reservoirs, West Java, Indonesia

**Cooperating Institutions** : Institute of Ecology (IOE), Padjadjaran University; Perusahaan Umum Listrik Negara (PLN); Dinas Perikanan Provinci and Unit Pelaksanan Technic (UPT)—Saguling/Cirata; with funding from the World Bank

**Duration** : July 1986-July 1989

**Key Personnel** IOE : Dr. Otto Soemarwoto; Ir. Gelar Wira Atmadja
ICLARM : Drs. Barry A. Costa-Pierce; Roger S.V. Pullin; John L. Munro and Prof. Harlan Lampe

**Objectives**

- To identify the most appropriate aquaculture and fisheries methods for resettlement of 1,500 families.
- To establish and run various pilot-scale aquaculture systems and conduct research on their improvement.
- To provide extension and training of farmers in Indonesia and scientific training of Indonesian experts at ICLARM.
- To complete a comprehensive aquaculture and fisheries development plan.

**Results**

The planning phase of the project was completed with assignment of 20 resident staff into three subprogram areas—(1) Aquaculture Development and Management, (2) Capture Fisheries Development and Management, (3) Sociocultural, Economics and Marketing—and with the rental of office facilities in Bandung and at the Saguling Reservoir dam site. Detailed planning discussions with all cooperating agencies has led to an implementation plan for each of the three subprogram areas.

A survey of existing aquaculture and fisheries activities in the West Java region and the newly-created reservoirs was initiated in 1986. At the close of 1986, it appeared that the most promising aquaculture systems were floating net cages and small-scale hatcheries for common carp. Some 59 floating net cages were installed by farmers in 1986 with increasing numbers of farmers obtaining credit from conventional financial institutions associated with and closely monitoring the progress of the project.

Aquaculture and fisheries activities in the Saguling Reservoir, West Java, Indonesia. A family integrated pond is in the foreground with floating net cage culture in the background. Note the small fishing boats on shore and near the cages. Photo by B. Costa-Pierce.

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|---|---|---|
| **Project Title** | : | Coastal Aquaculture Center |
| **Cooperating Bodies** | : | The Government of Solomon Islands (GSI) and the Guadalcanal Provincial Government (GPG) |
| **Duration** | : | 1986--ongoing |
| **Key Personnel ICLARM** | : | Dr. John L. Munro; Mr. Graham Usher—Technical Cooperation Officer provided by the Overseas Development Administration of the United Kingdom (ODA) |
| GSI | : | Mr. Baraka Kaitira (GSI Fisheries Department) |

**Objectives**

- To test, develop and demonstrate methods for the cultivation of economically valuable aquatic organisms, including the production of eggs, larvae, spat, seed and mature animals or plants.
- To investigate methods for environmental enhancement or manipulation which relate to artificial improvement of natural fisheries.
- To investigate and develop methods for processing and marketing aquaculture products.
- To appraise the social and economic impacts of such developments in the region.
- To provide public dissemination of the results of the above activities.
- To serve as a regional source of fisheries and aquaculture information and as an administrative base for ICLARM's activities within the South Pacific region.

**Results**

Negotiations for the development of the Coastal Aquaculture Center culminated in the signing of an Agreement between ICLARM, the Government of Solomon Islands (GSI) and the Guadalcanal Provincial Government (GPG) on 4 June 1986. The three-part agreement provides the basis for establishment of this regional center on Guadalcanal Island and for development of a giant clam hatchery as a collaborative research and development project executed by ICLARM and the GSI Fisheries Department. The Agreement also makes provision for the possibility of part of the giant clam hatchery facilities being subleased to a commercial company, owned and operated by the GSI and GPG, at some future date.

The "Grant of a fixed term estate" for a period of fifty years was signed on 7 October 1986, and included the 4.8-ha site, together with the adjacent subtidal and intertidal zone along a 400-m sea frontage and to a distance of 100 m from shore. The site is 25 km west of the national capital, Honiara. It is bounded by a fringing coral reef along its full length and has a substantial beach rock platform on the eastern side which will be used for construction of intertidal tanks. A copious, permanent freshwater spring emerges on site and assures an adequate supply of potable water. The site was part of an extensive, but neglected, coconut plantation. Clearance of part of the site, involving removal of the coconut palms from the work areas and levelling of selected areas commenced on 13 October 1986.

Mr. Graham Usher, Research Associate, was seconded to ICLARM by the United Kingdom Overseas Development Administration to serve as Hatchery Manager in the

Coastal Aquaculture Center. After six months of preparatory work in Australia, participating in the research at James Cook University's Orpheus Island Research Station and in the design of the hatchery, he moved to the Solomon Islands in mid-year to initiate the development of the hatchery. Mr. Baraka Kaitira, Fisheries Officer in the Solomon Islands Fisheries Department, was assigned to the Giant Clam project at that time as Mr. Usher's counterpart.

Plans for the first buildings (the giant clam hatchery/laboratory and the hatchery manager's residence) were finalized by mid-November and orders were placed for all major items of equipment.

Dr. J. Munro prepared several papers and reports on mollusc fisheries and aquaculture during the year, while work has continued on the analysis of growth and mortality rates of giant clams in a number of localities and on the estimation of economic parameters in hatchery and nursery operations.

Clearing the site of the Coastal Aquaculture Center, near Honiara, Solomon Islands.

| | | |
|---|---|---|
| Project Title | : | International Giant Clam Mariculture Project |
| Principal Cooperating Institution | : | James Cook University of North Queensland (JCUNQ) |
| Other Cooperating Institution. | : | 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 Science Institute, University of the Philippines, Quezon City (UP); Fisheries Division, Ministry of Agriculture and Fisheries, Suva, Fiji (MAFF); Fisheries Department, Ministry of Natural Resources, Honiara, Solomon Islands (MNR); Tropical Development Research Institute, Overseas Development Administration, London, England (TDRI); University of Newcastle-upon-Tyne (UNT); and the Micronesian Mariculture Demonstration Centre, Koror, Republic of Palau (MMDC). |
| Duration | : | 1983-1988 (first phase) |
| Key Personnel ICLARM | : | Dr. John L. Munro; Mr. Graham F. Usher—Technical Cooperation Officer provided by the Overseas Development Administration of the United Kingdom (ODA) |
| JCUNQ | : | Dr. John Lucas; Dr. Christine M. Crawford (resigned 13 June 1986); Mr. Richard D. Braley (appointed 23 June 1986); Mr. Warwick J. Nash |

Objectives

- To create a foundation of scientific knowledge which will enable giant clams to be raised in sufficient numbers in hatcheries to make reef restocking or extensive mariculture feasible.
- To reverse the trend of the larger species towards extinction.
- To develop a new industry in the equatorial Indo-Pacific based upon the extensive cultivation of an esteemed traditional food resource, which will provide increased food supplies and exportable products.
- To create ultimately mariculture systems for the only phototrophic, and thus self-feeding potential farm animal known to humankind.

Results

A major advance has been the discovery that, in terms of growth and survival under Australian conditions, the lower intertidal zone is the most favorable area for the ocean nursery phases of *Tridacna gigas*. This possibility was suggested by J. Munro in 1985 and has now been confirmed by the JCUNQ group. This has important implications for the economics of clam farming because the ocean nursery phase is highly labor-intensive. For example, the MMDC *Tridacna derasa* nursery in Palau is in water 4-5 m deep and

many hundreds of man-hours of underwater work are needed each year for the maintenance of a relatively small nursery. If the nurseries can be located in the intertidal the work load could be dramatically reduced and the output of juvenile clams/man-year correspondingly increased.

Field methods for surveys and population estimates have been refined by the ICLARM, Fiji and UP groups and growth and mortality rates derived for species in several areas. A small suite of computer programs for analysis of growth and mortality estimates has been assembled and a comprehensive insight into the magnitude and variability of the parameters of growth, mortality and recruitment is emerging.

These estimates are now permitting site-specific production curves to be calculated and will also lead the way to the formulation of scientifically based recommendations concerning the exploitation and management of wild stocks and an evaluation of feasibility of restocking depleted reefs with hatchery-reared juvenile clams.

Acquisition of information on economic factors, utilization of clam products, possible market outlets, product development and social aspects are the main concern of several participating groups and useful work has also been sponsored by the Forum Fisheries Agency.

ICLARM activities within the project have focused primarily on the design and development of a giant clam hatchery in the Solomon Islands. Completion of a formal agreement with the Government of Solomon Islands and the Guadalcanal Provincial Government took longer than anticipated. However, this gave ample time to refine the design of the hatchery and associated seawater system, to cost out most items of equipment and to tailor plans to available funds. Substantial capital grants were received from the Australia and Pacific Science Foundation and the L.B. and M.J. Skaggs Foundation. Generous ODA support for the project was also continued.

## INFORMATION PROGRAM

### Background

For fisheries as for many other fields of science, information is difficult to get in tropical and developing countries. Researchers, in particular, suffer from lack of access to current ideas, current literature and even standard textbooks. Compounding this, too often, research activities fail to produce usable research results and publications. In general, the flows of information are south-north in direction rather than around the tropics.

There are also financial aspects to the acquisition dimension of this problem. Researchers often cannot attend meetings with their peers in other countries, particularly those in other regions; library budgets (where there is a library) are meager, while the cost of western journals and books and use of computerized database services are exorbitant by developing country standards. The high cost of journals leads further to the ironic situation that tropical researchers who publish in western journals cannot afford to buy back their own research results.

