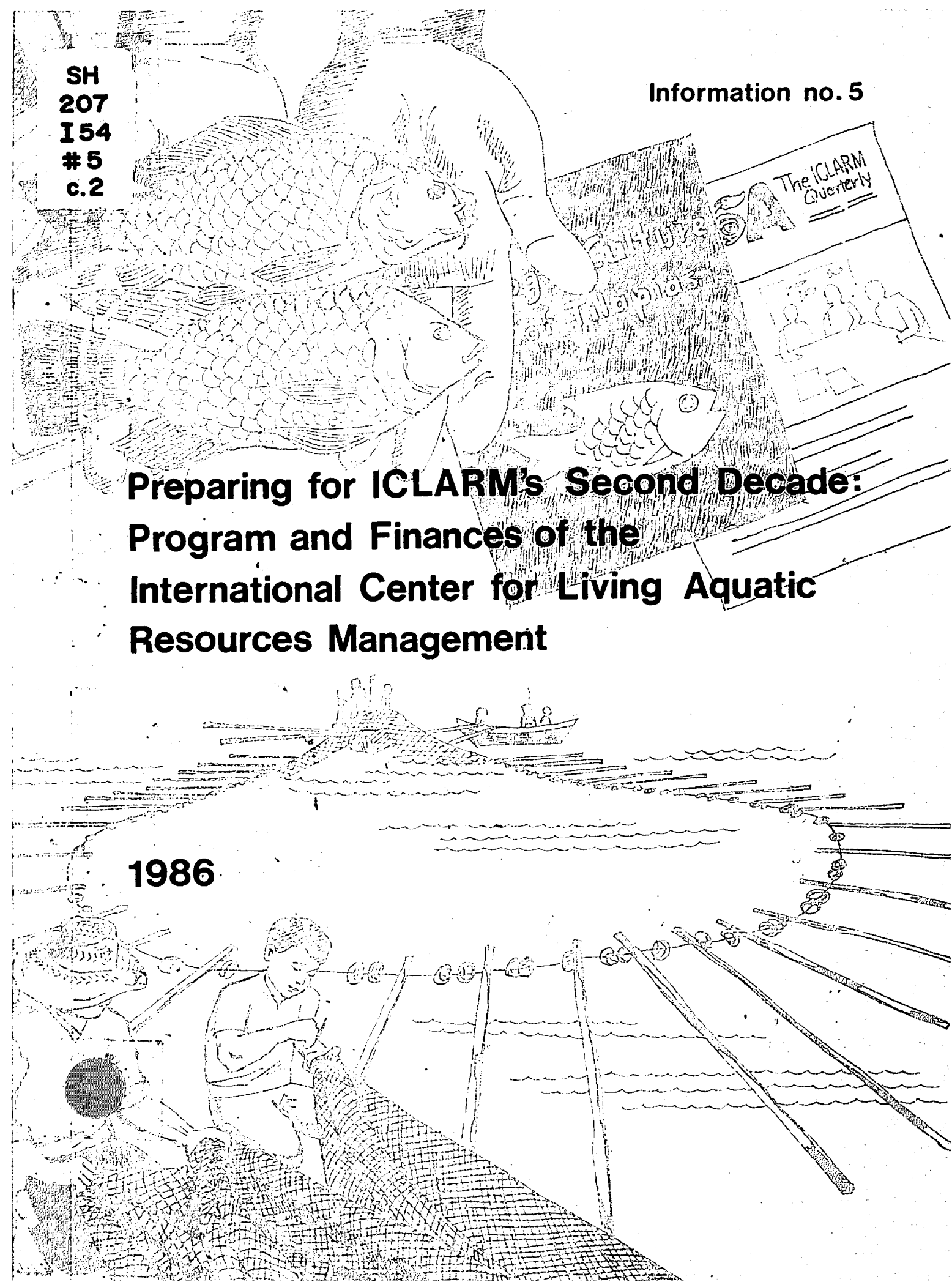


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**INTERNATIONAL CENTER FOR LIVING AQUATIC RESOURCES MANAGEMENT
MANILA, PHILIPPINES**

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1986

INTERNATIONAL CENTER FOR LIVING AQUATIC RESOURCES MANAGEMENT
MANILA, PHILIPPINES

Statement of Purpose

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

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

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

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

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

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

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

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Preface

The primary purpose of this discussion paper is to provide current and prospective ICLARM supporters with information about the Center's programs, particularly future directions both programmatic and geographic. In this sense, the document seeks to lay the foundation for the Center's second decade by reviewing in general terms what has been accomplished to date and which issues or approaches will receive priority in the future. A secondary purpose is to provide details of the Center's historical and present financial status, prospects for diversification of financial support and alternatives for attaining minimum financial security.

The draft of this discussion paper was approved in mid-June 1986 by the Executive Committee of ICLARM's Board of Trustees. Full details of ICLARM activities to date can be found in the recent publication, ICLARM Directory of Activities to March 1986, which also indicates the wide range of national and regional organizations throughout the Tropics with which the Center cooperates.

This discussion paper is being provided primarily as background material to participants in the first formal meeting of the ICLARM Support Group, scheduled for 2 November 1986 in conjunction with the annual meeting of the Consultative Group on International Agricultural Research (CGIAR) in Washington, D.C. This initial meeting of the ICLARM Support Group will be convened by Mr. Timothy Rothermel, Director of Global and Inter-regional Programmes of the United Nations Development Programme (UNDP). The discussion paper should also be useful to other donors not attending the CGIAR meetings.

Several of ICLARM's present and potential donors have responded very favorably to proposals to organize the ICLARM Support Group. The formation of the Support Group was viewed by many as the opportunity to establish a formal mechanism for communications between ICLARM and its growing number of donors, as well as amongst donors themselves. The regular meetings of the Support Group will serve as an excellent forum to discuss ICLARM's research programs, directions and priorities and the funding required by ICLARM to achieve its research objectives. At the same time, the donors will be provided with the venue to review ICLARM's progress and impact and the overall management of the Center's programs and finances. In this manner, the Support Group is envisaged to provide the ICLARM Board of Trustees with donor feedback on policy and management issues, but particularly with advice on the finances needed to establish the Center on a firmer footing so that ICLARM's recent serious financial problems can be avoided in the future.

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Executive Summary

The worldwide crisis facing the aquatic resources sector is multidimensional with environmental, biological, nutritional, socioeconomic and institutional dimensions and is not only a production constraint solvable through standard development approaches. Rapidly growing coastal populations are putting increasing pressure on aquatic environments. Production from capture fisheries around the world has levelled off in the past decade at approximately 75 million tonnes, and major increases are unlikely in the future. Even sustaining current levels of production requires implementation of imaginative management approaches for offshore and coastal areas based on sound information regarding potential impact of alternative interventions. Aquaculture is growing rapidly and has the long-term potential to fill some of the gap between capture fisheries supply and increasing demands from a growing population. However, the scientific bases underlying aquaculture systems are still poorly understood.

Responsible aquatic resource use cannot develop without a sound research base that is interdisciplinary in nature and management-oriented in thrust. The International Center for Living Aquatic Resources Management (ICLARM) offers such an approach. The Center is a non-profit, non-governmental research organization oriented toward the goal of improving the condition of the rural poor in tropical developing countries by increasing their productivity, nutrition, employment and income opportunities through the wise use of aquatic resources.

ICLARM was established in the Philippines in early 1977 after an initial formative period in Hawaii. The Center has a global research, training and information mandate similar to many of the international research centers that are supported by the Consultative Group for International Agricultural Research (CGIAR). However, ICLARM is not yet formally supported by or affiliated with the CGIAR, though it receives support from many of the organizations that contribute to the CGIAR system and attends the annual CGIAR meetings in an observer capacity.

Although similar in many ways, especially in sharing a primary mandate for research, ICLARM differs in two important respects from most of the relatively large commodity-specific international centers that are part of the CGIAR system. First of all, ICLARM has only very modest research facilities of its own; rather the Center works most often in close collaboration with staff of national and regional organizations using wherever possible the facilities of those organizations. In this manner, the programs of ICLARM's cooperators benefit explicitly rather than only indirectly from the Center's activities. Secondly, ICLARM's work is not commodity-specific but rather deals with a wide range of interdisciplinary issues in the fisheries, aquaculture and coastal zone continuum. Such an approach is necessary because the issues in these areas are not simply production constraints, solvable primarily through technological advance.

The Center has four interrelated program areas, refined to manageable themes during the Center's first decade:

- *Resource Assessment and Management* – focuses on development of interdisciplinary methodologies for multispecies stock assessment and management; coastal zone management research and planning; and the socioeconomic problems of small-scale fisheries.
- *Aquaculture* – addresses constraints to sustainable aquaculture production increases through focus on genetics of major cultured freshwater species; technology for low-cost culture systems, including coastal aquaculture systems; and economics of aquaculture development.
- *Education and Training* – provides internships and training through cooperative research; short courses in stock assessment and management; and coordinates social science and tropical fisheries science networks.
- *Information* – assists ICLARM cooperative research programs and networks through worldwide data and information linkages; produces Naga, the ICLARM Quarterly and five technical series; engages in research on worldwide fisheries information quality and use and means of improvement.

ICLARM pursues the above program of work through the leadership of a relatively small number of ICLARM core staff in Manila, working closely with selected field activities in cooperation with national and regional research organizations. This approach, facilitated by a highly productive core staff, has enabled the Center to achieve with its cooperators an enviable publication record of over 350 contributions in just nine years of operation.

Over its nine years of existence, the Center's programs have been refined to carefully chosen priority areas that can be pursued in a cost-effective manner. Currently, ICLARM senior professional staff numbers only six permanent members in programs and administration and nine in project-specific fixed term contracts (one of the former and five of the latter serve outside ICLARM's Manila headquarters). Ten mid-level professional staff and 25 support staff complete the Center's personnel in Manila. One regional office is operational in the South Pacific. The full staff complement of ICLARM is thus relatively small. ICLARM's cooperative approach to research and networking allows the Center's staff and programs to be highly effective and globally relevant.¹

Despite the apparent relevance and success to date of ICLARM's programs, however, the Center has never enjoyed full professional staffing or adequate funding. Since 1977, unrestricted core support has come from a relatively small number of contributors and in dollar terms, the level of such support is lower now than it was three years ago. Partially offsetting this has been an increase in the levels of restricted core support. Special project support attracted by the Center and restricted funding that supports the Center's cooperating institutions has increased considerably as ICLARM struggled to survive but such support cannot fully take the place of unrestricted and restricted core support for the Center itself.

¹A full record of ICLARM's first nine years' activities can be found in the document "ICLARM Directory of Activities to March 1986."

Due to the severe financial crisis faced by ICLARM in 1984 and 1985, senior staff positions were reduced to only six, well below optimum levels. Due to continuing financial constraints, the following key senior professional staff positions are still vacant, listed in order of priority by which they would be filled when funding becomes available.²

- Associate Scientist, Aquaculture
- Director, Education and Training
- Associate Scientist, Resource Assessment and Management
- Deputy Director General
- Associate Scientist (Aquaculture), South Pacific
- Associate Scientist (Research), Information
- Associate Scientist, Education and Training

The Center's current senior professional staff is therefore below a critical mass. As ICLARM prepares to embark on its second decade, it seeks additional unrestricted or restricted core support to enable the filling of these seven positions, critical to attaining adequate scientific depth in ICLARM's major program areas.

ICLARM's current contributors number 14 and in 1986 are expected to contribute a total of US\$2.23 million to the full ICLARM program.³ Of this amount, US\$1.49 million can be categorized as unrestricted and restricted core support.

To adequately staff its program leadership positions at headquarters and in its regional offices and to maintain its information program and administrative support, ICLARM requires a minimum core budget of US\$2.5 million, excluding funding that passes through ICLARM to the Center's cooperating institutions. Much of this amount can be in the form of restricted core support (e.g., for an Associate Scientist in the Aquaculture Program to work on integrated farming systems). Based on experience to date, ICLARM believes that of the desired total, certainly no more than US\$500,000 can be raised annually through overheads on special projects or restricted grants, publication sales and short-term consultancies of professional staff.

Therefore, raising US\$2 million annually in unrestricted and restricted core program support is the Center's goal. This amount represents a 34% increase over 1986 levels of such support and is a relatively modest objective given the successful global nature, achievements and potential of the ICLARM's programs.

² Excludes the two projected regional positions to be filled in Africa and Latin America as ICLARM's cooperative research program expands on these continents.

³ See Appendices A-D for full details of the Center's finances and contributors.

Overview of ICLARM and Its Programs

RATIONALE FOR ICLARM

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 third world countries, it makes up more than half. Indeed rice and fish is probably the most common dish in the tropics. As important as food intake 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 living aquatic resources and their environments.

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.

A crisis of major proportions exists for the living aquatic resources sector in tropical developing countries because these economically and environmentally important yet fragile systems are widely mismanaged. Increasingly around the world these 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 can be of immense value to humankind for decades to come.

Since the 1970s, annual yields have begun to decline from numerous major fisheries. So far, the exploitation of new resources has offset this decline, but rates of increase in aquatic food production are falling far 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.

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 76.5 million tonnes fisheries production in 1983, only 9% was generated by aquaculture. The rate of growth of the aquaculture sector

(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.

The crisis facing the aquatic resources sector thus has environmental, nutrition, income and employment dimensions and is not simply a production constraint solvable through standard development approaches.

Wise resources use cannot develop without a sound research base that is interdisciplinary in nature and management-oriented in thrust. The International Center for Living Aquatic Resources Management (ICLARM) offers such an approach. ICLARM is a research organization oriented toward the goal of improving the condition of the rural poor in tropical developing countries by increasing their productivity, nutrition, employment and income opportunities through the wise use of aquatic resources.

PURPOSE OF ICLARM

ICLARM is one of about 20 international, non-profit, autonomous research centers which concentrate upon those critical aspects of food production and resource management that are not covered adequately by other research organizations, and which are of wide importance, regionally or globally. ICLARM was incorporated in the Philippines in 1977.

As an international non-government organization, ICLARM's role is to complement and support the activities of national and regional research institutions in fisheries, aquaculture and coastal zone management in tropical developing countries. The stimulation and strengthening of global research activities by the Center are directed toward the improvement of the nutrition, income and employment opportunities of lower income people in these countries. The Center's interdisciplinary research is designed to increase utilization and promote rational management of aquatic resources toward these goals through four major interactive program areas: Aquaculture, Resource Assessment and Management, Education and Training and Information (Fig. 1). ICLARM is the only international non-government research center in the tropics that deals with the full range of interdisciplinary research issues in the fisheries and aquaculture continuum (Fig. 2).

ICLARM is one of the smallest of the international agricultural research centers, and perhaps not coincidentally, very cost-effective (Fig. 3). The flexibility that characterizes the Center's program is made possible not only by a small, dedicated and highly productive staff, but also by the unique way in which ICLARM carries out its research.