In response to these and other interrelated problems, ICLARM has been taking the initiative in several areas to improve upon the workings, use and contributions of tropical aquatic science information systems. The Center's Information Program is particularly important also, in the context of the regional and global networks that the Center coordinates. For these reasons, ICLARM's Information Program is not only a service in support of the Center's cooperative research program but also an active program in its own right.

### Program Themes

ICLARM has been attempting to lessen the problem of isolation of the individual scientists in several ways. First, the Center distributes free to institutions in many developing countries, the result of its own research, conferences and commissioned reviews of important subjects, while over 3,500 persons receive the information-packed NAGA, the ICLARM Quarterly. Second, through its Selective Information Service funded by IDRC, ICLARM provides free database and reference services on request. Third, the Center began a Network of Tropical Fisheries Scientists, which provides a free newsletter, Fishbyte, and FAO publications on aspects of fisheries science. A second network for tropical aquaculture researchers is due to

begin in 1987. Fourth, by initiating the development of the Asian Fisheries Society (AFS), the Center has helped to establish a regional fisheries research journal of international standards for the Asian region, as well as a regional tri-annual Forum for Asian Fisheries Scientists.

The major functions of ICLARM's Information Program, when it was still an information service, were to provide library and publication facilities in support of ICLARM activities. The library, which began in 1978, has grown rapidly to hold over 8,000 volumes and over 500 serial titles and to have a patronage of over 1,000 external users annually during the past few years. The publication section has produced more than 50 major titles since the first reports rolled off the press at the beginning of 1980, in addition to NAGA, the ICLARM Quarterly (formerly the ICLARM Newsletter), annual reports and numerous brochures, catalogs and flyers. These publications are but a subset of ICLARM's contributions to the literature, which now exceed 350. All of the staff and cooperating institution contributions to be published with or by ICLARM pass through the information program for editing, typesetting, layout and artwork. Articles for external publication must also be edited before release.

In 1984, another role began, that of providing information on request to developing-country researchers through a well-publicized *Selective Fisheries Information Service*, which is partially funded by IDRC. Its main feature is a question/answer service, which provides a package of information to requestors, usually including a computer literature search, addresses of other researchers and copies of important articles. The Service also provides for publication of bibliographies and reviews in subjects shown to be important by the numbers of request for information. Over 400 enquiries from researchers have been answered to date.

In 1985, the ICLARM Board of Trustees approved the addition of a research function to the Information Program. There have been no funds to staff an information research program to date. However, some progress has already been made through existing staff.

The overall information research program is shown in Fig. 1, which demonstrates the two-phase approach. The library has carried out a preliminary users' study; the publication staff are engaged in a survey of the use of reprints; and library staff have been conducting a citation analysis of ICLARM publications. A recent FAO grant to ICLARM enabled the Center to produce a special issue of NAGA covering education and training opportunities worldwide. Much is still to be done to quantify the world of tropical fisheries. However, ICLARM seems to be the only organization in the world engaged in a systematic study of this nature and it will provide the Center with another key role in fisheries in this "information age". In the long run, the research program's results will benefit fisheries educators, managers and publishers, as well as the researchers themselves.

The information program is also beginning to create an "extension" role through library consultancies; editorial consultancies (largely in response to the Center's funding crisis); formal and informal training in all aspects

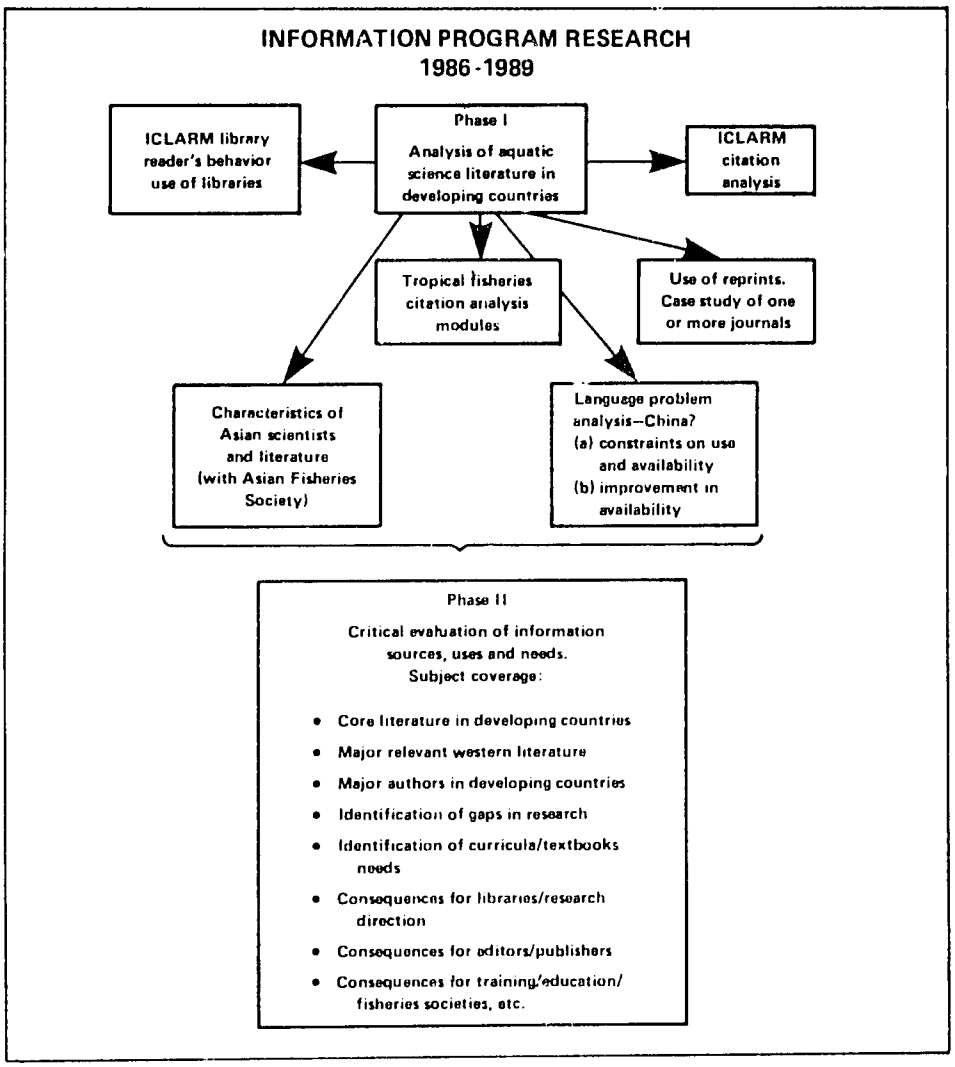



Fig. 1. The two-phase approach of ICLARM's information research program.

of information; and editing workshops. For example, the information program will play an important role in the ASEAN-USAID Coastal Resources Management Project.

The program is active in seeking computer-based information dissemination and retrieval methods, and looks forward to producing "electronic" material as microcomputers become more familiar tools in fisheries research.

Finally, the program supports the Asian Fisheries Society (AFS), which ICLARM initiated in 1983 and which recently successfully held its first Forum attended by over 400 scientists from 27 countries. ICLARM's Information Program currently provides the Society's secretariat, while staff time is also given to preparation of materials for Society purposes. For instance, during 1986 a major task was the editing and publishing of the proceedings of the First Asian Fisheries Forum and planning for a new Society journal to begin in 1987. The Society also involves direct costs to ICLARM in materials, postage and institutional membership.

## Publishing Activities

*Distribution.* A new distributor for ICLARM publications is Bangladesh Agency Limited, 68, Kakrail, Ramna, Dacca-2, Bangladesh, starting November 1986. ICLARM also has a distributor for North America in Oregon, USA, and a European distributor in Germany.

From sales, library exchange and free issue, the total number of books in ICLARM's five technical series distributed since the first publication in 1980 is over 65,000.

Distribution of Naga, The ICLARM Quarterly (new name of the ICLARM Newsletter) from the first issue in July 1978 now exceeds 116,000. Present distribution is 4,000 of each issue.

*Exhibitions.* ICLARM books were exhibited at the Agri-Aqua, Livestock and Poultry International Fair '86, Philcite, Manila, Philippines on 24 May to 1 June 1986 which coincided with the First Asian Fisheries Forum; Frankfurt Book Fair (Philippine booth), Germany, on 1-6 October 1986; at the Fishfarmers Technical Assistance Foundation, Inc. National Conference on Prawn Farming Technology, Development Bank of the Philippines, Manila, on 23-24 October; and at the First National Symposium and Workshop on Tilapia Farming sponsored by the Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna, Philippines, on 20-22 November 1986.

*Contributions.* The number of items published or in press by ICLARM staff and in the Center's technical series during 1986 was 77, bringing the total number of items to 352 since ICLARM's first output over a decade ago. The full list is contained in this Report.

## Library

The library materials on broad areas of aquaculture, fisheries and coastal zone management and disciplines ranging from basic biological research to economics have increased by 13% since 1985 to 7,174 volumes of books and monographs including theses and dissertations, conference papers and proceedings. However, the number of serials from all over the world decreased from 592 to 555 titles of which 21% were subscriptions. Irrelevant serial titles, mostly gifts, including duplicates, were discarded and donated to other fisheries libraries in Metro Manila. Reprints now total 3,196 titles; 19 microfiche titles were added also to the collection during the year. A large increase in library holdings is expected in early 1987 with the arrival of new reference materials for the ASEAN-USAID Coastal Resources Management Project.

Since 1981, the Press Foundation of Asia (Manila) has continuously monitored and delivered clippings on subject areas of interest to ICLARM.

A compilation of Serials Holdings lists has been completed and will be inputted onto a computer. It is hoped that the lists will be made available on diskettes for distribution to other fisheries institutions.

The library's microcomputer (from SFIS project funds) is now fully utilized with the arrival of the long-awaited bibliographic software CDS/ISIS from Unesco, Paris. The microcomputer will also be used for electronic mail.

Through the SFIS project, the library will be able to buy the compact disc version of the Aquatic Sciences and Fisheries Abstracts (ASFA CD-ROM), including a player. Additional microcomputers are also expected in early 1987.

The continuing growth in library use by external users (1,338 during 1986) helped the staff in undertaking a preliminary study of reading behavior of users of the ICLARM library. The results (Naga, April 1986) have helped to understand user needs as well as to gain an insight into the users of the ICLARM library and will be useful in planning collection development, specifically in streamlining the serials collection.

## Program Plans for 1987 and the Next Decade

Under sponsorship from IDRC, a trip to investigate fisheries information needs in Africa was made in late 1986, which resulted in a draft proposal for a module of ICLARM's Selective Fisheries Information Service in Africa. It is expected that a service will begin based in Malawi, where ICLARM is establishing an aquaculture project office.

During 1987-1988, the Program will supervise an information research project for the Asian Fisheries Society to investigate the characteristics of Asian fisheries scientists and their publications. Another function on behalf of the Society will be the executive editorial work for and publishing of the new journal, Asian Fisheries Science, to begin in 1987.

Information training activities will increase in future years, because the Center is fast becoming a leader, in Southeast Asia at least, in information retrieval facilities, with the recent acquisition of the compact disc version of the Aquatic Sciences and Fisheries Abstracts in addition to the existing online searching facility using the DIALOG system in California.

## Meetings Attended, Papers Presented

Regional Seminar on the Handling and Dissemination of Oceanographic Information and Data, National Institute of Oceanography, Goa, India, 17-21 March 1986. (R.M. Temprosa)

Papers presented:

R.M. Temprosa. Lectures on building up a marine science library and running a specialized information system.

The First Asian Fisheries Forum, Manila, Philippines, 26-31 May 1986. (J.L. Maclean, R.M. Temprosa)

Seminar-Workshop on the Use of Microcomputers in Libraries, Manila, Philippines, 25-27 June 1986. (N.R. Balagapo, N.I. Jhocson)

Seminar on Union Listing of Periodical Holdings and Acquisition Procedures, Manila, Philippines, 18 July 1986. (E.B. Gonzalez)

Manila Life Sciences Editorial Workshop II, ICLARM, Manila, Philippines, 5 August 1986. (M.A. Carigma, L.B. Dizon and M.S.M. Sadorra)

Seminar-Workshop on the Use of Microcomputers in Libraries, Manila, Philippines, 17-19 September 1986. (E.B. Gonzalez, R.M. Temprosa)

Southern African Development Coordination Conference (SADCC) Aquaculture Workshop, Kariba, Zimbabwe, 29 September-3 October 1986. (J.L. Maclean)

Paper presented:

J.L. Maclean. Aquaculture information sources.

Training Course on Information Research and Management, ASEAN-USAID Coastal Resources Management Project, ICLARM, Manila, Philippines, 30 September-12 October 1986. (Lecturers: M.A. Carigma, L.B. Dizon, N.I. Jhocson, J.L. Maclean, M.S.M. Sadorra and R.M. Temprosa)

Towards a Research Framework for Tropical Integrated Agriculture Culture Farming Systems, Manila, Philippines, 15-17 October 1986. (J.L. Maclean)

Paper presented:

J.L. Maclean. The flow of information in integrated farming research.

UNESCO-UPILS Asian Regional Seminar/Workshop on Integrated Microcomputer Softwares for Library and Information Services in Developing Countries, University of the Philippines, Quezon City, 10-14 November 1986. (E.B. Gonzalez)

Lecture-Demonstration on the Use of CDS/ISIS, University of the Philippines Institute of Library Science, Quezon City, 18 November 1986. (R.M. Temprosa)

Seminar-Workshop on Public Relations and Communications for Librarians, Manila, Philippines, 24-26 November 1986. (N.R. Balagapo)

Second Session of the International Oceanographic Data Exchange (IODE) Group of Experts on Marine Information Management (GE-MIM) and the Twelfth Session of the Intergovernmental Oceanographic Commission (IOC) Working Committee on IODE, Moscow, USSR, 8-17 December 1986. (R.M. Temprosa)

## Publications and Consultancy Reports

Carigma, M.A. 1986. Fisheries training opportunities worldwide. Naga, The ICLARM Quarterly 9(4): 16-17.

Jhocson, N.I. 1986. The ICLARM library user: a profile. Naga, The ICLARM Quarterly 9(2): 20.

Maclean, J.L. 1986. End of a marine reserve: Sumilon Island revisited. Naga, The ICLARM Quarterly 9(1): 13.

Maclean, J.L. 1986. Who's working on *Eucheuma?* Naga, The ICLARM Quarterly 9(1): 17.

Maclean, J.L. 1986. A database analysis kit for your information toolbox. Naga, The ICLARM Quarterly 9(2): 6-7.

Maclean, J.L. 1986. How do you rate as a user and producer of information? Naga, The ICLARM Quarterly 9(2): 10-12.

Maclean, J.L. 1986. Who's working on artificial reefs? Naga, The ICLARM Quarterly 9(2): 22-23.

Maclean, J.L. 1986. Who's working on freshwater cage culture? Naga, The ICLARM Quarterly 9(3): 18.

Maclean, J.L. 1986. Who's working on rice-fish culture? Naga, The ICLARM Quarterly 9(4): 37.

Maclean, J.L., Editor. 1986. Naga, The ICLARM Quarterly, Volume 9, Numbers 1-4.

Maclean, J.L. and L.B. Dizon, Editors. 1986. ICLARM Report 1985. 117 p.

Maclean, J.L., L.B. Dizon and L.V. Hosillos, Editors. 1986. The First Asian Fisheries Forum. 727 p. Asian Fisheries Society, Manila, Philippines.

Maclean, J.L. Report of Consultancy to the Asian Development Bank; editing proceedings of the Regional Seminar on the Use of Rural Health Services, Manila, 20-25 January 1986.

Temprosa, R.M. Report of Consultancy on WARDA Documentation Unit, West Africa Rice Development Association, Monrovia, Liberia, 20 January-21 February 1986.

Varley, A. and R.M. Temprosa. 1986. Regional seminar on the handling and dissemination of oceanographic information and data. Naga, The ICLARM Quarterly 9(2): 17.

## Information Program Project Summaries

| | | |
|---|---|---|
| Project Title | : | Selective Fisheries Information Service |
| Cooperating Institution | : | International Development Research Centre (IDRC), Canada |
| Duration | : | March 1984-March 1987 |
| Key Personnel ICLARM | : | Mr. Jay L. Maclean; Ms. Rosalinda M. Temprosa; Ms. Norma I. Jhocson |

### 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 produce bibliographies and reviews on important topics as identified by trends in enquiries.

### Results

A total of 247 in-depth enquiries was answered during the year while other requests were treated as part of regular ICLARM library reference services.

Tilapia continued to be the most requested subject area for information and advice followed by integrated farming, resource management, shrimp, culture systems, socio-economics, fish biology, nutrition, molluscs and fisheries in general. Requests which were outside ICLARM's areas of expertise were referred to other appropriate information centers. SFIS maintains detailed records of all queries received since its inception in 1984.

The January 1986 issue of the Naga, formerly the ICLARM Newsletter, marked the beginning of publishing articles on computer literature search analyses on various subjects - *Eucheuma*, artificial reefs, freshwater cage culture, rice-fish culture and seabass. One review was also published in 1986 through the project, on the biology and culture of tropical oysters.

Assistance and advice on aquatic science information management have been provided through attendance, lectures and papers presented at various seminars and workshops, training courses and meetings in the Philippines, India, Africa and the USSR. Short-term training in library methodologies, online searching and database management has also been conducted for individuals and various groups from the region.

Opportunities for project staff development have also proven a major factor in carrying out effectively the various functions of the project.

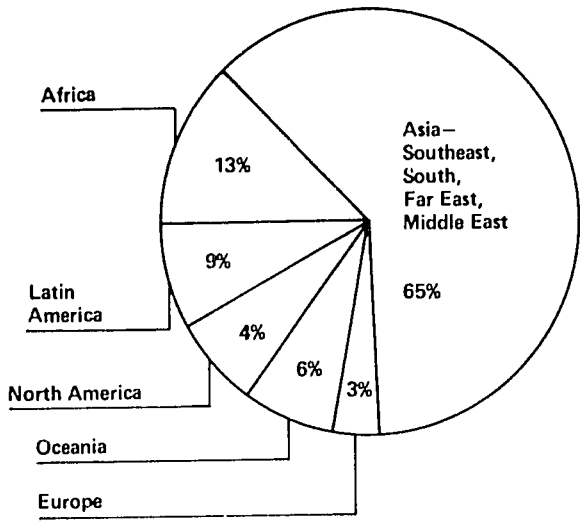



Fig. 1. Geographical spread of SFIS enquiries in 1986.

## Training Conducted

Lecture-Demonstration of the Capabilities and Actual Operation of an Online Information Retrieval System for a Group of Development Communication Students, University of the Philippines at Los Baños, 27 August 1986.