The Center was designed to function in a fashion similar to the International Agricultural Research Centers, except that it has no centralized research facility of its own. ICLARM's research activities are cooperative in nature, usually carried out in partnership with national and regional institutions. The "multiplier" effect of the Center's research, training and information activities is high and contributes to increased individual and institutional capabilities. This approach has produced high quality results and important conceptual advances in the fisheries management field. This focus upon cooperation is also highly appropriate in that it assists more of the Center's colleagues in the tropics to develop sustained careers for themselves in the fisheries and aquaculture field, an involvement that is essential if the complex development and management problems facing the sector around

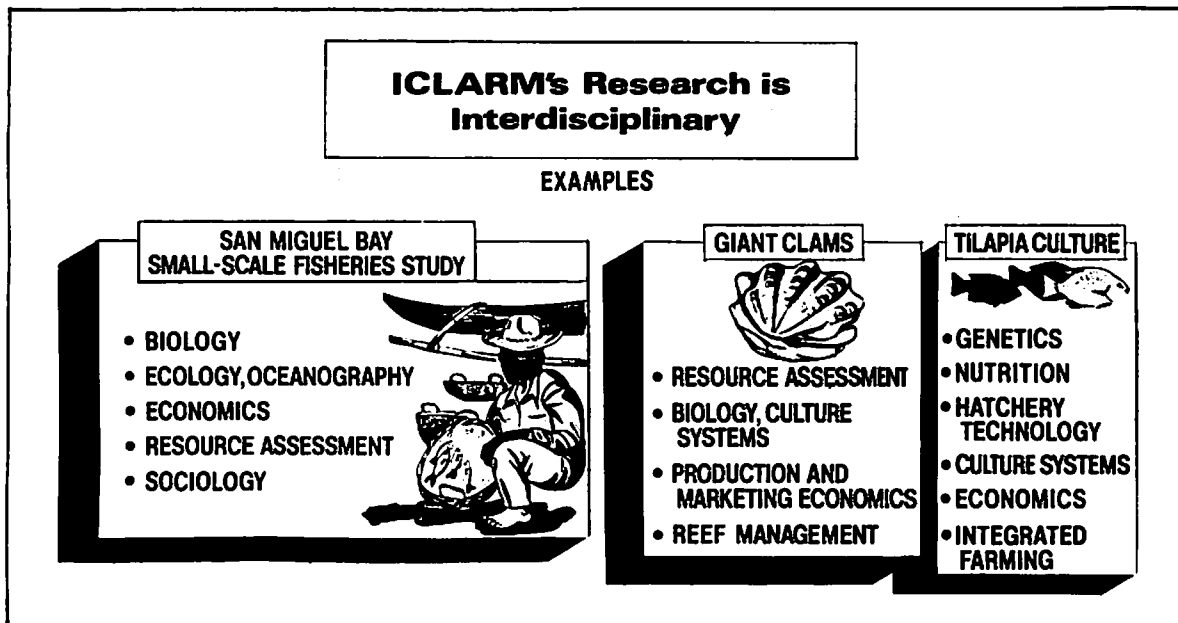


Fig. 1. ICLARM's interdisciplinary research is designed to increase utilization and promote rational management of aquatic resources through its four major interactive program areas.

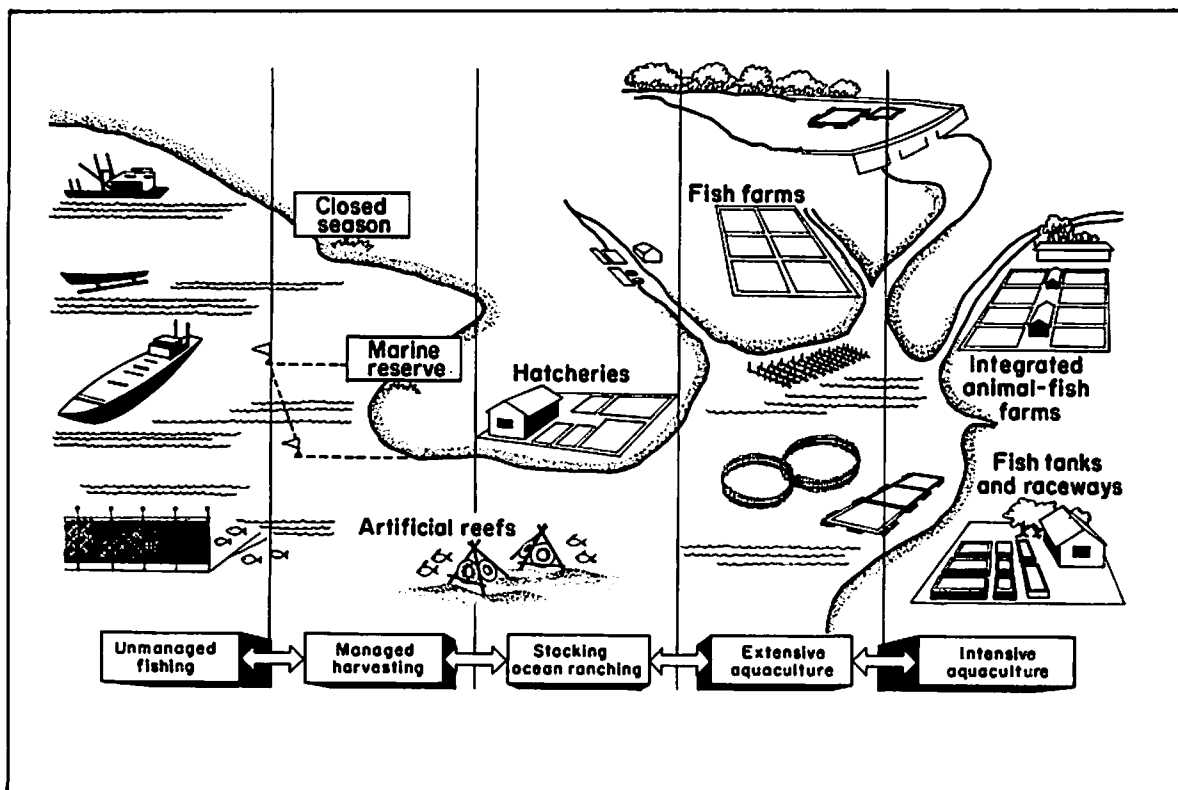


Fig. 2. Utilization of aquatic resources: a continuum of activities requiring a comprehensive, interdisciplinary approach to research such as has been initiated by ICLARM.

the world are to be dealt with successfully. ICLARM has found research, training and information networks to be particularly effective means towards this end.

OPERATION OF ICLARM

ICLARM is neither a funding organization nor a consulting firm. Rather it is a unique and very active research institution with a dynamic program of long-term research, methodology development, training and information dissemination. The Center focuses particularly on "upstream" research of a strategic and long-range nature and in addition pursues "downstream" or more applied and adaptive research through cooperative research activities with national and regional organizations (Table 1). ICLARM is designed to complement the work of international governmental organizations, such as the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Development Programme (UNDP), that undertake development projects in the aquatic resources sector. The Center's research has always had a strong interdisciplinary flavor (Fig. 1).

Because the task of management-oriented research on living aquatic resources is of global dimensions, ICLARM:

- actively supports development of national and regional research capacity through *training and cooperative research*
- makes extensive use of *networks* as training and information exchange mechanisms
- serves as a *worldwide clearinghouse for information* to support fisheries and aquaculture researchers, policymakers and their institutions.

The central scientific staff is based in Manila. Due to the severe financial crisis faced by ICLARM in 1984 and 1985, senior staff positions were reduced to only six, well below optimum levels (see Appendix E for list of senior and mid-level staff as of September 1986). Due to continuing financial constraints, the following key senior positions are still vacant (listed in order of priority by which they would be filled when funding becomes available):

- Associate Scientist, Aquaculture
- Director, Education and Training
- Associate Scientist, Resource Assessment and Management
- Deputy Director General
- Associate Scientist (Aquaculture), South Pacific
- Associate Scientist (Research), Information
- Associate Scientist, Education and Training

Location of funds to fill these positions, especially the first four, would allow ICLARM to regain that minimum critical mass necessary for effective program leadership and scientific advance.

The Center strives to maintain a balance between the core staff in Manila, who have accomplished much in way of scientific advance and methodology development, and the more applied work of the field staff. Achieving this balance of course requires the right mix of long-term unrestricted or program financial support and restricted project-specific funds. A number of scientists on fixed-term assignments with cooperating institutions in various

locations around the tropics complement the central staff. In 1985, ICLARM opened its South Pacific office, the first such regional office outside the headquarters.

ICLARM's program began with an initial geographic focus on Southeast Asia and the Pacific. The Southeast Asian location for ICLARM headquarters was selected because of

Table 1. ICLARM cooperative research, training and information projects, by program area.¹

Resource Assessment and Management	
Network of Tropical Fisheries Scientists	Global
Management Oriented Fisheries Modules	Global
Stock Assessment Research Methods	Global
Small-Scale Fisheries Management	Global
Integrated Coastal Resources Management	Southeast Asia (ASEAN)
Bivalve Stock Assessment	Thailand
Small Pelagics Stock Assessment	Philippines
Aquaculture	
Network of Tropical Aquaculture Scientists ²	Global
Finfish Genetics (planning phase)	Asia/Africa
Integrated Farming Systems	Asia/Africa
Coastal Aquaculture Centre	South Pacific/Solomon Islands
International Giant Clam Mariculture	Asia/Pacific
Rice-Fish Culture Reassessment ³	Asia
Reservoir Aquaculture and Management	Indonesia
Tilapia Broodstock Improvement ³	Philippines
Education and Training	
Asian Fisheries Social Science Research Network	Asia
Training Directories (Naga special issues)	Global
Fisheries Management Internships	Global
Fisheries Management Training Courses ⁴	Global
Coastal Zone Management (various courses)	Asia
Fisheries Management Manuals	Global
Information	
Selective Information Service	Global
Naga, the ICLARM Quarterly	Global
Library	Global
Publications (5 ICLARM Series)	Global
Analysis of Tropical Aquatic Science Literature	Tropics

¹ Please refer to the 1985 Annual Report of ICLARM for details of the above projects and to the ICLARM Directory of Activities since 1977 for earlier projects.

² To be initiated in 1987.

³ Proposals pending with funding support agencies.

⁴ Funding being sought; ICLARM contributions to date have been primarily with FAO/DANIDA courses.

the prominent fisheries and aquaculture sectors of this region. Most of the top fishing countries in the tropics are in Asia and virtually all worldwide aquaculture production until the late 1970s came from this region. During the 1980s, ICLARM's program expanded first to the South Pacific and Latin America and most recently to Africa.

The policies of the Center are set by a 15-member Board of Trustees who are drawn from the international community and 13 of whom serve in their personal capacities. The Philippine minister responsible for fisheries serves in an ex-officio capacity as does ICLARM's Director General. The input of these individuals and the active program development of the Center's scientific staff with colleagues in cooperating institutions have enabled ICLARM to stay in the forefront of research on living aquatic resources management.

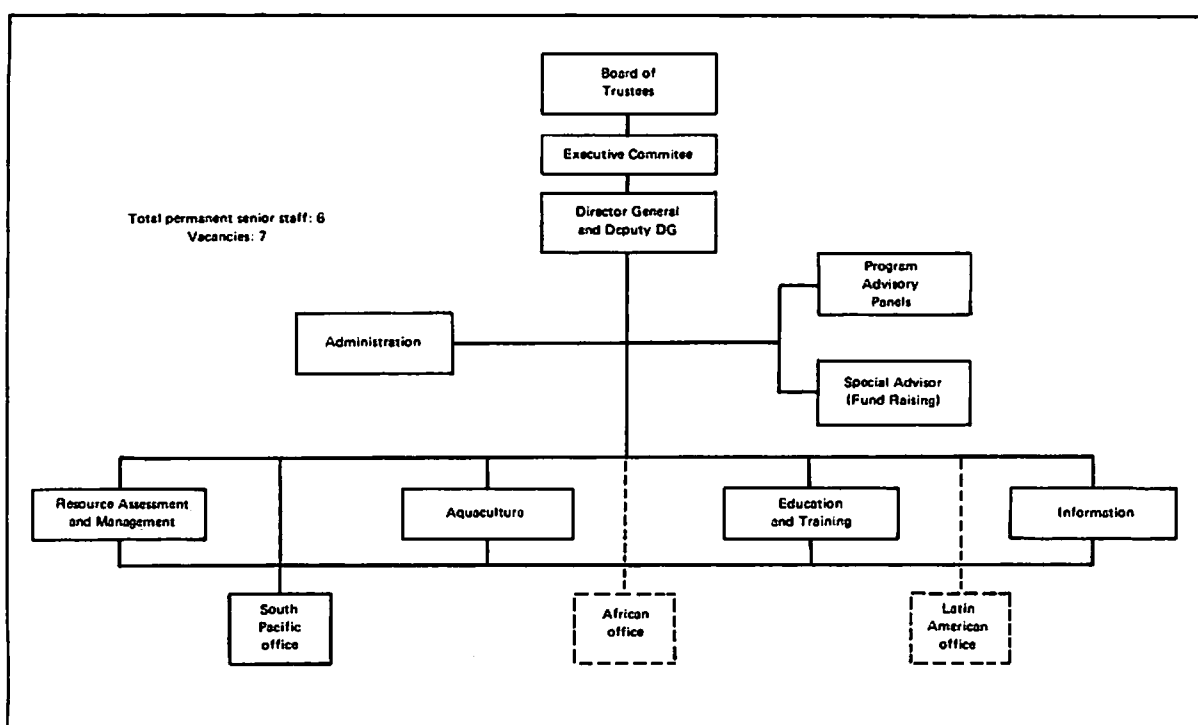


Fig. 3. ICLARM structure showing current program areas, current regional office and future regional offices (dotted lines).

ACHIEVEMENTS OF ICLARM

During the first nine years of ICLARM's existence, its program in tropical fisheries research has had considerable impact (Fig. 4). The Center's more significant accomplishments are the identification and pursuit of critical issues related to tropical fisheries problems and contribution to the shifting of thinking from resource development (expansion) to management concerns and approaches, the strengthening of developing-country research and training capabilities, and the demonstration of the usefulness of interdisciplinary research.