Practicum on Online Searching for Eight Graduate Students from the Institute of Library Science, University of the Philippines, Diliman, 8 September 1986.

Practicum on Online Searching and Database Management for the Eleven Participants of the Training Course on Information Research and Management organized and sponsored by the ASEAN/USAID Coastal Resources Management Project, 3 October 1986.

Practicum on Database Management for a Student from AMA Computer College, Manila for a total of 100 hours starting 20 October 1986.

Practicum on Library Methodologies in a Special Library for Five Graduating Students from the Institute of Library Science, University of the Philippines, Diliman, 10-11, 15-17 December 1986.

ICLARM sometimes works beyond the tropics. SFIS Project Leader, Linda Temprosa took part in the Second Session of the International Oceanographic Data Exchange (IODE) Group of Experts on Marine Information Management and the Twelfth Session of the Intergovernmental Oceanographic Commission (IOC) Working Committee on IODE, Moscow, 8-17 December 1986. On her *L/R* are: Dr. L.D'Ozouville (CCOP/SOPAC), Suva, Fiji; Mr. Robert Freeman (FAO/FIDI), Rome, Italy; and Mr. Harry Dooley (ICES), Denmark at the opening ceremony.

| | | |
|---|---|---|
| **Project Title** | : | Database of Fisheries and Aquaculture Training Opportunities Worldwide |
| **Cooperating Institution** | : | Food and Agriculture Organization (FAO), Rome |
| **Duration** | : | May-November 1986 |
| **Key Personnel ICLARM** | : | Ms. Marie Assunta A. Carigma |

## Objectives

- To conduct a questionnaire survey of regular aquaculture and fisheries programs, both short-term and long-term, being offered by institutions in the different regions.
- To input and maintain the data gathered on microcomputer and update the database regularly.
- To publish the results of the survey (the output of the computerized database) in Naga, The ICLARM Quarterly, as an update of the October 1982 "Education and Training" issue of the ICLARM Newsletter, and to make the database available on diskette to requestors.

## Results

ICLARM undertook this project in response to a recommendation made by the Advisory Committee on Marine Resources Research (ACMRR) and under the sponsorship of the Fishery Resources and Environment Division of the Food and Agriculture Organization (FAO), Rome.

A questionnaire survey was sent out in June 1986 to about 600 institutions all around the world. The questionnaire inquired about fisheries, aquaculture, or combined courses being offered by the respondent-institutions at various levels (high school, vocational, bachelor's, master's, doctorate). It also elicited such information as language of instruction, willingness to conduct individual training on request and to accept applicants from developing countries, areas of specialization, regular short courses, application requirements, etc. Some more information was also culled from other reports, directories and miscellaneous publications, articles and brochures to supplement the questionnaire responses. The database and survey results were published as a special issue of Naga (October 1986, Vol. 9, No. 4).

The database currently comprises 316 entries institutions and universities which offer some form of training or education in fisheries and aquaculture or other related fields. See Fig. 2 for the breakdown per region.

Fig. 3 shows the proportion of fisheries and aquaculture courses/programs available in the institutions listed under each region.

The database has a country/institution index and a continent/country/institution index. A subject and/or species index may also be prepared with the next update.

A diskette copy and a printout of the database have been provided to FAO where it may be used for discussion and planning purposes. Diskette copies can also be requested by interested parties from ICLARM for a minimum fee.

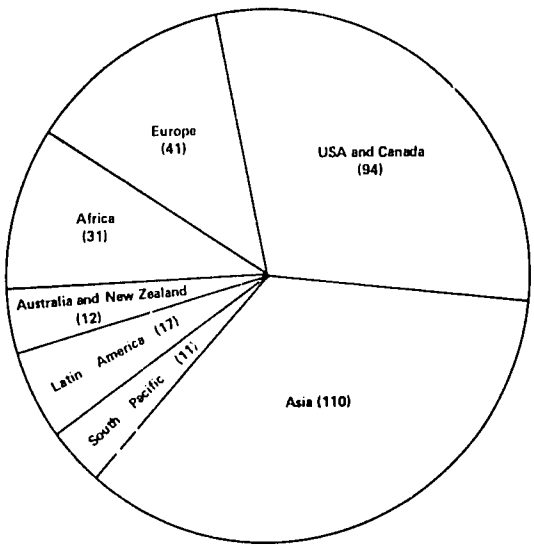



Fig. 2. Number of training institutions listed per region.

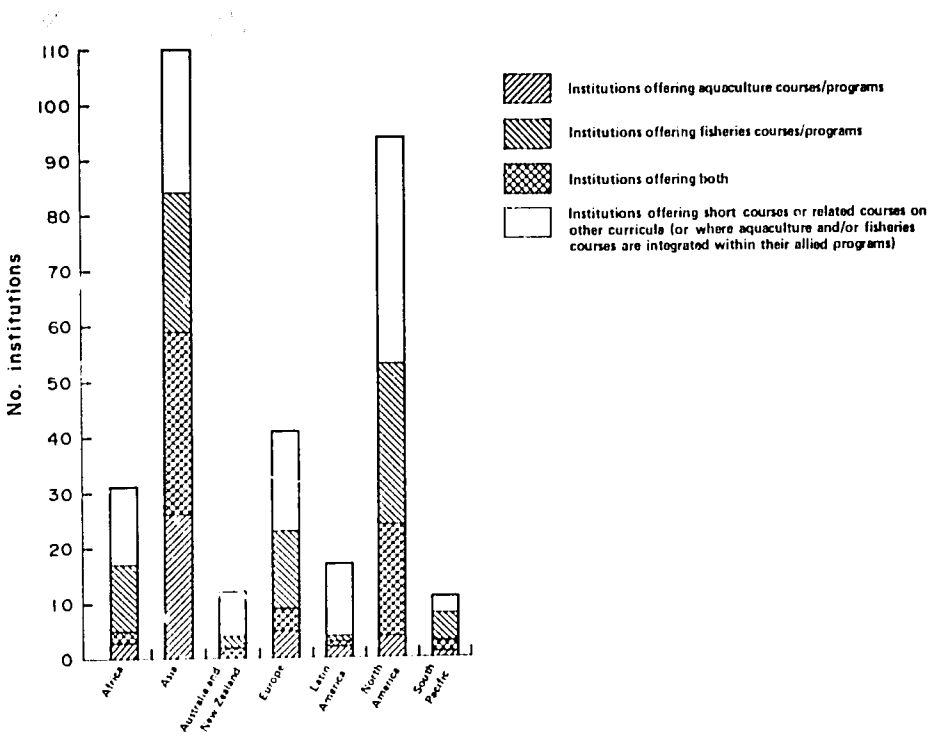



Fig. 3. Numbers of fisheries and aquaculture programs available in the institutions listed under each region.

**Project Title** : The ICLARM Library User: A Profile

**Duration** : August 1985-March 1986

**Key Personnel** : ICLARM Library Staff

**Major Objective**

To undertake a preliminary study of the reading habits of external users of the ICLARM library, as an example of library use by researchers.

This study was conducted over nine months from August 1985 to March 1986 through a questionnaire which the users were asked to fill in as they used the various library materials. The data were supplemented by counts of the books, serials, reprints, clippings and maps used each day. It was felt that it was a fairly simple and inexpensive method of obtaining useful information about the users served by the library.

The specific questions this study aimed to answer were: (1) how many and what type of publications researchers read; (2) how much time was spent on each and how deeply read; (3) the purpose(s) in reading these articles or books; and (4) who the researchers were.

A total of 844 questionnaires were distributed; 355 were returned, a 42% response rate.

**Results**

In all, 7,326 items were used. Serials (49.7%) were the most frequently used material, followed by books (32%), reprints (16%) and others (maps, clippings file and non-print materials–2.3%).

A total of 312 serial titles were used 3,644 times. These serial titles represent 61% of all those in the collection. Of the serials not used, 96% were received through exchange or gifts or subscriptions which were cancelled.

The most frequently used serials are shown in Table 1. FAO's products, INFOFISH and ASFA are clearly most important. Just recently, we received a two-year bill for ASFA ($1,644) and looking at how frequently it was used helped in the decision to continue subscription.

Fig. 4 illustrates how much time was spent reading articles and books. Since some materials were xeroxed (180 serial articles; 6 books) rather than read in the library, the questionnaire was designed to remove bias that would be caused by indicating such items in the time spent reading each item.

The main reasons for using materials were (1) research work–to apply research findings or methods to a current project; to prepare a research proposal or project; for management purposes, planning, budgeting or management of research; (2) 'writing up' results–to prepare an article, book, thesis or report; for citation purposes; to prepare a lecture or presentation; (3) general interest and current awareness; and (4) other purposes.

External users come mainly from Philippine institutions but include overseas students and scientists. One-third are students pursuing baccalaureate, master's or doctoral degrees; 20% have baccalaureate degrees; 12%, master's degrees and 2%, doctoral degrees. Others did not specify.

The information gained has helped to understand the needs of, as well as to gain an insight into, the users of the ICLARM library and will be useful in planning collection development, specifically in streamlining the serials collection.

Table 1. Ten most frequently used serials. (Three serials tied for 10th place)

| Title | No. of times used |
|---|---|
| INFOFISH Marketing Digest | 320 |
| Aquaculture | 295 |
| ASFA (Aquatic Science & Fisheries Abstracts (1 & 2) | 230 |
| INFOFISH Trade News | 182 |
| Journal of Fish Biology | 132 |
| Greenfields (Philippine agriculture) | 92 |
| Current Contents | 89 |
| Marine Pollution Bulletin | 89 |
| Philippine Journal of Fisheries | 87 |
| ICLARM Newsletter | 83 |
| Science | 83 |
| Canadian Journal of Fisheries and Aquatic Science | 83 |

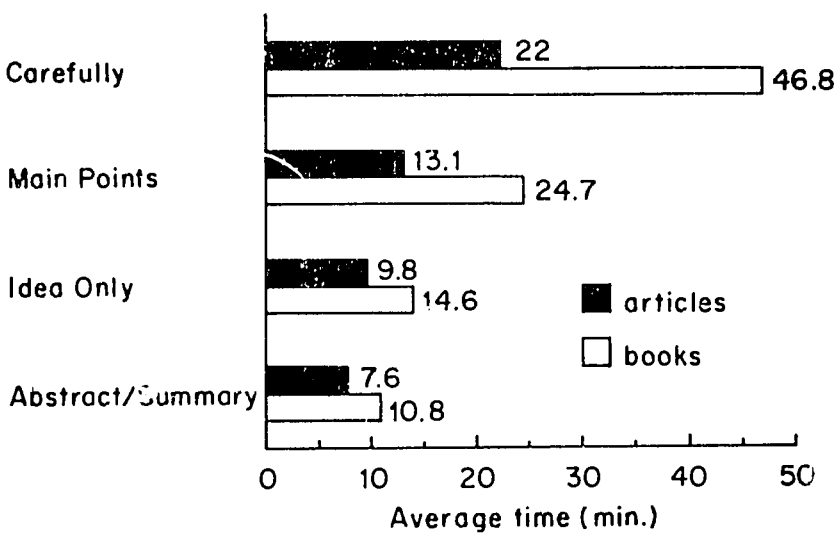



Fig. 4. The average time in minutes spent by ICLARM library users reading articles and books.

**Project Title** : Reprint Use in Scientific Information Dissemination

**Cooperating Institutions** : *Kalikasan*, the Philippine Journal of Biology; Fisheries Research Journal of the Philippines (FRJP)

**Duration** : January-July 1986 and September-December 1986

**Key Personnel** ICLARM : Mrs. Leticia B. Dizon; Ms. Marie Sol M. Sadorra; Ms. Marie Assunta A. Carigma
*Kalikasan* : Dr. Irineo J. Dogma, Jr.
FRJP : Dr. Virginia L. Aprieto

**Major Objective**

To study the characteristics of biological science literature in developing countries through the reprint system, which is one of its key components.

**Specific Objectives**

- To determine the uses of reprints of articles in *Kalikasan*, the Philippine Journal of Biology and in the Fisheries Research Journal of the Philippines through a questionnaire survey among authors.
- To identify constraints to the reprint system and to suggest ways to overcome them and in the same manner, to identify and strengthen the attributes of the system.
- To establish the value of reprint use in the dissemination of scientific tropical fisheries information.

**Results**

In April 1986, the first batch of questionnaires was mailed to authors of articles published in Vol. 1 to 12 of *Kalikasan* and Vol. 1 to 9 of Fisheries Research Journal of the Philippines. The first tabulation, in July 1986, yielded a poor turnout of responses. For *Kalikasan*, 79 (22.57%) responses were received out of the 350 questionnaires distributed. For the Fisheries Research Journal of the Philippines, 42 (32.06%) questionnaires were returned out of the 131 sent to authors.

In September 1986, a second batch of questionnaires was sent out to follow up those authors who by that time had not yet responded. The second tabulation yielded the following results: The *Kalikasan* questionnaire responses totaled 148, a 42.28% turnout. For FRJP, a total of 58 questionnaires were returned, a turnout of 44.27%.

Some findings from the tabulated data are that reprints are still actively used and sought after by readers of the two journals studied. They are a valuable and cheap source of information for researchers in developing countries but are expensive to authors who have to bear the cost of mailing them.

The majority of the *Kalikasan* authors/respondents were in their 40s. About two-thirds were male and three-fifths were Ph.D. degree holders. Most of the authors have received and have given away less than 100 reprints. The majority of the reprint requests came from colleagues/professionals overseas; almost all came from persons in the same biological fields as the authors. The most common reason for requesting reprints was

for research; surprisingly, the least cited reason was the costliness of journals. Most of the requesters learned of the article they requested through abstracting/indexing services. The bulk of the requests were received within the first year of publication of the article.

For the FRJP, the majority of the respondents were also in their 40s. There was an almost equal proportion of male and female respondents. About three-fourths are Ph.D. degree holders. Almost all respondents received between 21 and 30 reprints. Most have sent out less than 20 reprints. As in *Kalikasan*, most of the reprint requests came from colleagues/professionals overseas; almost all came from persons in the same biological field. The most common way by which requesters learned of the article was by reading about the article. Complete statistical analysis of the data is pending finalization of the responses.

## EDUCATION AND TRAINING

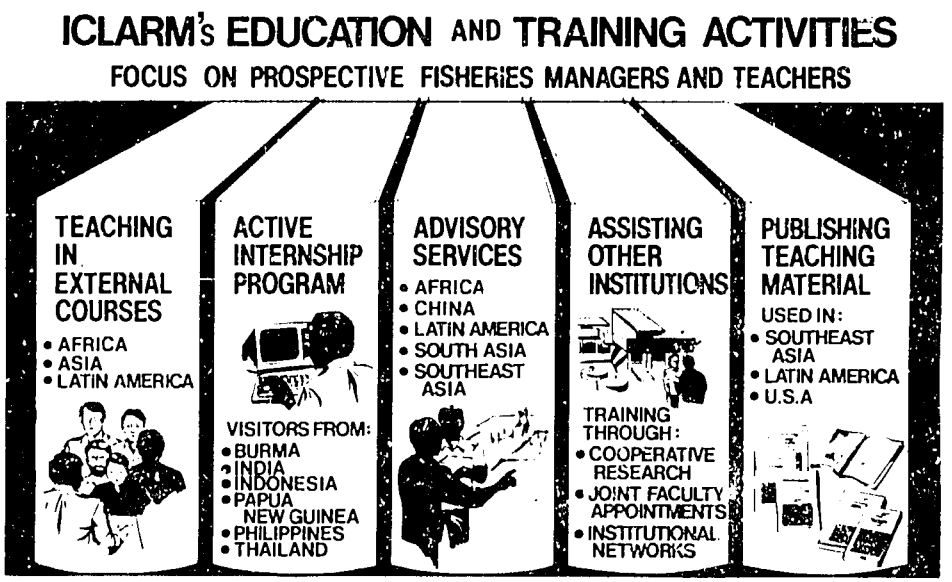
### Background

There is tremendous need for training opportunities for researchers and aquatic resource managers, but this training must be relevant for tropical third world settings. Most training available to date for such individuals has been offered in temperate locations and has been based upon methods and case studies largely inappropriate for the tropics. ICLARM envisions an Education and Training Program that would not only offer specialized nondegree courses, but which would also contribute to the development of curricula and educational materials appropriate for the tropics. ICLARM thus sees a role for itself not only in individual or short-course training but also in support of other training institutions, including universities.

ICLARM's education and training activities to date have been carried out primarily in the context of the Center's networks and cooperative research programs and in response to requests by FAO and other international and regional agencies for ICLARM staff to participate in their training courses. Twenty-six interns have spent variable lengths of time working one-on-one with senior scientists in the Resource Assessment and Management Program, then returning to their home base to pursue cooperative research with ICLARM. Scholarships for degree training in fisheries and aquaculture economics at cooperating educational institutions have also been made available thorugh the Asian Fisheries Social Science Research Network which is coordinated by ICLARM. Due to financial constraints, ICLARM's Education and Training Program has never had its own permanent staff. In response to an evident need, however, ICLARM plans to take on a more prominent training role in the future in areas of its expertise and program priorities, maintaining strong horizontal linkages to the Aquaculture, Resource Assessment and Management, and Information Programs of the Center.

### Program Themes

Given its active research and information programs, ICLARM is in an ideal position to assure that its former trainees receive continued support in their professional development after the initial training period is completed. The training program envisioned by the Center thus will focus primarily on areas consistent with the research priorities of the Aquaculture, Resource Assessment and Management, and Information programs.




The Center's linkages with educational institutions around the tropics can also assure that curriculum materials in tropical fisheries science, for example, are not developed in isolation from the degree-granting institutions in which they would be used. ICLARM's own interdisciplinary scientific staff can also assure that this necessary broader perspective is maintained in the training programs sponsored by the Center. These are but some of the reasons why ICLARM believes it is uniquely suited for a more active training role in the future, funds permitting.

## The Asian Fisheries Social Science Research Network (AFSSRN)

AFSSRN was initiated in 1983 to support and assist the development of social science research among the participating institutions in Southeast Asia.

The Network is funded by the Ford Foundation and the International Development Research Centre (IDRC) of Canada. There are eight member institutions apart from ICLARM which provides the headquarters for the coordinator. They are: the Agency for Agricultural Research and Development (CAER) and Universitas Diponegoro (UNDIP) in Indonesia; Universiti Pertanian Malaysia (UPM); University of the Philippines at Los Baños (UPLB), University of the Philippines in the Visayas (UPV), and the Southeast Asian Fisheries Development Center (SEAFDEC), Iloilo in the Philippines; and Kasetsart University (KU), Thailand, and the Thai Department of Fisheries.