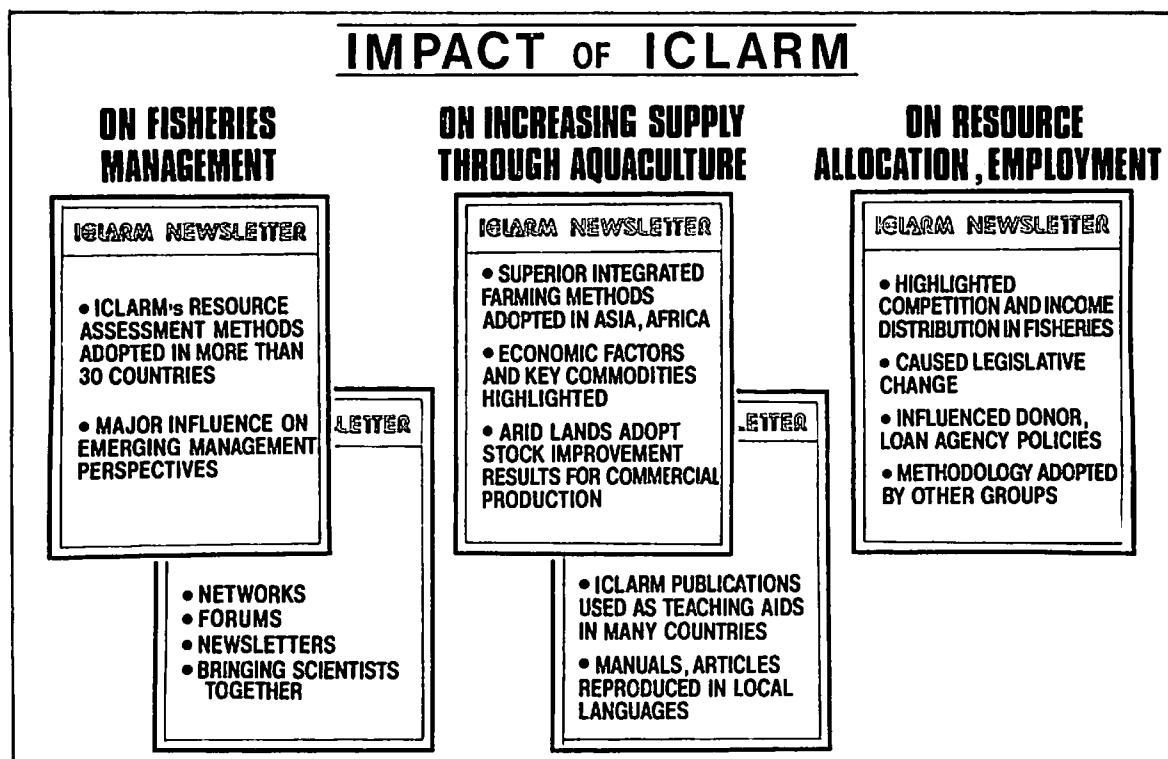


Fig. 4. ICLARM's program in tropical fisheries and aquaculture has had considerable impact.

There has been a clear recognition for some time that research is a necessary component of the fisheries and aquaculture development process. The Technical Advisory Committee (TAC) of the Consultative Group on International Agriculture Research (CGIAR) stated in 1973 that "to improve existing culture practices . . . well organized scientific research is of utmost importance." The US Agency for International Development (USAID) has evaluated ICLARM's programs twice since it began funding the Center in 1979. The 1982 review team concluded "ICLARM's multidisciplinary approach to aquatic resources problems of a general nature in tropical areas, which includes a higher than usual socio-economic component, is a fundamental step towards establishing the scientific and technical bases on which development and management (current and future) can be based."

ICLARM also receives continuous feedback on the Center's usefulness from many individuals and institutions around the world. ICLARM literature is widely used throughout the developing world and the 350 scientific publications produced so far are in constant demand. Multispecies stock assessment and small-scale fisheries research methodologies developed by ICLARM are in increasing use around the world. Tilapia production is increasing worldwide, in part due to ICLARM's cooperative research with national institutions on this low-cost species.

NAGA, the ICLARM Quarterly (formerly the ICLARM Newsletter) reaches 3,500 readers around the world and publication exchanges are made with a large number of developing country institutions. More than 40 cooperative research projects have been initiated in various developing countries in Africa, Asia and Latin America and scientific linkages are

operational with many institutions. Seven major reviews have been published and eight international conferences and workshops have been conducted by ICLARM, which subsequently published the proceedings. Requests for participation by ICLARM in various research topics far surpass the Center's ability to respond; research and information networks have been used to increase the multiplier effect of ICLARM's work.

The need for and usefulness of an independent, international, non-governmental fisheries research organization working in cooperation with national institutions have been clearly established.

FINANCIAL SUPPORT AND CONTINUITY

Since 1977, ICLARM has received unrestricted and core program support from a number of donors including Australian Development Assistance Bureau (ADAB), Ford Foundation, German Agency for Technical Cooperation (GTZ), the Royal Norwegian Agency for International Development (NORAD), Rockefeller Foundation, UNDP and USAID. Additional restricted core support for cooperative research projects has come from these donors and the Asian Development Bank, FAO, International Development Research Centre of Canada, Kuwait Institute for Scientific Research, New Zealand, Planters-Products, Inc., San Miguel Corporation, the Skaggs Foundation, UK Overseas Development Agency, United Nations University and World Bank (full details on contributions by year can be found in Appendix D).

The Center has no endowment and depends entirely upon grants from donor organizations. While the number of donors that have supported ICLARM is diverse and growing, the Center continues to operate under conditions of some considerable uncertainty due to the short-term nature of this support. The years 1983-1985 were particularly difficult as the Center experienced declining income, especially of an unrestricted nature, and almost literally collapsed at the end of 1985 to little more than a short-term project implementor. In 1986, ICLARM has begun to recover from this situation (Fig. 5), but long-term donor commitments remain few in number and the Center remains far too heavily dependent upon restricted, short-term income.

To help overcome these problems, the ICLARM Support Group is being formed, under UNDP leadership. The Support Group will hopefully lead to more diversified and longer-term support for the research, training and information activities of the Center. Also, the Support Group is expected to assist ICLARM in gaining some form of recognition from the CGIAR with which the Center seeks membership or affiliate status.

The Center seeks annual unrestricted and restricted core program support of approximately US\$2.0 million to supplement special project support which will continue to be raised from individual donors on a case-by-case basis. This represents a 34% increase over current levels of support.

Total expected income in 1986 will be approximately US\$2.3 million, of which US\$0.84 million (37%) is unrestricted core, US\$0.65 (28%) is restricted core and US\$0.82 million (35%) is special projects. The Center's Board of Trustees and staff strongly believe that a relative increase in unrestricted support is necessary to maintain the scientific approach and success of the Center. Unrestricted support is especially important to maintain the

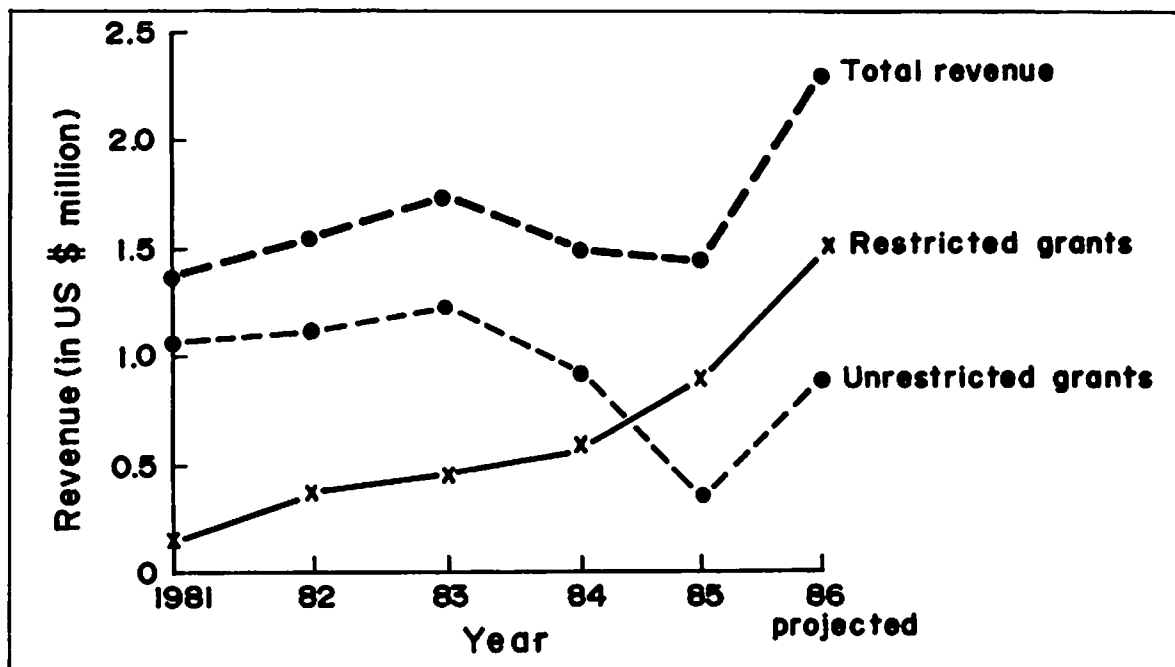


Fig. 5. ICLARM income profile, 1981-1986 (in current dollars not adjusted for inflation).

cooperative research activities with broadly defined groups of collaborating institutions at the national level and the global networks and information programs of the Center.

Further details of the Center's finances can be found on p. 37. The following sections of the discussion paper describe ICLARM's programs and finances in greater detail.

Aquaculture Program

RATIONALE FOR PROGRAM PRIORITIES

Aquaculture, the raising of aquatic organisms under controlled or managed conditions, has vast potential for raising nutritional standards and incomes in tropical developing countries (Fig. 6). Fish are excellent converters of low-grade feedstuffs and agricultural residues into high-grade animal protein and 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. In this successful proving period, 25 projects were completed with 20 cooperating institutions together with various ancillary activities: training, workshops, conferences, reviews and advisory services.

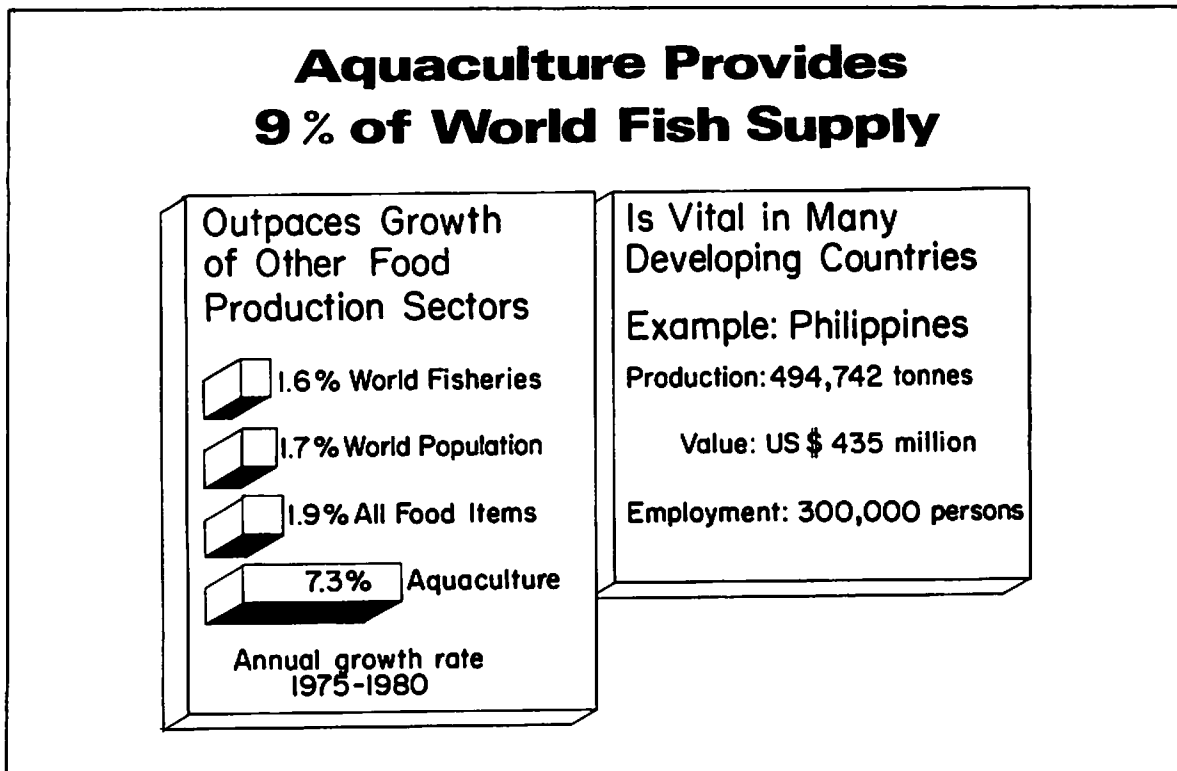


Fig. 6. Aquaculture, which provides 9% of world fisheries production, has vast potential for raising nutritional standards and incomes in tropical developing countries.

The full field of aquaculture research issues is extremely broad. From its experience 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:

1. the *genetic improvement of cultured fish, especially of tilapias*;
2. 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); that is, systems popularly known as wastefed aquaculture and integrated farming and also encompassing some coastal aquaculture systems; and
3. *aquaculture economics and policy*, including production and marketing aspects as well as broader development issues.

ICLARM also chose to concentrate on warmwater finfish and molluscs appropriate for less capital-intensive aquaculture by small-scale farmers supplying domestic markets; notably tilapia (an African fish, viewed as a future "aquatic chicken"), carps and bivalve molluscs (clams, cockles, mussels and oysters). ICLARM's research for 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 (see p. 16). Overall, the program has only a small involvement in research on shrimps, prawns and other luxury foods, and this is primarily from a broad economic and social feasibility viewpoint.

ICLARM undertakes multidisciplinary collaborative research and training, combining biological and social sciences. In addition to generating important research results and strengthening developing country institutions, ICLARM seeks to provide leadership in research methodology, data handling and systems modelling.

Up to 1985, program activities were largely confined to Asia. However, the chosen research themes and commodities have broader geographical focus. For example, the centuries-old traditions and modern improvements in Asian integrated farming systems 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 rapidly in Africa and the South Pacific from their initial base in Asia and are particularly 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, many of which lack professional fish geneticists and the required facilities to initiate and carry through 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 expects to assume a lead role. Planning missions are already underway.

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, principally plankton and the bacteria associated with detritus, 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 (t) of fish/ha/yr were demonstrated with livestock manure as the sole input. Yields of 7-8 t/ha/yr are regularly attained on Asian farms; backyard ponds (approximately 200 m²) in Thailand, supplied with farm and household wastes, yield an average 175 kg of fish/yr, a valuable nutritional supplement to the family, sufficient to supply the entire animal protein needs of a rural household of five members.

While these systems are known to be highly productive and lead to increased incomes for farmers who adopt them, however, 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 and crop-fish (especially rice-fish) in which ICLARM has had considerable experience to date;
- transfer and adaptation of successful Asian technology to Africa in which ICLARM is beginning to play a more prominent role;
- 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 an International Giant Clam Mariculture Project, which is coordinated through ICLARM's South Pacific Office.

This involvement arose from recognition of the technical feasibility of non-intensive 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 (traditional usage) and by 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, Diliman and Silliman University in the Philippines, the University of Papua New Guinea, the Fisheries Division of Fiji and Solomon Islands and University of Newcastle upon Tyne, U.K. working with Universitas Diponegoro in Indonesia.

The principal objectives of this regional 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 socio-economic 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 Centre 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 Centre 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 the Indo-Pacific marine faunal and floral regions 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 analysis 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 eight national institutions that belong to this network (see p. 27 for further details).

ICLARM's aquaculture research is increasingly interdisciplinary. Research on genetics improvement and especially technology for low-cost systems has an explicit social science component, and this component will be pursued as funding permits.

FUTURE PROGRAM ACTIVITIES

In 1986, ICLARM's Aquaculture Program entered a transitional phase from the project-by-project framework of past activities towards a more integrated and sustainable research and training effort. This will involve 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, particularly the integration of agriculture with aquaculture. These frameworks, like the International Giant Clam Mariculture Project, will provide a set of activities over the next five years through which international cooperation will be developed, particularly between African and Asian scientists.