Coordinator of the Network at its inception was Dr. Brian Lockwood. In October 1986, he resigned from ICLARM and took up a post in Australia.

His successor is Prof. Harlan Lampe, a resource economist from the University of Rhode Island, USA.

In December 1986 the Network involved 43 research workers at the eight member institutions. Eight other participants were on study leave and within 1987 it is expected that as many as eight more researchers will begin their advanced studies either at Universities within or outside the region.

The Network, in strengthening social science research capacities in the member institutions, is providing more and more information from its research that is useful to decisionmakers both in government and in industry. The Network pursues a policy of conducting research on issues of national, local or regional significance. Inasmuch as many issues of importance require expertise from diverse disciplines the Network also strongly promotes the collaboration of social scientists with colleagues from other disciplines. As the Network gives more attention to fisheries resource management issues in the future, this collaboration will be increasingly important.

In promoting fisheries social science research the Network has been a strong force in advancing education and training. The research results were a direct contribution to teaching by enhancing the understanding of the issues by teachers and provide study materials on national problems for use by students. The Network was also instrumental in establishing a program of study for the M.Sc. in fisheries economics at the Universiti Pertanian Malaysia (UPM). This program has been central to the professional development thrust of the Network. Short courses also form an integral part of the Network program and indeed the Network members provide short courses and workshops of value to other disciplines. A particularly useful program of this kind has been the short course for the study of aquaculture economics offered by UPM. A continuing program of short courses on methods of research and analysis is provided to sharpen research skills and improve research results. An important milestone in the Network support of education was reached at the Workshop on Fisheries Economics Curricula in March 1986.

The Network members have completed more than 20 research projects and the results of ten of these have been presented in research reports. The remaining reports are in preparation. While the Network reports are prepared in English the results of several studies have also been prepared in the national language. The Network, while keen to maintain communications among members and with interested people worldwide, also has a responsibility to assure that research results are accessible in each country as well. ICLARM through its communications expertise can provide essential support for the dissemination of information from the Network.

*Network Development, Coordination and Administration*

The fifth Network team leaders conference was held in Singapore on 20 to 22 October following a marketing workshop in Malaysia (see below).

The leaders meeting had three principal objectives: 1) to review the performance of the Network since the last meeting in March 1986; 2) to review the team plans presented for phase three; 3) to review new project proposals.

The matter of singular importance to all teams and their members is the future of the Network, or Phase III. The current Phase II expires at the end of March 1988. A complete Network plan for Phase III is to be submitted to IDRC for continued funding. The team leaders presented preliminary research plans for Phase III that reflected the interests and capacities of the respective teams.

The leaders also reviewed nine research proposals that had been submitted for completion during Phase II. This project review process is an important Network activity that brings to bear the critical judgement and experience of all of the leaders. This led to recommendations for improvements to all of the projects that were submitted and accepted. Two proposed projects were withdrawn from consideration after preliminary discussions while a third was rejected as being inappropriate.

Considering the importance of the preparations for Phase III and the need for very close coordination of planning efforts it appeared that some changes in the operations of the office of coordinator were necessary. To this end it was announced that the coordinator would plan, during the course of the first part of 1987, to spend up to two months at each of the major team sites (Semarang, Serdang, Bangkok and Iloilo) in order to: 1) provide assistance and support for research program planning for Phase III; 2) provide support for research project design and execution; 3) present short courses or lectures on matters of interest to the team members and others at the host institution; 4) permit the coordinator to better understand the research as well as fisheries environment of the Network teams.

The next workshop and team leaders meeting are tentatively planned for September 1987.

*Network Research in Progress*

The following projects were underway in 1986:

| Title | Institution |
|---|---|
| Market Potential for Freshwater Fish | UPM |
| Marketing Analysis of the Fish Fry and Fingerling Industry in Malaysia | UPM |
| Economic Analysis of Freshwater Fish Production and Marketing in Malaysia | UPM |
| Economic Evaluation of Sea Bass Culture in Selected Areas of Thailand | KU |
| Price Analysis of Selected Marine Fish | KU |
| Economic Viability of Freshwater Prawn Culture in Thailand | KU |

| | |
|---|---|
| Evaluation of the Socioeconomics and Diffusion Process of Hulbot-hulbot Fishing in Iloilo, Philippines | UPV |
| The Environmental Setting of Several Municipal Fisheries in Iloilo | UPV |
| Socioeconomic Analysis of the Seaweed Industry in the Visayas | UPV/SEAFDEC |
| Socioeconomic Analysis of the National Bangus Breeding Program | SEAFDEC |
| Analysis of Catfish Production and Marketing in Central Java | UNDIP |
| Consumer Expenditure Patterns for Fish and Shellfish in Selected Rural Communities of Central Java | UNDIP |
| The Economic and Nutritional Value of Fish from Traditional Kitchen Ponds in Central Java | UNDIP |
| The Economies of Size Among Motorized Fishing Boats in North Sumatra | CAER |

*Workshops and Training*

*The Workshop on Southeast Asian Training Programs in Fisheries and Aquaculture Economics.* This workshop was convened to review the courses and curricula extant and planned that are being offered by participating institutions. The workshop, cosponsored by the University Diponegoro, was held from 12 to 16 March in Jepara, Central Java, at facilities of the University. There were twenty-nine workshop participants.

The workshop first reviewed the courses currently offered at both the undergraduate and graduate level by participating institutions. This was followed by a review of courses planned for presentation in the future. Particular attention was given to the national and academic need for the courses in educating fisheries economists and other professionals.

The utility of non-degree programs and short courses in professional development was another important issue addressed by the workshop. Since considerable emphasis has been placed by the Network upon short or special courses to enhance professional skills critical attention was given past courses and potential future offerings. With some modifications and additions the proceedings of the workshop are being prepared for general release and publication.

*The Marketing Workshop.* At the Marketing Workshop held in Johor Baru, Malaysia, from 14 to 17 October 1986, twenty-two papers were presented. Of these, sixteen were research reports based upon the Network sponsored activities during the preceding year or so. This workshop was a milestone marking the results of the concerted efforts of the teams and their members to investigate marketing issues. In the case of Malaysia and Thailand the results of the research were immediately made available to the

government organizations with responsibility for these matters. The Lembaga Kemajuan Ikan Malaysia (LKIM) cosponsored the Malaysian work and was represented at the workshop.

*Training Course on Microcomputer Applications to Fisheries Social Science Research.* This four-week training course was offered by the Center for Policy Studies of UPLB to ten participants and two observers. The three modules of the course were: 1) survey research applications; 2) spreadsheets and 3) word processing. The team members have been making effective use of the training on the computers that have been provided to the teams through a direct grant from IDRC.

The Coordinator has lectured to the Training Course for Senior Aquaculturists in Asia and the Pacific Region for the Network of Aquaculture Training Centres in Asia (NACA) at Iloilo, Philippines, and to the faculty and staff of the University Diponegoro, Semarang, Central Java. He has also lectured to the class in Fisheries Economics at the University of the Philippines in the Visayas at Iloilo. He also presented a short course on microcomputers in research to the faculty of the University of Diponegoro, Semarang, Indonesia.

The coordinator also participated in the training course on Acquisition of Fisheries Information: Methods, Problems and Solutions given by ICLARM in Dhaka, Bangladesh. He also serves as an advisor on social science research issues to the ICLARM-Padjadjaran University program at Bandung, Indonesia.

He attended the NACA workshop on Socioeconomics of Aquaculture Development from 28 to 31 October 1986 and participated in the seminar-workshop on the Socioeconomic Impact of Fishing Technologies on Fishing Communities in Asia and the Pacific sponsored by APDC at PCARRD, Los Baños, Philippines where he served as a moderator.

## Program Activities for 1987 and the Next Decade

To a certain extent, training activities can be self-supporting as evidenced by the large number of already-funded training requests that ICLARM receives. The planning of training activities, the development of specific courses, work on curriculum development, including preparation of textbooks, however, should be activities of ICLARM and supported by the Center's own resources. With the exception of the AFSSRN, coordinated by ICLARM, the Center's approach to training to date has suffered from lack of staff to lead the effort, resulting in an ad-hoc approach which, in the long run, is inadequate for an international center of ICLARM's stature and advantage. Even the AFSSRN has suffered from limited financial support and external pressure to diversify the number of member institutions faster than financial support really warranted.

To overcome the staffing constraint, ICLARM hopes to designate its first Director, Education and Training as soon as funds permit. This individual should be an experienced educator who could plan ICLARM's program, participate with other ICLARM professional staff in the actual

courses, and take the lead in developing teaching materials and curricula with the input of other ICLARM staff.

ICLARM's training courses would initially focus on two areas where the Center's research contributions have been clearly recognized and where its lack of physical research facilities would not be a constraint; these are in (1) living aquatic resources management and (2) research methodologies. The Center has pioneered the development of microcomputer software for fisheries stock assessment and is already extending this work into fisheries economics and management. For example, funds are being actively sought for two one-month fisheries stock assessment and management training courses for researchers and midlevel managers. One of these courses would be offered in cooperation with National Shanghai University.

New staff to be hired in ICLARM's aquaculture program in 1987 will lead a similar development of microcomputer-based research methodologies for that program, including analytical frameworks for integrated agriculture-aquaculture farming systems, which can then later form the basis for aquaculture training programs. These will all be specialized courses to assure maximum benefit to trainees. Several other training courses will be offered through various ICLARM projects such as those on coastal zone and small-scale fisheries management.