Asian/African linkages. 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 aquacultural development and lack of trained personnel.

Africa needs simple, low-cost aquacultural 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 ICLARM 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 have undertaken planning missions to Cameroon, Ghana, Ivory Coast, Malawi, Zambia and Zimbabwe. A program base is being established in Malawi, the lead country for fisheries and aquaculture for SADCC and linkages are being established in Eastern, Southern and West Africa. Plans are in progress for research and training activities in integrated farming system and fish genetics. A major feature of these will be workshops, study visits and conferences involving African and Asian researchers.

CONCLUSION

It is clear that the ICLARM aquaculture activities envisaged will require the development of international networks, new national research and training facilities in Africa and Asia and sustained financial support. Of particular interest is the use of wild strains to replenish domestic stocks. To ensure continuity of research, particularly in fish genetics, it is envisaged that some of the required facilities would be maintained under ICLARM's management, following the precedent set by ICLARM's Coastal Aquaculture Center in the Solomon Islands. It has been the experience of agriculture researchers in the CGIAR system that such management control is essential, particularly for the pursuit of more basic "up-stream" research. In this respect, ICLARM is not seeking to establish, own and maintain large and expensive centers but rather to manage modest, basic facilities for holding and experimenting on cultured fish. The majority of the ICLARM research and training efforts will be undertaken, as before, through cooperation with and strengthening of existing national and regional institutions.

Resource Assessment and Management Program

RATIONALE FOR PROGRAM PRIORITIES

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;
- *magnification along coastlines of problems occurring in adjacent systems* (e.g., erosion on the terrestrial side, pollution on the aquatic side), because of reduced dimensionality. That is, problems generated on a per area basis affect coastlines along a linear dimension. The result is accelerated deterioration in many aquatic environments, reducing their ability to sustain high levels of production; and
- *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 densities and consequently reduce catch rates of near-shore fisheries, depress market prices and render small-scale fisheries unprofitable.

The Resource Assessment and Management Program of ICLARM 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 living aquatic resources and formulate options for managing them; and
- helping resource managers to *evaluate appropriate resource management options* and implement management programs.

PROGRAM THEMES

From its inception, the Resource Assessment and Management Program of ICLARM has put emphasis on the management problems of tropical small-scale fisheries, especially those in the coastal zone. These fisheries employ the majority of all fishermen, and produce

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 the central part of the country.

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 (Fig. 8). 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.

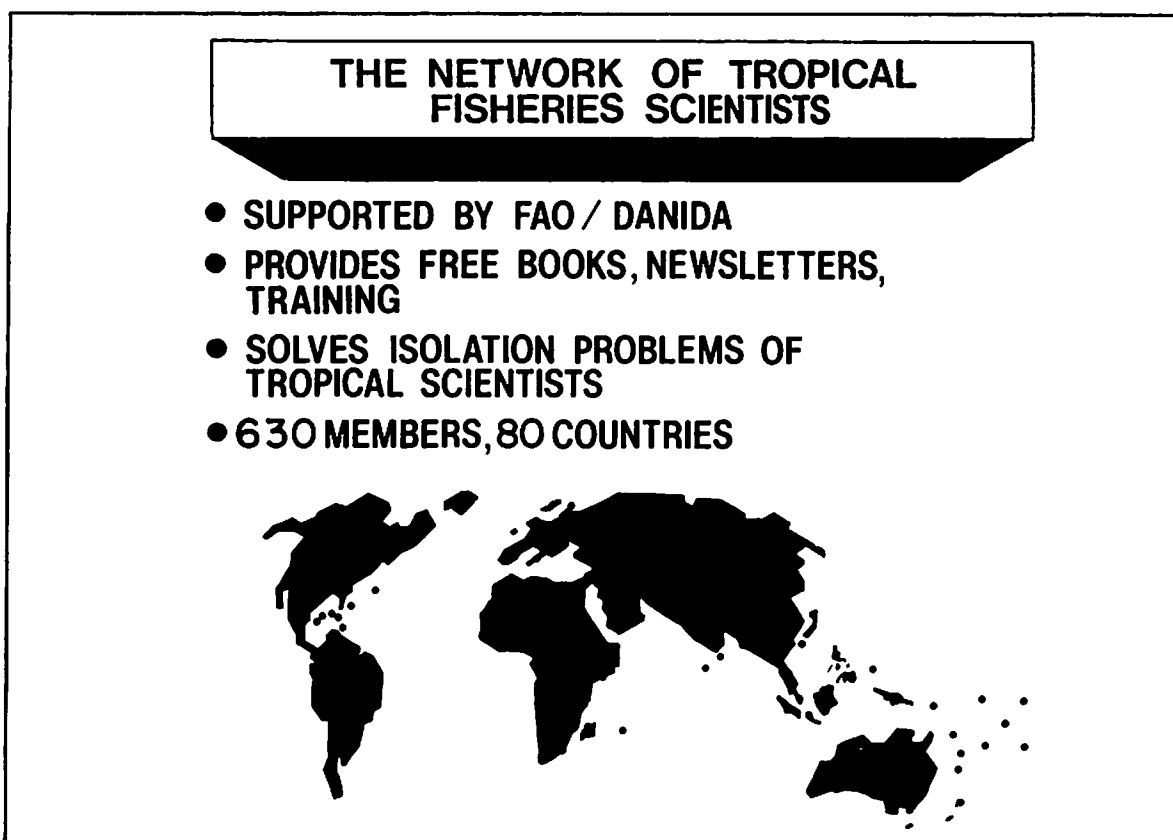


Fig. 8. The Network of Tropical Fisheries Scientists enhances communication between fisheries scientists working on the assessment, conservation and management of tropical fisheries.

FUTURE PROGRAM ACTIVITIES

The NTFS and complementary training and methodology development activities of ICLARM central staff will remain key elements in ICLARM's program. Increasingly, specific cooperative projects with national and regional institutions, possibly with outposted ICLARM staff members, will be undertaken.

Within the Resource Assessment and Management Program, two such major externally funded projects are 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 achieve a semblance of program continuity as the level of unrestricted core support available to it declined.

Coastal Resources Management Project. The coastal zone represents an area where the terrestrial boundary interfaces with the marine and atmospheric biospheres. In the tropics, this zone is characterized by highly productive ecosystems which support a broad range of diversified economic activities. Possibly no other region in the world is more dependent on the sustainable utilization of the living coastal resources than the Association of Southeast Asian Nations (ASEAN) region comprising Brunei, Indonesia, Malaysia, the Philippines, Singapore and Thailand. Given the burgeoning population and rapid economic growth in these ASEAN 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 components focusing on 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 in Brunei, Indonesia, Malaysia, Philippines, Singapore and Thailand which play the major role in program implementation. 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 (Fig. 9).

Initially, USAID funding is available for a first four-year phase, but it is the expectation of the national institutions and ICLARM that this activity will continue for some years to come and that, if successful, 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 its previous Southeast Asian focus to other parts of the world, especially South Asia.

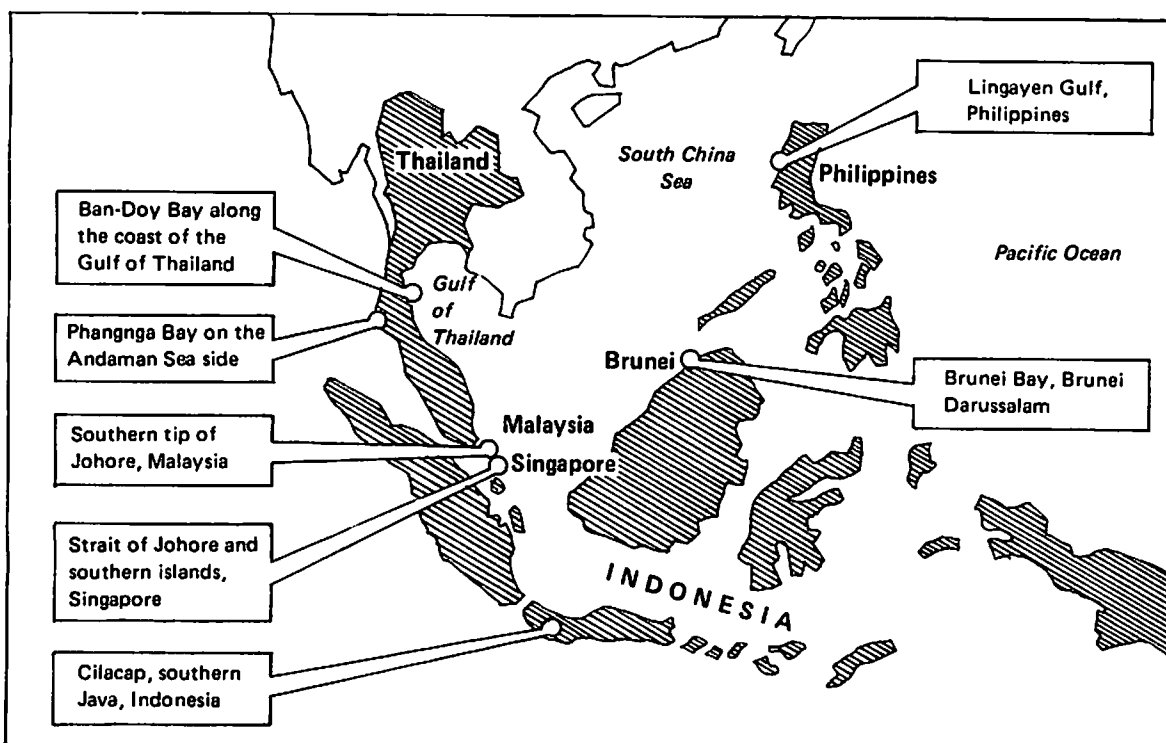


Fig. 9. Sites for in-country research activities of the Coastal Resources Management Project.

Emphasis in this project 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 methodological procedures or frameworks with high potentials for generalized applications.

Design of minimum-cost data base systems for integrated management purposes and identification of hardware/software required for data storing, processing and retrieval for efficient data analysis and information use is also emphasized. Microcomputer software designs for management purposes at different levels of the decisionmaking process (production unit, region, country) are expected to be developed as additional tools for management.

Beginning in mid-1986, two major research projects within the Bay of Bengal region (in Bangladesh and on the west coast of Thailand) will be conducted where small-scale fisheries management policies will be conceptualized for analytical purposes, and subsequent monitoring and evaluation procedures will be defined and implemented. These management projects will provide a complementary empirical base for the formulation and design of methodologies leading to successful management programs in small-scale fisheries.

In addition, a manual for a "data base system for small-scale fisheries management" will be developed in collaboration with FAO and the implementation feasibility of this manual tested in the Bangladesh and the Thailand projects.

OTHER ACTIVITIES OUTSIDE ASIA

There is a common misconception that ICLARM works only in Asia. In actuality, the Center has long had cooperative research linkages and training activities in Latin America, the South Pacific and Africa. These linkages are expected to expand by contacts developed through the international Network of Tropical Fisheries Scientists which currently has over 600 members worldwide. A few examples of ICLARM's linkages will give flavor to this non-Asian work.

Latin America and Caribbean. ICLARM has had since 1981 an active cooperative project with the Instituto del Mar del Peru, funded by GTZ and concentrating on the assessment, through compilation and analysis of time series data, of the effect of El Niño on the Peruvian marine fisheries. This project, which has a training component, has led to several smaller 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 harvest.

Another major linkage is with the Instituto de Ciencia del Mar y Limnología of the National Autonomous University of Mexico, with whom an agreement formalizing and expanding our previously informal cooperation in training and fish stock assessment has been signed recently.

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. This now forms a major component of the Aquaculture Program (see p. 16) and has led to the development of the ICLARM Coastal Aquaculture Centre in the Solomon Islands, for which a regional role is foreseen, and the formal establishment of ICLARM's first regional office outside Manila.

ICLARM's current activities in the South Pacific, which also include a recent fisheries stock assessment review, have been developed in close consultation with the South Pacific Forum Fisheries Agency. Future activities are likely to include training in stock assessment and the testing of an integrated systems approach to assessment and management of island fisheries.

Africa. Africa has vast inland fisheries resources but many parts are characterized by alternating periods of aridity and inundation causing extreme fluctuation in fish supply. Other areas, proximal to the great lakes, major rivers, reservoirs or swamp systems have

more constant supplies obtained under relatively benign conditions which could complement, or in certain circumstances compete with supplies from aquaculture. Coastal areas of the western equatorial zone and the major part of coastal eastern Africa have highly seasonal catches governed principally by climatic factors while the arid north- and southwestern coasts are characterized by upwelling zones, high productivity, a high industrial fishing potential and very sparse consumer populations. Such variations in fish supply and demand suggest that considerable attention be given to improved methods of fish handling and processing. They also have important implications for the economic viability of aquaculture and inland fisheries in the form of competitive interactions, depending on social and marketing conditions.

ICLARM has already had a considerable impact on African fisheries science through the development of microcomputer-based stock assessment methods applicable to marine and inland fisheries. A Stock Assessment Module developed with the Zambia Department of Fisheries, for example, has involved training in microcomputer techniques at ICLARM, Manila and provision of a microcomputer and software for analyzing Zambian data bases. ICLARM's methods are being spread throughout Africa through ICLARM's Network of Tropical Fisheries Scientists and several training courses.

CONCLUSION

Future activities of ICLARM's Resource Assessment and Management Program 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 decisionmaking in the developing countries.

Education and Training Program

RATIONALE FOR PROGRAM PRIORITIES

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 have been offered in temperate locations and have 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 non-degree 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 (Fig. 10). 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.

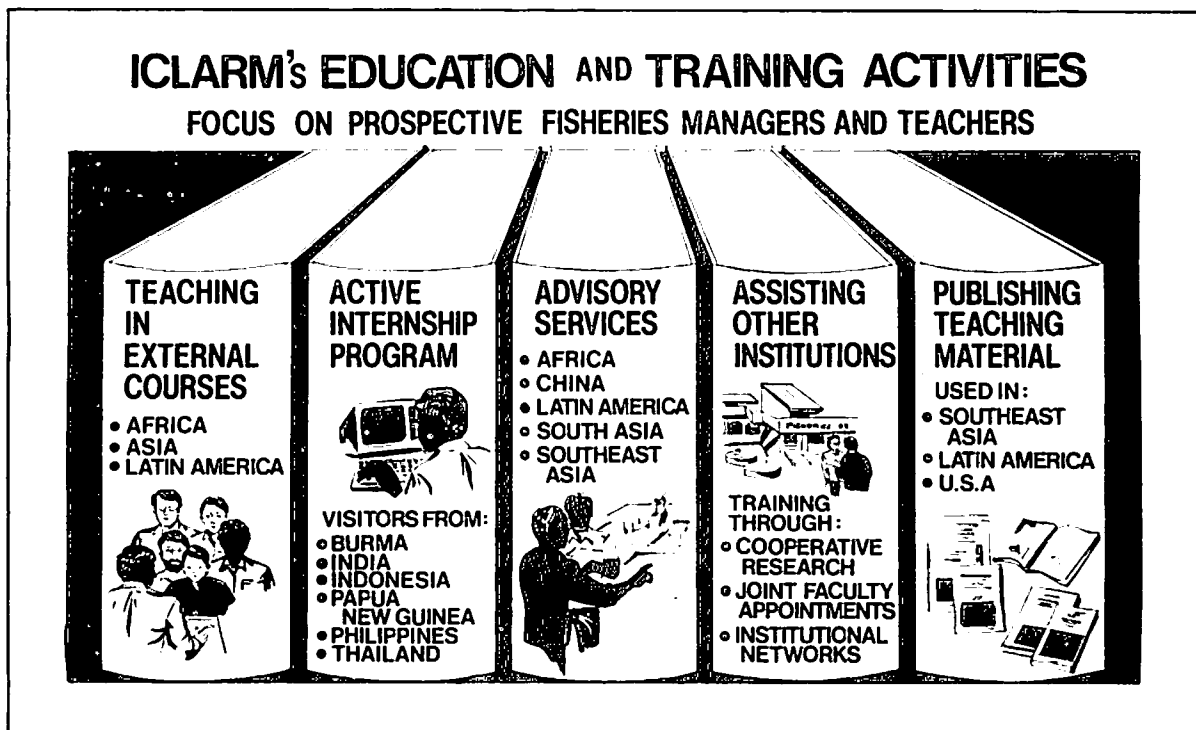


Fig. 10. Education and training activities are important components in all ICLARM programs.

Scholarships for degree training in fisheries and aquaculture economics at cooperating educational institutions have also been made available through 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.

Asian Fisheries Social Science Research Network. One example of an ongoing ICLARM activity which integrates training and research is the Asian Fisheries Social Science Research Network (AFSSRN). By initiating the Network in 1983 with IDRC of Canada and Asian institutions (Fig. 11), ICLARM and its national partners took an important step towards developing a program to strengthen the capacity of Asian countries to carry out research and provide sound advice on the many serious socioeconomic problems confronting fisheries management and aquaculture development in the tropics. The Network is breaking down the main constraints that limited the effectiveness and quality of socioeconomic research on fisheries issues in the past: weak institutional support for long-term research programs, and a shortage of social scientists with the special skills and professional confidence needed to develop and carry out such research programs.

The Network is strengthening national research capacity to deal with the socioeconomic aspects of fisheries management and aquaculture development in Asia by encouraging the development of centers of specialization in fishery social sciences in institutions capable of developing and sustaining programs of teaching and/or research in the long term. The AFSSRN also assists the specialist teams in member institutions to plan medium- to long-term research programs and related training programs, both degree and short-term, and to develop, apply and evaluate innovative methodologies for socioeconomic and multidisciplinary research on tropical fisheries and aquaculture. The Network is institutionally based because its objectives can be met only where it can obtain institutional commitments to develop and sustain over a long period of time socioeconomic programs of teaching and/or research related to fisheries and aquaculture. It is also a professional training program in a relatively new branch of applied economics and thus depends on recruiting individual social

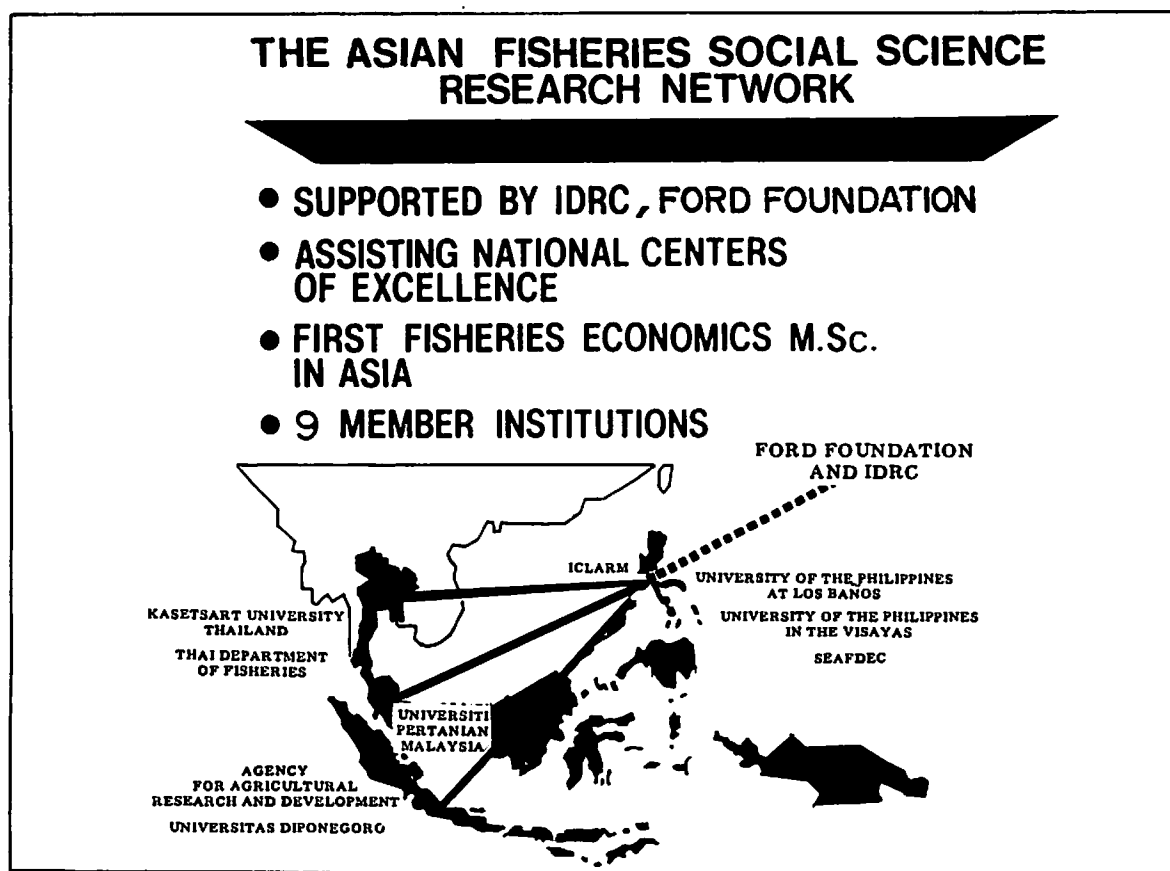


Fig. 11. Member institutions of the Asian Fisheries Social Science Research Network.

scientists who are willing to give a professional commitment to this new specialization. Member institutions as of mid-1986 are shown on Fig. 11.

ICLARM initiated this Network to help meet a growing and increasingly recognized need in Asia for stronger analyses of socioeconomic aspects of fisheries management and aquaculture development. A two phase five-year grant was obtained from the International Development Research Centre of Canada (IDRC) which also recognized the need for a greater social science input in fishery research. Subsequently, funding to help ICLARM cover coordination costs was obtained from the Ford Foundation.

A new graduate degree course offered by Universiti Pertanian Malaysia laid the foundation for the Network's professional training program. Regional workshops have been held and are planned on appropriate methods for aquacultural economics and fisheries marketing research and on course curricula development. The Network's research program covers a fairly wide range of issues in capture fisheries and aquaculture: six projects have been completed and 20 are currently underway.

ICLARM encourages the member institutions to take an active and responsible part in developing the Network program. A Committee of the eight research Team Leaders and the Coordinator was formed in 1985 for this purpose, and the Committee has assumed responsibility for assessing all research proposals submitted for Network funding. The Committee will take increasing responsibility for developing Network activities and for seeking additional funding.

Financial constraints affect the training component of the network program severely, limiting the range of training activities, the numbers of trainees and the participation of outside trainers. Research funding is more satisfactory. It is still small, but in some member institutions the present capacity to carry out research is quite limited. As member teams develop expertise and experience, they will be able to attract research funds internally. Network research funding from external sources is seen as a development tool rather than as a necessary long-run component.

A program of institutional and professional development of this kind is a long-term activity and, if it is to meet its objectives, it must be assured of long-term professional and financial support. ICLARM is able to provide professional leadership, encouragement and training support, but the major constraint on further development and geographical expansion of the Network is financial.

FUTURE PROGRAM ACTIVITIES

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, in 1987, funding permitting. 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 mid-level managers planned for 1987 in Manila.

New staff to be hired in the 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 for which ICLARM will hopefully retain control over participation requirements to assure maximum benefit to trainees. Numerous other training courses will be offered through various ICLARM projects such as those on coastal zone and small-scale fisheries management.

CONCLUSION

For these Education and Training plans to proceed, ICLARM needs both funds and strengthened institutional linkages. On the funding side, the position of Director, Education and Training, should be funded from the ICLARM core program. Financial support is being solicited from microcomputer companies (e.g., IBM) to equip the new ICLARM training room. These are modest facilities which can accommodate up to 20 trainees in a classroom typesetting. On the linkage side, ICLARM will need to strengthen its ties with other training institutions worldwide to supplement the Center's in-house expertise for specific courses and topics. For the development of curriculum materials, the existing linkage of the Center with the Asian Fisheries Society (for which ICLARM currently provides the Secretariat) and its 600+ professional members will provide an avenue for contributions from the region's top scientists and educators. The increased involvement of these individuals with ICLARM would help assure that the curriculum materials developed are relevant for tropical needs and institutions yet reflect the tremendous diversity of aquatic ecosystems (e.g., coral reefs, estuaries, mangrove swampland, river systems, inland reservoirs) that exist in the tropics.

Information Program

RATIONALE FOR PROGRAM PRIORITIES

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 takes particular pride in its Information Program. Not only has the program in its publications reflected ICLARM's strong commitment to publish the results of the Center's cooperative research activities, but it has also been taking the initiative to help solve several inter-related problems that prevent scientists in the tropics from participating to the fullest extent possible in global and regional information programs. Problems exist on both the acquisition and the publication/distribution side of information programs.

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 results 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 references 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.

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.

FUTURE PROGRAM ACTIVITIES

In 1985, the ICLARM Board of Trustees approved the addition of a research function to the Information Service, which in effect upgraded it to the program level. There were no funds to staff an information research program in 1985, but an individual is now being recruited. Meanwhile, some progress has already been made through existing staff.

In the long run, the research program's results will benefit fisheries educators, managers and publishers, as well as the researchers themselves. The overall information research program is shown in Fig. 12, which demonstrates the two-phase approach. As mentioned, some of the modules of the first phase have already begun by stretching the duties of present information program staff. 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 is enabling 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".

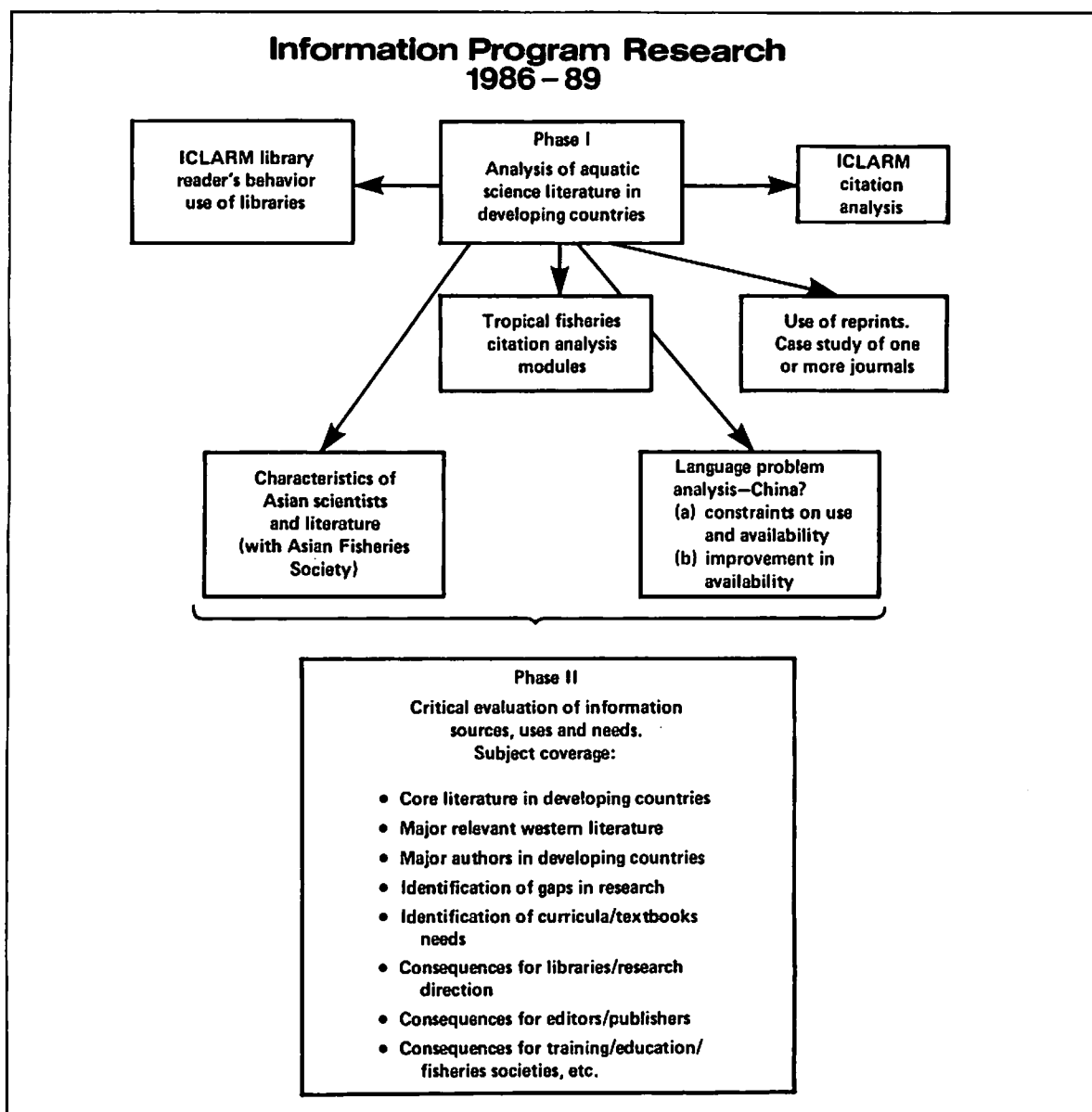


Fig. 12. The two-phase approach of ICLARM's information research program.

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 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. The Society involves direct costs to ICLARM in materials, postage and institutional membership.

CONCLUSION

ICLARM is engaged in many efforts with other institutions to attack the information-lack problem of tropical fisheries researchers. However, many of these efforts have been a top-down approach, without an examination of the real nature or size of the audiences addressed and without an understanding of the nature of their problems.

ICLARM sees the resolution of these issues as an area of long-term basic research of an international nature, for which the Center is particularly suited and for which it was designed. ICLARM thus is embarking on a program of research to quantify the information problems and needs of tropical fisheries researchers, and subsequently to investigate ways to improve information generation and flow.