## Publications

Israel, D.C., R.F. Agbayani, D.T. de la Pena, Jr. 1986. Comparative economic analysis of different scales of prawn *(P. monodon)* hatchery production systems. SEAFDEC. AFSSRN Res. Rep. 7.

Israel, D.C. and R.F. Agbayani. 1986. Costs and returns of individual and integrated prawn hatchery-nursery-growout production systems: a comparative analysis. SEAFDEC. AFSSRN Res. Rep. 8.

Mabunay, M.L.E. 1986. Socioeconomics of marketing practices of small-scale capture fisheries in Iloilo Province, Philippines. UPV. Working Paper 4.

Mudiantono. 1986. An assessment of milkfish marketing in Semarang Regency, Central Java, Indonesia. UNDIP, Working Paper 5.

Mudiantono, J. Hutabarat and Subijanto. 1986. The economics of aquaculture: the case of shrimp cultivation in Central Java, Indonesia. UNDIP. AFSSRN Res. Rep. 10.

Octavio, G.G., M.E.S. Piadozo and I.S. Pamplona. 1986. An assessment of the credit and financial programs for the fishery sector, Philippines. Dept. of Agric. Econ., UPLB, AFFSRN Res. Rep. 9.

Padilla, J.E. 1986. Economics of innovation adoption: the case of brackishwater aquaculture in Bulacan, Philippines. UPM, Working Paper 2.

Posadas, B.C. 1986. Fish consumption in Iloilo: a consumer profile and behavior study. UPV. Working Paper 3.

Tokrisna, R., S. Tugsinavisuitti, M. Muangkoe and S. Kao-ian. 1986. Marketing system of fresh cephalopod in Thailand. UPM. Working Paper 7.

Twenty papers are currently in the process of preparation for publication. Of these 16 will be included in a single volume that will constitute

a report of the Marketing Workshop. The report of the Workshop on Curriculum Planning and Development is being edited for publication as a single document. The results of the major marketing project completed by the Malaysian team are also being reviewed for publication.

## ADMINISTRATION AND FINANCE

Over the past ten years of ICLARM's existence, the number of donors providing financial support for the Center has grown from one (The Rockefeller Foundation) in the first few years to fourteen in 1986. This number is expected to grow further in 1987 to sixteen or more (see Table 1). This expansion in the number of donors is viewed by many as a diversification of support and thus an indication of the Center's future financial stability. However, the increasing tendency among donors to provide only restricted and special project grants has resulted in funding constraints for and the deviation of staff time away from core research programs. Unless reversed, this trend may cause the Center to lose its ability to maintain the initiative in key areas of fisheries and aquaculture research.

In 1986, total ICLARM annual income increased by 54% to over US$2.0 million, the highest ever in the Center's history. Much of this increase, however, was brought about by restricted core and special project grants which allowed ICLARM to expand its field of activities and add to its number of staff but failed to provide the Center with the funding it needed to pursue its full core programs. This trend has continued into 1987, with ICLARM facing a shortfall in funding for an already scaled-down core budget in spite of an expected total income level of close to US$4.0 million (see Fig. 1).

Given the above funding difficulties, the 1986 efforts of the Center's management and trustees have been focused on fundraising. Although they have been successful in a) organizing the ICLARM Support Group, b) in making inroads into the CGIAR and its Technical Advisory Committee and c) in securing some pledges for long-term support, ICLARM's financial situation remains far from comfortable.

Table 1. ICLARM contributors and other income, 1977-1987 in US$.

| | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986[1] | 1987[2] | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A. UNRESTRICTED GRANTS | | | | | | | | | | | | |
| ockefeller Foundation | 453,748 | 600,000 | 700,000 | 750,000 | 812,000 | 850,000 | 850,000 | 720,000 | | | | 5,735,748 |
| Jnited States Agency for Intl. Dev. | | | 300,000 | 200,000 | 300,000 | 320,000 | 320,000 | | 300,000 | 523,662 | 476,338 | 2,740,000 |
| Australian Development Assistance Bureau | | | | | | 20,986 | 29,750 | 83,257 | 46,350 | 105,315 | 107,200 | 392,858 |
| San Miguel Corporation | | | | | | | | 714 | 1,047 | | | 1,761 |
| Planters Products Inc. | | | | | | | | | 1,047 | | | 1,047 |
| Norwegian Ministry of Dev. Cooperation | | | | | | | | | | 52,009 | | 52,009 |
| Subtotal | 453,748 | 600,000 | 1,000,000 | 950,000 | 1,112,000 | 1,190,986 | 1,199,750 | 803,971 | 348,444 | 680,986 | 583,538 | 8,923,423 |
| B. RESTRICTED CORE GRANTS | | | | | | | | | | | | |
| Rockefeller Foundation | | | | 22,795 | | | | 50,000 | 50,000 | 8,470 | | 122,795 |
| Food and Agriculture Organization | | | | | | | 6,703 | 5,000 | 5,000 | 5,172 | 10,000 | 26,875 |
| Ford Foundation | | | | | | | | | 165,138 | 65,211 | 114,098 | 344,447 |
| New Zealand Embassy | | | | | | | | | 12,582 | | | 12,582 |
| Australian Development Assistance Bureau | | | | | | | | | 53,397 | | | 53,397 |
| United States Agency for Intl. Dev. | | | | | | | | | | 85,987 | 123,570 | 209,557 |
| German Agency for Tech. Cooperation (GTZ) | | | | | | | | | | 52,008 | 65,442 | 117,450 |
| United Nations Development Programme | | | | | | | | | | 32,649 | 57,500 | 90,149 |
| International Development Research Centre | | | | | | | | | | 12,775 | 16,716 | 29,491 |
| Overseas Development Administration | | | | | | | | | | 19,718 | 23,293 | 43,011 |
| Skaggs Foundation | | | | | | | | | | | 10,000 | 10,000 |
| Norwegian Ministry of Dev. Cooperation | | | | | | | | | | | 9,700 | 9,700 |
| Australian Pacific Science Foundation | | | | | | | | | | | 13,500 | 13,500 |
| Asian Development Bank | | | | | | | | | | | 5,300 | 5,300 |
| Subtotal | 0 | 0 | 0 | 22,795 | 0 | 0 | 6,703 | 55,000 | 281,117 | 273,520 | 449,119 | 1,088,254 |

Continued

Table 1. Continued

| | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986[1] | 1987[2] | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C. SPECIAL PROJECT GRANTS | | | | | | | | | | | | |
| Rockefeller Foundation | 3,000 | | | | 32,947 | | | | | | | 35,947 |
| United Nations University | | | | 20,000 | 20,000 | | | | | | | 40,000 |
| New Jersey Marine Science Center | | | | 10,000 | 6,000 | 31,283 | 10,000 | | | | | 57,283 |
| Australian Development Assistance Bureau | | | | 57,845 | | | | | | | | 57,845 |
| United States Agency for Intl. Dev. | | | | | 6,245 | | | | | | | |
| German Agency for Tech. Cooperation (GTZ) | | | | | 55,234 | 269,597 | 231,165 | 191,588 | 292,366 | 342,211 | 1,707 714 | 2,056,170 |
| United Nations Development Programme | | | | | 15,292 | 23,638 | 33,379 | | | 260,355 | 156,000 | 1,456,305 |
| Philippine Council for Agriculture and Resources Research and Development | | | | | | | | | | 27,351 | | 99,660 |
| Kuwait Institute for Scientific Research | | | | | 2,850 | 10,426 | | | | | | 13,276 |
| Skaggs Foundation | | | | | | 51,856 | 54,447 | 67,721 | 30,883 | | | 204,907 |
| International Development Research Centre | | | | | | | | 7,500 | | | | 7,500 |
| Intl. Bank for Reconstruction & Development | | | | | | | 117,109 | 200,754 | 225,906 | 118,387 | 94,764 | 756,920 |
| Ford Foundation | | | | | | | | | | 90,197 | 233,090 | 323,287 |
| Der Bundesminister für Wirtschaftliche Zusammenarbeit (BMZ) | | | | | | | | | | | 113,436 | 113,436 |
| Food and Agriculture Organization | | | | | | | | | | 8,114 | 32,400 | 40,514 |
| Asian Development Bank | | | | | | | | | | | 5,000 | 5,000 |
| | | | | | | | | | | | 100,000 | 100,000 |
| Subtotal | 3,000 | 0 | 0 | 87,845 | 138,568 | 386,800 | 446,100 | 467,563 | 549,155 | 846,615 | 2,442,404 | 5,368,050 |
| D. OTHER INCOME | | | | | | | | | | | | |
| Overheads & Staff Time from Special Projects | | | | | | | 46,975 | 53,254 | 31,475 | 286,832 | 135,062 | 553,598 |
| Overheads from Restricted Core | | | | | | | | | | 36,000 | 117,929 | 153,929 |
| Consultancies | 6,110 | 2,522 | | 5,552 | 18,472 | 12,072 | 28,767 | 47,152 | 62,927 | 63,987 | | 247,541 |
| Project Produce | | | 7,578 | 40,886 | 27,946 | 94 | | | | | | 76,504 |
| Training Fees | | | | | | | | 5,896 | 2,400 | | | 8,296 |
| Publication Sales | | | | 1,496 | 6,215 | 17,342 | 26,275 | 28,248 | 26,464 | 18,379 | 25,000 | 149,419 |
| Interests/Dividends/Miscellaneous | 2,026 | 5,904 | 9,489 | 26,107 | 55,936 | 4,432 | 9,669 | 14,490 | 17,869 | 19,048 | 10,000 | 174,970 |
| Subtotal | 8,136 | 8,426 | 17,067 | 74,041 | 108,569 | 33,940 | 111,686 | 149,020 | 141,135 | 424,246 | 287,991 | 1,364,257 |
| GRAND TOTAL | 464,884 | 508,426 | 1,017,067 | 1,134,681 | 1,359,137 | 1,611,726 | 1,764,239 | 1,475,554 | 1,319,851 | 2,225,367 | 3,763,052 | 16,743,984 |

[1]Based on unaudited year-end results.
[2]Projected based on existing commitments. Does not include recent commitments (e.g., France and Germany) for which written confirmation is awaited.