Regional Programs

ICLARM's mandate and its research, training and information programs are global in nature. The Center's linkages include African, Asian, Central and South American institutions as described in preceding sections. To be sure, much of the Center's work to date has had an Asian orientation, but this is a reflection of the region's population size, the relative importance of Asia in the living aquatic resources sector and of the importance of aquatic products in the diets of Asian peoples. Approximately one-third of the worldwide fisheries catch is either caught by Asian fleets or taken by others from Asian waters. Over 95% of the world's aquaculture comes from Asia. Most Asian countries derive 50% or more of their animal protein requirements from aquatic products, and the aquatic sector provides a high share of total employment opportunities. The Asian region also has the longest coastline of all regions in the world, but at the same time has amongst the highest densities of coastal populations. Consequently, environmental problems, including those created by overfishing, tend to be an order of magnitude greater in Asia than in many other regions. The experience of Asia—and the problems of Asia—are thus potentially instructive for other regions of the world where population pressure is increasing and environmental problems are growing.

Tropical research experiences and insights are not a one-way street from Asia to other regions, however. For example, Pacific Island coastal tenure systems may offer some insights into ways in which coastal management systems can be established elsewhere. Recent work is shedding light on some of the major environmental factors that affect ocean systems, including such important fisheries as the Peruvian anchoveta fishery, in good years the world's largest.

As an international rather than a regional organization, ICLARM can help bridge the south-south gap that currently separates aquatic science research institutions located in the tropics. An important element in this effort, apart from the Center's networks and information program which are already international in nature, is the development of research activities in ICLARM's major program themes that cross geographical boundaries. Some of these, such as tilapia research and giant clam activities, have already been described in previous sections of this discussion paper. ICLARM plans a combination of international networks and regional projects to help improve the exchange amongst scientists around the tropics.

ICLARM will not be establishing regional offices outside Asia just for the sake of having such a physical presence. Initially, the Center's activities will be centered on cooperative research programs that have a clear and strong scientific justification. The initial activities will be modest and will adhere to the cooperative mode of the Center's operations elsewhere.

The first such formal regional presence outside Asia was established by ICLARM in the South Pacific in 1985.

SOUTH PACIFIC

Initially, ICLARM's activities have focused primarily on the International Giant Clam Mariculture Project, which includes linkages with numerous Asian and Pacific countries and institutions, and, in cooperation with the Solomon Islands Fisheries Department, on the development of the ICLARM Coastal Aquaculture Centre on Guadalcanal (see p. 16 for further details). In addition to its Pacific linkages, the program has strong cooperative linkages with James Cook University in Australia (which receives support from the Australian Centre for International Agricultural Research) and modest funding from numerous sources, including the Australian Development Assistance Bureau (ADAB), Overseas Development Agency (ODA) of the UK, the Government of New Zealand, the Australia and Pacific Science Foundation and the Skaggs Foundation. ODA has seconded a full-time hatchery manager to the program, and technical staff is also provided by the Fisheries Department of the Solomon Islands. Land for the Coastal Aquaculture Centre is being provided also by the Solomon Islands government under a long-term lease to ICLARM.

The Director of ICLARM's South Pacific Program will transfer in 1987 to the Solomon Islands from James Cook University in Australia where he has been based during the planning phase of the program.

In addition to the giant clam program, ICLARM has close links with the Forum Fisheries Agency (FFA), also based in the Solomon Islands, which coordinates a Pacific-wide program of fisheries development activities. ICLARM and the FFA are particularly interested to develop joint fisheries stock assessment and management training activities, funding permitting. These training activities, and the giant clam work, will also provide opportunities for Asian-Pacific exchange and collaboration.

OTHER REGIONS

For a relatively small international organization of ICLARM's nature and purpose, expansion of regional programs and staff must not be at the expense of the headquarters scientific staff in Manila. It would be relatively easy for ICLARM to successfully bid for short-term development-oriented contracts around the world, but the Board of Trustees and staff have taken the position that this would only distract from the scientific research purpose of the organization. Much of the scientific advance achieved by the staff to date, particularly that on research methods, has been achieved by headquarters staff over periods of several years. This would not have been possible if headquarters staff were reduced to proposal writers and short-term project supervisors. Consequently, the addition of new regional offices for ICLARM in Africa and Latin America will be approached with considerable caution and only as restricted funding warrants.

In sum, while regional approaches provide ICLARM with opportunities for greater collaboration, and in certain instances, more cost-effective means of program and project implementation with cooperating institutions, the expansion of the Center's regional programs should not be done at the expense of the core staff and program centered at and managed from ICLARM's headquarters in the Philippines.

ICLARM Finances

BACKGROUND

ICLARM, being similar to the international agricultural centers that are part of the CGIAR system, has adopted similar financial management terminology. Like the CGIAR Centers, ICLARM lacks endowment funds. The Center makes distinctions among funding for unrestricted core, restricted core and special projects. It is important to point out that the cooperative approach to research that typifies ICLARM's program means that much of the restricted and special project funds provided to ICLARM simply pass through the center to its cooperators. The number of special projects outside core program themes has been minimal during most of ICLARM's life, but increased quite dramatically in 1986 as ICLARM fought for survival.

After its 1977 incorporation in the Philippines, the Center received unrestricted core support first from the Rockefeller Foundation, then later from the United States Agency for International Development (USAID), the Australian Development Assistance Bureau (ADAB) and most recently from the Royal Norwegian Agency for International Development (NORAD). Restricted core support developed slowly, with the first grants made by the United Nations University and the Australian Development Assistance Bureau in 1980, and the German Agency for Technical Cooperation in 1981 (see Appendix D). In its early years, ICLARM was thus dependent upon a relatively small group of core supporters (see Fig. 13).

In 1985, ICLARM's revenue profile changed significantly. As the Rockefeller Foundation shifted its program focus away from Asia and concluded its unrestricted core support for ICLARM at the end of 1984, the annual level of unrestricted grants to the Center declined by 57%. For the first time in ICLARM's history, the level of restricted and special project grants exceeded that of unrestricted grants in 1985 (Fig. 14). Total revenue dropped 25% from US\$1.76 million in 1983 to US\$1.32 million in 1985.

The substantial reduction in unrestricted core support, which had supported headquarters' scientific and information staff and facilities and permitted research initiatives, forced ICLARM to restrict its research program activities. The 1985 financial strategy adopted by ICLARM was to conserve whatever resources were available in order to keep key headquarters staff positions filled for as long as possible. Thus, ICLARM cancelled or indefinitely deferred several in-house projects, publications and other program activities for which restricted funding could not be found and from which staff time had to be diverted. A significant portion of staff time was channeled, by necessity, into income-generating consultancies, the preparation of project proposals and involvement in funded projects. Every effort was made to increase and standardize the overheads charged by ICLARM for restricted project activities to reflect real costs of project implementation, but

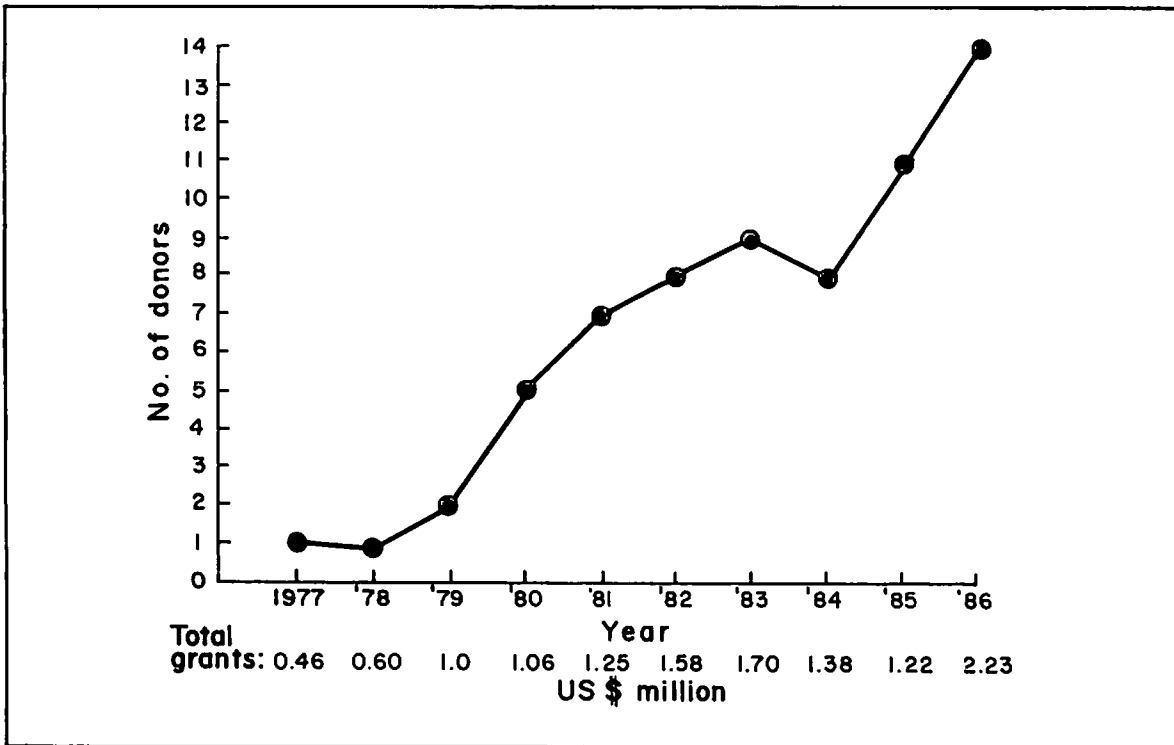


Fig. 13. Donor numbers and total grants. See Appendix D for full details. Above figures and number of donors include all categories of support (unrestricted and restricted core, special projects).

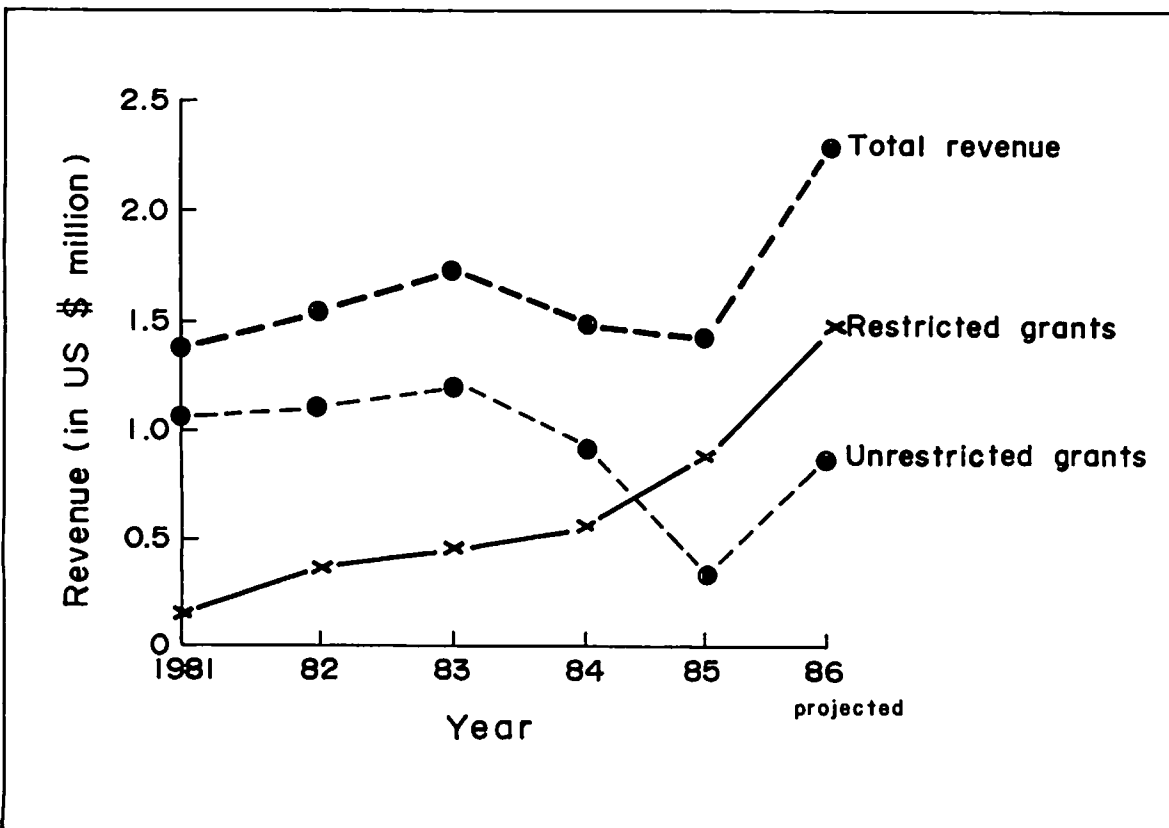


Fig. 14. ICLARM income profile, 1981-1986. Of the total US\$1.47 million restricted grants in 1986, US\$651,467 (44%) may be classified as restricted core and US\$820,374 (55%) as special projects.

such an approach is not easy and by no means universally acceptable amongst donors. Nevertheless, steady progress was made in this regard.

Severe cost-cutting measures were also implemented. In August, ICLARM offices moved to a new location in Manila to realize savings from lower rental rates. Aside from implementing additional controls on expenses for utilities, supplies and communications, major purchases and capital investments were deferred. Senior core professional staff was reduced in number by 25%. In addition, all salary adjustments were deferred not only for promotion and merit but also for increases to compensate for the rapid rise in Philippine peso cost of living indices which particularly affected locally-hired staff paid in pesos. The final outcome of these steps was total 1985 core expenditures of US\$726,416 versus an original 1985 core budget approved by the Board of Trustees of US\$1.06 million, and senior professional staff reduced to only six individuals.

By October 1985, the Center was on the verge of virtual collapse with only minimal reserves of \$50,000 remaining and no unrestricted core funds available for payroll and other obligations. Only extraordinary responses at the end of 1985 by Germany and Australia (which advanced their expected grants) and by Norway (which contributed for the first time) averted financial disaster.

1986 STATUS AND FINANCIAL PROJECTIONS

Since those dark days of 1985, ICLARM has made further progress to increase and diversify its support, though the Center remains very heavily dependent on short-term restricted core and special project funds (Fig. 14). Of expected total income in 1986 of almost \$2.3 million, approximately 36% is unrestricted core in nature, 28% is restricted core, and 35% is special project (see Fig. 15). Six senior staff positions at headquarters remain unfilled.

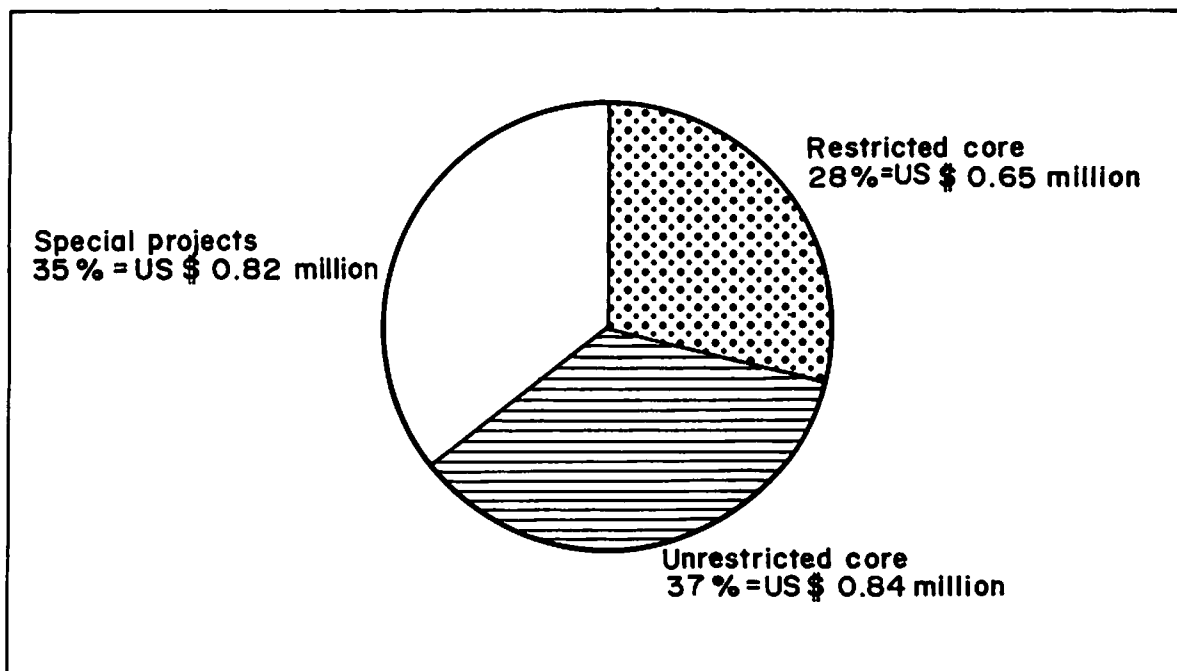


Fig. 15. 1986 revenue composition (see Appendix A).

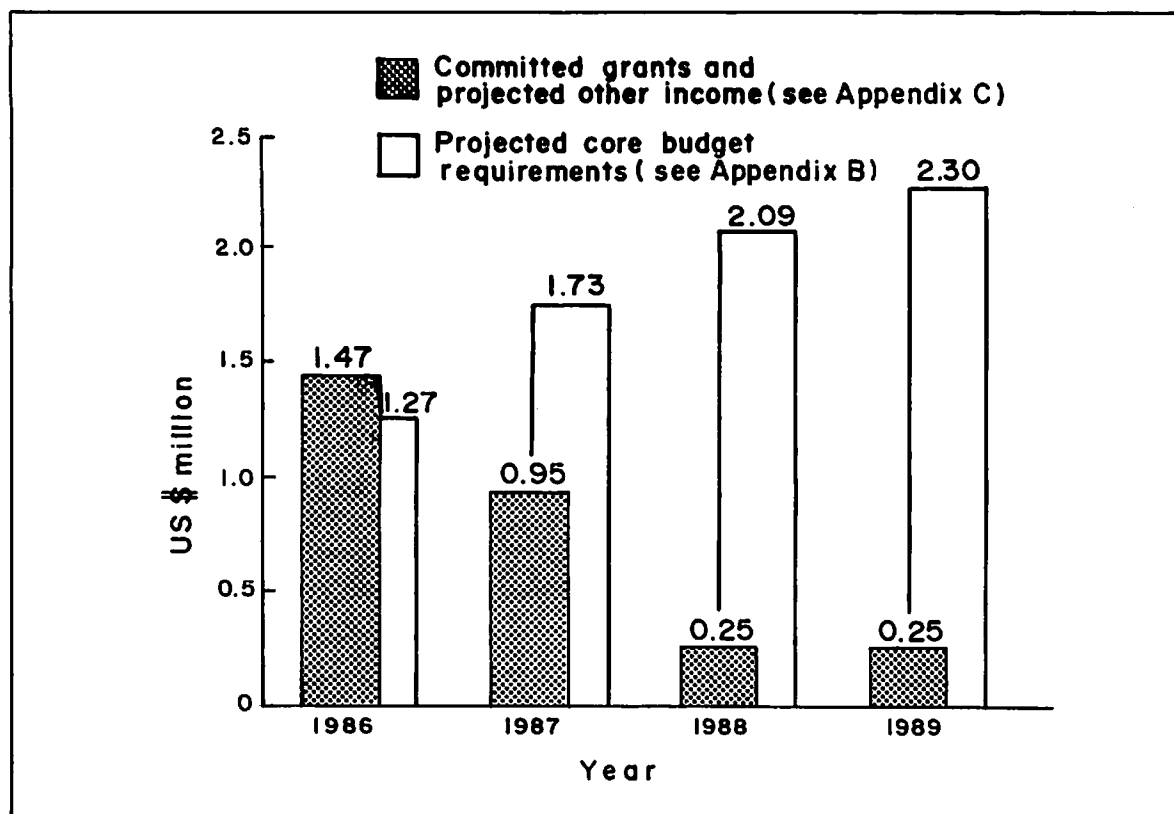


Fig. 16. Projections through 1989: core funding requirements and committed support as of September 1986.

It is the objective of the Center to increase its unrestricted and restricted core support. To reach its minimum critical mass of core professional staff members and sufficient financial support for program initiative and flexibility, the Center will require approximately \$2 million in unrestricted and restricted core support annually. Appendix A contains the Center's 1986 core budget and Appendix B contains budget projections through 1989 based on realistic plans to reach its minimum critical mass of staff and program activities. Funding requirements are expected to rise from \$1.3 million in 1986 to \$1.7 million in 1987 and onwards to \$2.3 million in 1989 (see Fig. 16).

Core support will continue to be supplemented by special project funding, but on a selective basis consistent with the Center's themes and mandate. Total annual budget for the Center under this approach is expected to approach US\$3 million, of which approximately 67% would be unrestricted and restricted core support and 33% special project.

As of September 1986, ICLARM has identified only 55% of its \$1.7 million 1987 core requirements.

FINANCIAL STRATEGY

Annual Income Requirements: Core budget projections for 1988 are approximately 62% higher than the Center's 1986 core budget. ICLARM has several means to meet its

projected annual \$2.0-2.3 million core budget needs. These include unrestricted core and restricted program grants, overheads and headquarters staff time on special project grants, consultancies by staff, proceeds from sale of publications and interest income on short-term financial placements.

Although the Center can earn modest overheads of 15-24% on the personnel components (or approximately 11% on all components) of most but not all restricted project and special project grants, it is clear that the Center cannot raise its \$2 million core fund requirements exclusively through overheads unless headquarters staff in Manila become solely administrators and raise more than \$10 million annually in restricted and special project funds. The Center's Board of Trustees and staff firmly believe that such an approach would totally undercut the value of the professional work of the organization and would contradict the innate worth of a small professionally active scientific staff at headquarters, supplemented by a few key field staff, as has been demonstrated by ICLARM to date.

Consequently, ICLARM proposes to raise the bulk of its annual \$2.0-2.3 million unrestricted and restricted core budget requirements through direct contributions from donors. Such support would also allow a slow rebuilding of the Center's financial reserves which have been dangerously depleted over the past two years.

Headquarters Building: A second issue with financial implications is the desire of ICLARM to move its headquarters from its current rented facilities in the commercial area of Makati, Metro Manila to a building of its own. The University of the Philippines at Diliman, Quezon City (a Manila suburb) has recently designated a 1.3-hectare parcel of university land for ICLARM use in the vicinity of other regional and international organizations on campus. ICLARM needs a building with approximately 3,000-m² floor space which at current construction costs in Manila would require approximately \$700,000 to build. Discussions have begun with possible funding agencies for support of this building plan.

In 1984, proposals were submitted to the Philippine government to cover the peso equivalent of ICLARM's \$60,000 annual rent and utilities expenses. In the extremely difficult financial circumstances currently faced by the Philippine government and economy, however, it is probably not realistic to expect either the redirection of a bilateral grant to ICLARM or a direct Philippine peso contribution. Consequently, if ICLARM is to move to a headquarters building of its own, which is highly desirable, it will have to raise the amount to cover construction costs from multilateral programs of donors or from other sources.

CONCLUSION

To summarize, ICLARM as its top priority seeks a semblance of continuity through the proposed ICLARM Support Group and asks the Group and other interested donors to assist the Center in raising the approximately US\$2 million annual unrestricted and restricted core support that is necessary to maintain and further develop the Center's research, training and information programs.

Conclusion

This document has had two major purposes.

First, it has attempted to lay out in broad terms the full dimensions of ICLARM's program of research, training and information. It has drawn attention to the high degree of interdisciplinary cooperation that exists amongst ICLARM's staff and with other individuals and institutions in the tropics through the Center's cooperative research projects and networks. To date, ICLARM has found these cooperative and interdisciplinary approaches to be particularly appropriate and effective means of pursuing research, training and information objectives agreed upon with its national and regional partners.

Second, it has attempted to draw the attention of present and potential donors to the ICLARM program and the financial requirements that are necessary to sustain it. Since the formal incorporation of ICLARM in the Philippines almost ten years ago, the Center's annual unrestricted core support has never exceeded US\$1.1 million. In most years, it has hovered around the US\$800-900,000 mark. In 1985, it dipped to US\$450,000. This level of unrestricted core support is insufficient to maintain an international center of ICLARM's broad mandate and purpose, no matter how cost-effective is that center's program, and no matter how successful that center is in raising restricted project-specific funding.

ICLARM has been able to survive, first, because of the continuing generosity of a small number of donors that brought the Center back from the brink of collapse at the end of 1985, and second, because of successful efforts to diversify the sources and magnitude of restricted core funding. Although the Center's total income in 1986 (US\$2.3 million) will be some 80% higher than 1985 income, the bulk of these funds, or approximately 65%, will be restricted and short-term, special project in nature. The current ICLARM senior professional staff, which numbers only six permanent members in programs and administration and nine in project-specific fixed-term contracts (one of the former and five of the latter serve outside ICLARM's Manila headquarters), is below the level necessary to implement and sustain a program of ICLARM's mandate and potential.

A minimum level of unrestricted or restricted core program support, in contrast to restricted project-specific support, is necessary for ICLARM to remain independent and flexible to pursue key issues in fisheries and coastal zone management and aquaculture development. The unrestricted funds, apart from paying basic scientific and a portion of information program costs at headquarters, are the source of seed-funds and in-house projects that have led in the past to some of the Center's most successful initiatives and cooperative research programs.

During the Center's fund-raising campaign over the past two years, it has been suggested occasionally to ICLARM staff and Board of Trustees that the Center should be able to

survive on purely restricted funding. We beg to disagree. If simple survival is a measure of success for an international center of ICLARM's potential, then we suggest that one is aiming too low. If one wishes instead for ICLARM to make progress and scientific advance in its research, training and information programs, particularly in the longer-term aspects of its work, a minimum level of unrestricted or restricted core support is absolutely essential.

In ICLARM's case, we believe that this should be approximately US\$2 million annually, supplemented by restricted project-specific support.

ICLARM therefore respectfully submits this document and the ICLARM programs that it outlines for the serious consideration and support of potential donors.

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Appendix A
PROJECTED REVENUES FOR 1986*

	Core		Special Project	Total
	Unrestricted	Restricted		
A. GRANTS				
United States (USAID)				
– Unrestricted Grant	600,000			600,000
– ASEAN Coastal Resources Management Project		144,650	140,771	285,421
– Publications (Thailand Fisheries Review)		10,000		10,000
Australia (ADAB)				
– Unrestricted Grant	105,315			105,315
Norway (NORAD)				
– Unrestricted Grant	52,009			52,009
United Nations Development Programme (UNDP)				
– Preparatory Assistance Grant: Integrated Farming Systems		42,000	20,500	62,500
Canada (IDRC)				
– Social Science Network			203,462	203,462
– Information Service		40,650		40,650
– Economics of Shellfish Processing			2,339	2,339
Germany (GTZ)				
– African Aquaculture		66,500	106,000	172,500
Denmark (FAO/DANIDA)				
– Network of Tropical Fisheries Scientists			6,869	6,869
United Kingdom (ODA)				
– Giant Clam Hatchery		22,911		22,911
Ford Foundation				
– Small-Scale Fisheries Management		65,756		65,756
– Social Science Network		31,414	22,740	54,154
World Bank				
– Reservoir Management (Indonesia)		3,000	75,000	78,000
– Small Pelagics Management (Philippines)		5,000	60,000	65,000
Australian Pacific Science Foundation				
– Giant Clam Hatchery		24,800		24,800
Food and Agriculture Organization (FAO)				
– Training Newsletter		5,000		5,000
Skaggs Foundation				
– Giant Clam Hatchery		10,000		10,000
Rockefeller Foundation				
– Fund-raising Grant		13,044		13,044
Other Projects				
– Bivalve Stock Assessment		109,873	189,562	299,435
Others Pending		50,000		50,000
Total Grants	<u>757,324</u>	<u>651,467</u>	<u>820,374</u>	<u>2,229,165</u>
B. OTHER REVENUE				
Consultancies/Honoraria	50,000			50,000
Publication Sales	25,000			25,000
Interests/Dividends/Others	10,000			10,000
Total Others	<u>85,000</u>			<u>85,000</u>
TOTAL REVENUES	<u>842,324</u>	<u>651,467</u>	<u>820,374</u>	<u>2,314,165</u>

*As of 15 September 1986

**Appendix B
CORE BUDGET PROJECTIONS TO 1989**

BASE BUDGET

By practice, ICLARM uses zero-base budgeting during the annual budget preparation process. However, an incremental expense approach in developing projections to 1989 is used here in order to more graphically present the effects of planned program activities on total ICLARM core funding requirements.

We use as a base for our projections the ICLARM 1986 unrestricted and restricted core budget (see Appendix Table B.1).

PROJECTIONS

In developing expense projections, we have concentrated on the following key costs.

Staffing

Based on planned program activities, ICLARM's total core staff will have to be expanded from its present size of 43 to 58 by 1989. Appendix Tables B.2 and B.3 show the changes in terms of total staff numbers we expect over the next three years and the corresponding incremental impact on total core expenses.

Capital investments

Although the base budget shows capital expenditures of US\$33,500 in 1986, this approximates expected annual depreciation expenses which ICLARM would allocate for the replacement of existing property and equipment. New capital expenditures are projected to be as follows:

	1987	1988	1989
Leasehold Improvements	\$ 13,000	\$ —	\$ —
Equipment			
Furniture	5,000	—	3,000
Microcomputers/Accessories	12,000	6,000	—
Typewriters	3,000	—	—
Vehicles	10,000	20,000	20,000
Library Equipment	—	2,000	—
Typesetting Equipment	—	25,000	—
	<u> </u>	<u> </u>	<u> </u>
Total	<u>\$ 43,000</u>	<u>\$ 53,000</u>	<u>\$ 23,000</u>

Appendix Table B.1. 1986 Unrestricted and Restricted Core Budget¹

	Personnel	Travel	Publications ³	Supplies/ Services	Training	Fixed assets	Total
A. CORE PROGRAMS							
Resource Assessment and Management ²	268,000	16,000	40,000	33,000	4,000	5,000	366,000
Aquaculture ²	179,000	24,000	30,000	31,000	3,000	10,000	277,000
Information	89,000	6,500	2,000	5,000	1,000	5,000	108,500
Education and Training	75,000	10,000	5,000	6,000		1,500	97,500
Subtotal	611,000	56,500	77,000	75,000	8,000	21,500	849,000
Library/Information Services	26,000		43,000	15,000	1,000	4,000	89,000
Core Programs Subtotal	637,000	56,500	120,000	90,000	9,000	25,500	938,000
B. GENERAL ADMINIS- TRATIVE							
Board of Trustees		34,000		3,000			37,000
Program Advisory		10,000		2,000			12,000
Administration and Finance	182,000	10,000		35,000	2,000	5,000	234,000
General Adminis- trative Subtotal	182,000	54,000		40,000	2,000	5,000	283,000
C. GENERAL OPERATING EXPENSES							
Rent and Utilities/ Maintenance				67,000		3,000	70,000
Audit/Legal Fees				2,500			2,500
Insurance				3,000			3,000
General Operating Subtotal				72,500		3,000	75,500
TOTAL	819,000	110,500	120,000	202,500	11,000	33,500	1,296,500

¹For 1986, the Board of Trustees approved a total *unrestricted core budget* of US\$1.09 million which includes staff time and overhead costs devoted to restricted core and special projects management. The above budget includes *restricted core expenses*, but not *special projects*.