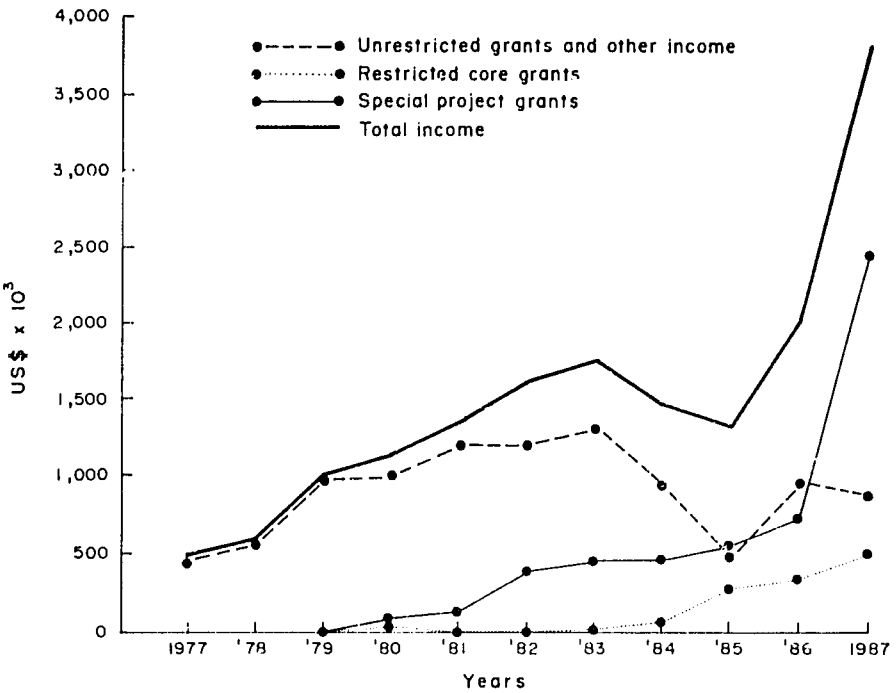



Fig. 1. ICLARM income profile, 1977-1987.

# 1986 SOURCES OF SUPPORT

1. Unrestricted Support

United States Agency for International Development (USAID)
Australian Development Assistance Bureau (ADAB)
Norwegian Ministry of Development Cooperation (NORAD)

2. Restricted Support

| Activity | Sources of 1986 Support |
|---|---|
| a. Giant Clam Project/Coastal Aquaculture Center | Overseas Development Administration (ODA) |
| b. Asian Fisheries Social Science Research Network | Ford Foundation |
| | International Development Research Centre (IDRC) of Canada |
| c. Management Options for Small-Scale Fisheries | Ford Foundation |
| 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) |
| f. Integrated Farming Systems | United Nations Development Programme (UNDP) |
| g. ASEAN Coastal Resources Management | United States Agency for International Development (USAID) |
| h. Economics of Shellfish Processing | International Development Research Centre (IDRC) of Canada |
| i. ICLARM Fund-Raising Program | The Rockefeller Foundation |
| j. Reservoir Management (Cirata and Saguling Dams, Indonesia) | International Bank for Reconstruction and Development (IBRD) |
| k. Philippine Small Pelagic Management | International Bank for Reconstruction and Development (IBRD) |
| l. Training Issue of Naga | Food and Agriculture Organization (FAO) |
| m. Appropriate Technology for Aquaculture in Africa | German Agency for Technical Cooperation (GTZ) |
| n. Tilapia Genetics Research in Asia and Africa | Der Bundesminister Für Wirtschaftliche Zusammenarbeit (BMZ) |

# STATEMENT OF REVENUES AND EXPENSES
## (US$)

| | 1986[1] | 1985[2] |
|---|---|---|
| **REVENUE** | | |
| Grants: – 1. Unrestricted | | |
| United States Agency for International Development (USAID) | 523,662 | 300,000 |
| Australian Development Assistance Bureau (ADAB) | 105,315 | 46,350 |
| Norwegian Ministry of Development Cooperation | 52,009 | -- |
| Planters Products Inc. | -- | 1,047 |
| San Miguel Corporation | -- | 1,047 |
| | 680,986 | 348,444 |
| 2. Restricted | | |
| German Agency for Technical Cooperation (GTZ) | 312,363 | 292,366 |
| International Development Research Centre (IDRC) | 131,162 | 225,906 |
| Ford Foundation | 65,211 | 165,138 |
| United States Agency for International Development (USAID) | 428,198 | -- |
| International Bank for Reconstruction and Development (IBRD) | 90,197 | -- |
| United Nations Development Programme (UNDP) | 60,000 | -- |
| Der Bundesminister Für Wirtschaftliche Zusammenarbeit (BMZ) | 8,114 | -- |
| Overseas Development Administration (ODA) | 19,718 | -- |
| Food and Agriculture Organization (FAO/DANIDA) | 5,172 | -- |
| Australian Development Assistance Bureau | -- | 53,397 |
| Rockefeller Foundation | -- | 50,000 |
| Kuwait Institute for Scientific Research | -- | 30,883 |
| New Zealand Embassy | -- | 12,582 |
| | 1,120,135 | 830,272 |
| | 1,801,121 | 1,178,716 |
| Miscellaneous (Consultancies, Overheads, Publication Sales, etc.) | 424,246 | 141,135 |
| | 2,225,367 | 1,319,851 |
| **EXPENSES** | | |
| Programs, research and development: | | |
| Aquaculture | 670,413 | 519,127 |
| Resource Assessment and Management | 636,530 | 175,577 |
| Education and Training | 284,304 | -- |
| Information | 264,760 | 210,122 |
| Program Development | 15,007 | 10,412 |
| Advisory Committee | 43 | 614 |
| Traditional Fisheries | -- | 253,957[3] |
| | 1,871,057 | 1,169,809 |
| Administrative | 284,239 | 309,617 |
| Depreciation | 20,205 | 29,310 |
| | 2,175,501 | 1,508,736 |
| Excess (deficiency) of Revenues over Expenses | 49,866 | (188,885) |
| FUND BALANCE, BEGINNING OF YEAR | 368,381 | 557,266 |
| FUND BALANCE, END OF YEAR | 418,247 | 368,381 |

[1] 1986 – unaudited.
[2] 1985 – audited.
[3] Traditional Fisheries Program incorporated in Resource Assessment and Management Program effective 1986.

## ICLARM STAFF

### Director General

Ian R. Smith, Ph.D.

### Resource Assessment and Management Program

| | |
|---|---|
| Daniel Pauly, Ph.D. | Director, Resource Assessment and Management Program |
| Max Aguero, Ph.D. | Associate Scientist, Management Options for Tropical Small-Scale Fisheries[1] |
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| Ms. Norma Parial, B.S. | Secretary, Philippine Small Pelagics Project[5] |
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| | |
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| Ms. Felicidad Estrada, B.S. | Secretary, Aquaculture Program |

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| Ms. Leni-Lou Estudillo, B.S. | Secretary, Information Program |

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| Ms. Eloisa Espiritu, B.S. | Typesetter |
| Mr. Ovidio Espiritu, Jr., B.S. | Draftsman |
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## Education and Training Program

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| Harlan C. Lampe, Prof. | Coordinator, Asian Fisheries Social Science Research Network[21] |
| Ms. Marissa Manela | Project sistant[22] |

## Administration and Finance

| | |
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[1] Starting 1 March 1986
[2] Starting 1 August 1986
[3] Starting 16 February 1986
[4] Starting 17 February 1986
[5] Starting 15 December 1986
[6] Starting December 1986
[7] Starting 1 January 1986
[8] Until 15 December 1986
[9] Starting 3 March 198[illegible]
[10] Starting 1 October 1986
[11] Starting 3 March 1986
[12] Starting 8 September 1986
[13] Starting 10 November 1986
[14] Starting 16 February 1986
[15] Starting 7 July 1986
[16] Starting 1 July 1986
[17] Starting 2 May 1986
[18] Starting 7 May 1986
[19] Starting 15 May 1986
[20] Until 31 October 1986
[21] Starting 1 October 1986
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[23] Starting 1 April 1986
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Following is the total list of publications and items in press by the end of 1986 from ICLARM staff and from external authors on commission. The list of 352 items is arranged according to document type: *primary literature*, including referred journals and ICLARM's Studies and Reviews series; *proceedings volumes; papers in proceedings volumes and book chapters; technical reports*, including those of ICLARM, FAO and other agencies; *bibliographies, translations*, including edited works; *reports*, such as annual reports from ICLARM and other centers, and conference summaries; and *semi-technical literature* as published in Naga, Fishbyte and external magazines.

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