²South Pacific Program expenses (approximately US\$120,000) are included in the Aquaculture budget. Personnel costs of the ICLARM South Pacific Director are allocated as follows: ten man-months—South Pacific Program; two man-months—Resource Assessment and Management Program.

³See p. 50 for further details. ICLARM generally recovers printing and distribution costs from research budgets. Publication sales are used to partially offset other editorial costs. ICLARM pays remaining costs in the belief that the Center should subsidize publications in order to assure they reach third world audiences at an affordable price.

Appendix Table B.2. ICLARM Core Staffing Requirements

	Actual 1986			1987			Projected 1988			1989		
	P	M	S	P	M	S	P	M	S	P	M	S
A. CORE PROGRAMS												
Resource Assessment and Management	3	2	4	3	2	5	4	2	5	4	2	5
Aquaculture ¹	2	1	2	3	1	3	4	1	6	5	1	6
Information	1	1	1	1	1	1	2	1	1	2	1	1
Education and Training ²	1	-	1	1	-	1	2	1	2	3	1	3
Library/Information	-	1	5	-	1	5	-	1	5	-	1	5
B. GENERAL SERVICES												
Administration	2	3	7	2	4	7	2	4	7	3	4	7
Publications	-	1	5	-	1	5	-	1	5	-	1	5
Total	<u>9</u>	<u>9</u>	<u>25</u>	<u>10</u>	<u>10</u>	<u>27</u>	<u>14</u>	<u>11</u>	<u>31</u>	<u>17</u>	<u>11</u>	<u>32</u>

P = Senior Professional; M = Mid-level Professional; S = Support

¹ South Pacific and Africa Programs staff are included here.

² Latin America Program staff are included here.

Appendix Table B.3. Incremental Staff Expenses

	1987	1988	1989
PROFESSIONAL STAFF			
1. Resource Assessment and Management			
— Associate Scientist Economist		70,000	
2. Aquaculture			
— Associate Scientist Systems	70,000		
3. Information			
— Associate Scientist			70,000
4. Education and Training			
— Senior Scientist Program Leader		80,000	
5. Africa			
— Senior Scientist Program Leader		80,000	
6. Latin America			
— Associate Scientist			70,000
7. Administration			
— Deputy Director General			70,000
Subtotal	<u>70,000</u>	<u>230,000</u>	<u>210,000</u>
MID-LEVEL STAFF			
1. Education and Training			
— Program Assistant	8,000		
2. Administration			
— Administrative Assistant	8,000		
Subtotal	<u>16,000</u>	<u> </u>	<u> </u>
SUPPORT STAFF			
1. Resource Assessment and Management			
— Research Assistant	5,000		
— Programmer	7,000		
2. Aquaculture			
— Research Assistant	5,000		
3. Education and Training			
— Secretary		5,000	
4. Africa			
— Research Assistants (2)		15,000	
— Secretary		5,000	
5. Latin America			
— Secretary			6,000
Subtotal	<u>17,000</u>	<u>25,000</u>	<u>6,000</u>
OTHERS			
1. Additional annual expenses for South Pacific/ Coastal Aquaculture Center	20,000		
2. Postdoctoral Fellows (2)	70,000		
Subtotal	<u>90,000</u>	<u> </u>	<u> </u>
GRAND TOTAL INCREMENTAL STAFF EXPENSES	<u><u>193,000</u></u>	<u><u>255,000</u></u>	<u><u>216,000</u></u>

Publications

The base budget assumes total costs of US\$120,000 for in-house publications broken down as follows: publication services costs—\$70,000; paper and printing costs—\$50,000. ICLARM's policy has been to have at least paper and printing costs funded externally. The present volume of deferred publications plus expected increases in project and staff publications will result in an increment of US\$35,000 in 1987 and US\$30,000 in 1988.

	1987	1988	1989
Base Budget (Previous year's)	\$ 1,296,500	\$ 1,627,500	\$ 1,997,500
Incremental Expenses:			
1. Staff	193,000	255,000	216,000
2. Capital Investments	43,000	10,000	(30,000)
3. Publications	35,000	30,000	—
4. Projects	50,000	50,000	—
5. Others	10,000	25,000	20,000
6. Operating Funds	<u>100,000</u>	<u>100,000</u>	<u>100,000</u>
Total Expenses	<u>\$ 1,727,500</u>	<u>\$ 2,097,500</u>	<u>\$ 2,303,500</u>

ICLARM shall continue its policy of having as much as possible all costs and at least printing and paper costs funded through restricted or special project funds. The core budget, however, should be prepared to absorb the fixed annual cost of maintaining publication services, and to permit support of selected publications (e.g., Studies and Reviews) that contribute substantially to development of the Center's research program.

Projects

In the past, ICLARM has been able to identify funders for various program projects. The very limited amount of unrestricted funds, however, has resulted in the shelving, deferral or scaling down of in-house projects which ICLARM considers vital to maintain leadership in existing program directions. In-house project funding, which includes primarily seed funds for new activities, will require at least US\$50,000 in 1987 and US\$100,000 annually thereafter.

Others

Library Acquisitions

Although the ICLARM library continues to be complimented by its present users, it must maintain its rate of acquisitions in order to continue to be useful in the future. As it is, ICLARM has already identified the need to beef up the library's collections on Resource Economics, Coastal Zone Management, Environmental Planning, and Education and Training. For this purpose, it is necessary to add at least US\$10,000 to the annual budget for acquisitions.

African Office

The staffing requirements have already been outlined. Other direct and travel expenses are projected to amount to approximately US\$25,000 annually beginning 1988. This office will most likely evolve from ICLARM's current project base in Malawi.

Latin America and Caribbean Office

Given ICLARM's hope that we will be able to identify a suitable Latin American university to host this office, direct expenses should be kept to a minimum. We, however, need to allocate at least US\$20,000 for communication, supplies and travel expenses in 1989.

Given the above considerations, ICLARM's projected core expenses will be as follows (without considering inflation factors and staff salary merit increases):

Appendix C CORE REVENUE PROJECTIONS¹ (1987-1989)

	1987	1988	1989
Committed Grants			
A. Unrestricted Core			
United States (USAID)	400,000	—	—
B. Restricted Core			
United States (USAID)			
— ASEAN Coastal Resources Management Project	145,000	145,000	145,000
Germany (GTZ)			
— African Aquaculture	45,000	—	—
World Bank			
— Reservoir Management	28,000	28,000	28,000
— Small Pelagics Management	41,000	—	—
UNDP			
— Preparatory Assistance Grant	27,000	—	—
Total Committed Grants	<u>686,000</u>	<u>173,000</u>	<u>173,000</u>
Other Revenue			
Consultancies/Honoraria	50,000	50,000	50,000
Publication Sales	25,000	25,000	25,000
Interest/Others	10,000	10,000	10,000
Total Other Revenue	<u>85,000</u>	<u>85,000</u>	<u>85,000</u>
Total Revenue	<u>771,000</u>	<u>258,000</u>	<u>258,000</u>
Add: Cash carried over from previous year	<u>180,000</u>	<u>—</u>	<u>—</u>
Total funds available	<u>951,000</u>	<u>258,000</u>	<u>258,000</u>
Less: Budgeted expenses	<u>1,727,500</u>	<u>2,097,500</u>	<u>2,303,500</u>
(Deficit) or cash carryover	<u>(776,500)</u>	<u>(1,839,500)</u>	<u>(2,045,500)</u>

¹ As of 15 September 1986.

Appendix D
ICLARM CONTRIBUTORS AND OTHER INCOME (1977-1986)
(IN US\$)

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	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986*	Total
I. UNRESTRICTED CORE GRANTS											
Rockefeller Foundation	453,748	600,000	700,000	750,000	812,000	850,000	850,000	720,000			5,735,748
United States Agency for Int'l. Dev.			300,000	200,000	300,000	320,000	320,000		300,000	200,000	1,940,000
Australian Development Assistance Bureau						20,986	29,750	83,257	46,350	105,315	285,658
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	357,324	8,016,223
II. RESTRICTED CORE AND SPECIAL PROJECTS GRANTS											
Rockefeller Foundation	3,000			22,795	32,947			50,000	50,000		158,742
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					53,397		111,242
United States Agency for Int'l. Dev.					6,425					276,863	283,288
German Agency for Technical Coop. Ltd.					55,234	269,597	278,140	244,842	323,823	388,638	1,560,274
United Nations Development Programme					15,292	23,638	33,379				72,309
Philippine Council for Agriculture and Resources Research and Development					2,850	10,426					13,276
Kuwait Institute for Scientific Research						51,856	54,447	67,721	30,883		204,907
International Development Research Centre							117,109	200,754	225,906	164,682	708,451
Skaggs Foundation								7,500			7,500
Ford Foundation									165,138	95,626	260,764
New Zealand Embassy									12,582		12,582
Food and Agriculture Organization							6,703	5,000	5,000	4,053	20,756
Overseas Development Administration										19,663	19,663
Subtotal	3,000			110,640	138,748	386,800	499,778	575,817	866,729	949,525	3,531,037
Total Grants Received	456,748	600,000	1,000,000	1,060,640	1,250,748	1,577,786	1,699,528	1,379,788	1,215,173	1,306,849	11,547,260
III. OTHERS											
Consultancies	6,110	2,522		5,552	18,472	12,072	28,767	47,132	62,927	24,313	207,867
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	14,337	120,377
Interests/Dividends/Miscellaneous	2,026	5,904	9,489	26,107	55,936	4,432	9,669	14,490	17,887	12,594	158,534
Subtotal	8,136	8,426	17,067	74,041	108,569	33,940	64,711	95,766	109,678	51,244	571,578
GRAND TOTAL	464,884	608,426	1,017,067	1,134,681	1,359,317	1,611,726	1,764,239	1,475,554	1,324,851	1,358,093	12,118,838

*Actual thru 31 August 1986. Does not include donations received but not yet spent (e.g., \$5,000 from Skaggs Foundation).

**Appendix E
ICLARM SENIOR AND MID-LEVEL
PROFESSIONAL STAFF
AS OF SEPTEMBER 1986**

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

SCIENTIFIC PROGRAMS/PROJECTS

AQUACULTURE PROGRAM

<p>Roger S.V. Pullin, Ph.D. Barry Costa-Pierce, Ph.D. John Balarin, M.Sc.</p>	<p>Director, Aquaculture Program Associate Scientist (Indonesia) Project Leader, Research for the Development of Tropical Aquacultural Technology Appropriate for Implementation in Rural Africa (Malawi) Associate Scientist (Thailand) Program Assistant</p>
<p>Jan Michael Vakily, M.Sc. Ms. Mary Ann Paguio, M.Sc.</p>	<p>Associate Scientist (Thailand) Program Assistant</p>

ICLARM SOUTH PACIFIC OFFICE

<p>John L. Munro, Ph.D. Graham F. Usher, M.Sc. Ms. Barbara Kinsey</p>	<p>Director, South Pacific (Australia) Research Associate (Solomon Islands) Research/Information Officer (Australia)</p>
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RESOURCE ASSESSMENT AND MANAGEMENT PROGRAM

<p>Daniel Pauly, Ph.D.</p>	<p>Director, Resource Assessment and Management Program</p>
<p>Max Aquero, Ph.D.</p>	<p>Associate Scientist, Management Options for Tropical Small-Scale Fisheries</p>
<p>Paul Dalzell, B.S. Ms. Annabelle Cruz, B.S.</p>	<p>Project Leader, Philippine Small Pelagics Program Assistant</p>

ASEAN INTEGRATED COASTAL RESOURCES MANAGEMENT PROJECT

Chua Thia-Eng, Ph.D.	Project Coordinator
Random DuBois, M.Sc.	Technical Advisor
James Paw, MAq.	Project Specialist

EDUCATION AND TRAINING PROGRAM

Brian A. Lockwood, Ph.D.	Coordinator, Asian Fisheries Social Science Research Network ¹
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INFORMATION PROGRAM

Jay L. Maclean, M.Sc.	Director, Information Program
Ms. Leticia Dizon, A.B.	Assistant Editor
Ms. Rosalinda Temprosa, B.S.	Chief Librarian
Ms. Norma Jhocson, B.S.	Associate Librarian

ADMINISTRATIVE SERVICES

Basilio M. Rodriguez, Jr., M.B.A.	Manager, Administration and Finance
Ms. Marieta Veneracion	Administrative Assistant
Ms. Remedios Apostol, B.S.	Chief Accountant
Ms. Ma. Concepcion Querubin, B.S.	Senior Secretary, Director General

AFFILIATE SCIENTISTS²

Wade O. Watanabe, Ph.D.	Aquaculture
James Ching-Ming Kuo, Ph.D.	Aquaculture
Kee-Chai Chong, Ph.D.	Aquaculture
Kevin Hopkins, Ph.D.	Aquaculture
John Colman, Ph.D.	Aquaculture

¹ Dr. Lockwood is Coordinator, AFSSRN, until 31 October 1986. Prof. Harlan Lampe will succeed him.

² Affiliate Scientists are former ICLARM employees who maintain an unpaid link with ICLARM for 1-2 years after termination of their contracts. During this period, they continue to contribute to the Center's publication program.



INTERNATIONAL CENTER FOR LIVING AQUATIC RESOURCES MANAGEMENT

The International Center for Living Aquatic Resources Management (ICLARM) is an autonomous, nonprofit, international scientific and technical center which has been organized to conduct, stimulate and accelerate research on all aspects of fisheries and other living aquatic resources.

The Center was incorporated in Manila on 20 January 1977 and its operational base was established in Manila in March 1977.

ICLARM is an operational organization, not a granting or funding entity. Its program of work is aimed to resolve critical technical and socioeconomic constraints to increased production, improved resource management and equitable distribution of benefits in economically developing countries. It pursues these objectives in the fields of aquaculture, resource assessment and management, education and training, and information through cooperative research with institutions in developing and developed countries.

Policies are set by a Board of Trustees with members drawn from the international community. Direction of ICLARM, under the policies set by the Board, is the responsibility of the Director General. Advice on programs is received by the Director General from Program Advisory Panels composed of scientists drawn from the international community.

The ICLARM core staff consists of internationally recruited scientists with expertise in aquaculture, fishery biology, population dynamics and socioeconomics. In addition, provision is made for interns, consultants and visiting fellows, contributing to breadth of competence and flexibility. The core program and core staff are supported by private foundations and governments.

